#9774 Nano Ninjas Engineering Notebook

Our Journey Through FTC: 2015-16 Res-Q Season

Portland, OR

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Thanks to Our Sponsors

Figure 1: Enterprise Sponsors

Figure 2: Financial Sponsors

Figure 3: Facility Sponsors

We are affiliated to

Stem4Girls

Science Technology Engineering and Math for Girls

Figure 4: Thanks to our coaches and mentors. Special thanks to our parents.

Figure 5: Our Hideout: Ramya's Garage

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1. About Us - The Nano Ninjas

1.1 Our Story

Team #9774 Nano Ninjas is a rookie FTC Team consisting of fifteen girls in seventh and eighth grade and is a neighborhood team located in Portland, OR. All middle schoolers, they have participated in FLL for the past three years, maintaining themselves as an all-girls team and have moved onto FTC this year. This year's challenge, Res-Q, has pushed the Ninjas to explore more about science, technology, engineering, and mathematics (STEM). This season, the Nano Ninjas started with a few training sessions with FTC team Hot Wired. The senior and highly-experiences team kindly showed the Ninjas the basic building skills they needed in order to make a functioning robot. Soon, the FTC challenge was released and FTC team Batteries in Black began a small challenge which gave them one week to construct a robot that can function on the field. The Ninjas got engaged in that and within a week, they had a robot which was able to climb up to the middle zone on the ramp and deploy climbers. After that small challenge, they quickly started preparing for League Zero. Because of issues with adapting to the new Android system and wifi complications, the Nano Ninjas were unable to make their robot work for any of the matches. However, they did not let this stop them. They continued to learn from their mistakes and when League Two came around the corner, they managed to have their robot operate for all the matches. And at League Three, they put all their knowledge and hard work together and placed in first place.

1.2 Our FIRST Journey

Team 9774 Nano Ninjas have been involved in the FIRST programs for several years now. Many members have participated in JFLL and almost all continued into FLL and now FTC. They have maintained their status as an all girls team throughout all of the years and hope to continue doing so in the future. The Nano Ninjas were mostly known as an

FLL team for three years (in the Senior Solutions, Nature's Fury, and World Class seasons).

As a rookie team, they won the first place Inspiration Award, and they were and still are honored by holding such a title. Teaching, learning, inspiration, and hard work are all integral aspects of their entire existence. They will not stop in creating a better world of young ones partaking in STEM. They strive as such and seek sponsorship so we can bring our efforts to a global perspective. But along with the Inspiration Award, they won first place in qualifying Championship and went to state. Their picture got onto the first page of the local newspaper and it warmed their hearts when young children would run to them saying they recognized them from the newspaper. They always took this chance to tell them about their experience and the power which is bestowed inside science, technology, engineering, and mathematics.

But their journey is not complete without its bumps in the road. During their second year in FLL, a gyro sensor breakdown held them back from continuing on to State Championships. Even after the season was over, they still did not give up, and instead worked harder to learn from their mistakes and ensure that they would not face any more problems of the kind.

The Ninjas then took a leap from FLL to FTC. Gradually, their FIRST team grew until it became an FTC team of fifteen intelligent, assiduous girls from all backgrounds and schools. And in these past few months, from even before the beginning of the season and Kickoff, their team has continued to grow closer and more united as one.

Now, as an FTC team, they are represented through STEM4Girls, a nonprofit organization which inspires young girls to partake in STEM. Only in its first year, STEM4Girls already has two other FLL teams and has put up an after-school coding class in the largest local middle school, Stoller Middle School. They are proud to be run through a program of such determined people whom hold the same vision as them of a world run by young girls in STEM.

As a rookie FTC team they are still adjusting to the different technology but are enjoying the new experience all the same! Even though they have ran into many issues with the new technology, such as pairing issues and unplanned restarts, they have managed to debug the problems so they do not happen in the future. The ninjas are excited about this year's challenge, FIRST Res-Q, and also discovering more about the new Android platform.

Their highly-capable coach and parent mentors come from all divergent occupations in obverses of engineering, business, manufacturing from companies such as Intel, Aplos, and Nike. Their lead mentor is high schooler Anna Nixon, a participant of FIRST since second grade. She is currently in her second year of high school and has gone through the entire journey of JFLL, FLL, FTC, and now FRC. They are honored to have her as a mentor as she has the most information and experience about FIRST robotics than any of the team members.

But what sets these not-so-nano Ninjas is their great commitment and dedication toward FIRST. In fact, the Ninjas meet nearly every single day and began meeting and planning months before the season began and went straight to meeting once Kickoff had happened.

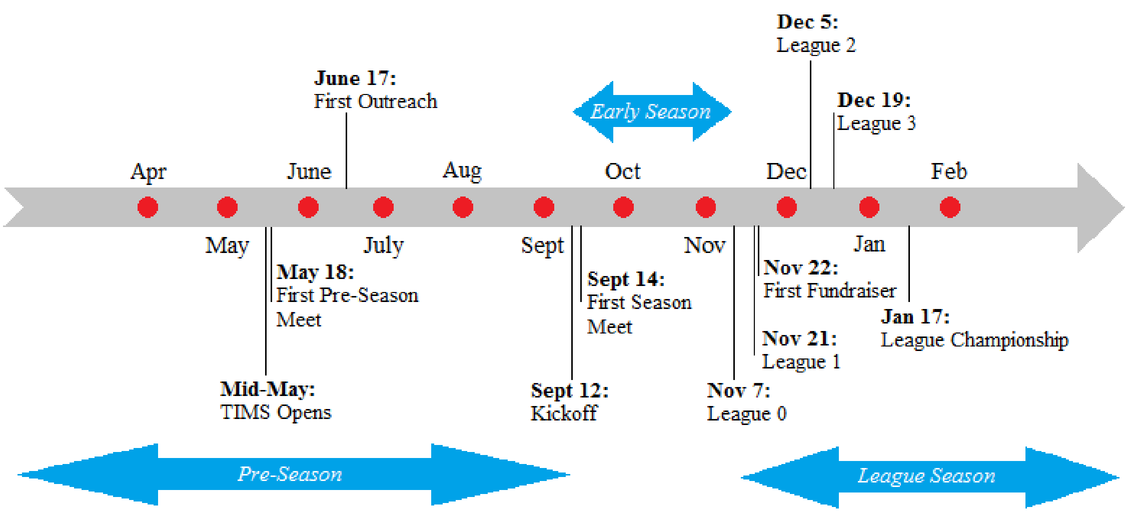
They leave no rock left unturned in their journey of achieving the most out of FIRST and STEM. One of the main strengths in the team is their ability to break off into specialty groups and concentrate to become an expert in that aspect. Be it robot building, programming, engineering notebook, these girls know themselves better than anyone else and are able to instinctively know their strengths and through teamwork, are able to put together all their expertise into FTC.

Sponsors have also been no problem for these Ninjas. They have over fifteen sponsors, ranging from Intel, Nike, and Mathnasium to BoardShare, Qorvo, and ScreenSteps, all proud to represent the Nano Ninjas.

Over the past four years, their team has presented substantial improvement and growth in impacting the community with STEM principles. They are certain they have inspired two FLL teams to form, but who knows how many other teams are out there that have formed because they have inspired them? They have also reached out nationally and even globally and enriched people in Canada, Japan, Oman, Saudi Arabia, and India to take up STEM and FIRST robotics.

1.3 Season Highlights: Our Timeline

We have created a timeline which highlights our main events this FTC year.



2. Nano Ninjas: Team Members

2.1 Nandhana

I'm am an eighth grader at Stoller Middle School. I have been participating in JFLL, FLL, and now FTC for a total of five years, after my older sister, Anna, influenced me to join a team. This year I have decided to focus on building, programming, and driving, but the overall process is the fun of the season.I've took a lot from FIRST, but most of all it's the ability to solve problems, like real engineers. This program teaches me to think outside the box. I have been able to adapt my skills at home and at school. Another thing FIRST has taught me is to be a better speaker and presenter by all the outreach and competition presentations. My goal this year is to promote STEM to girls and make our community more aware of programs like FIRST, as well as help my team do the best we can do. My primary responsibility is to work on robot building, programming and driving.

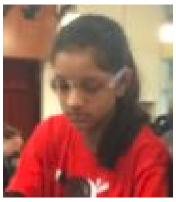
2.2 Namitha

My name is Namitha Nixon, I'm am an 8th grader at Stoller Middle School. I have participated in JFLL for 2 years and FLL for 3 years, but this is my rookie year in FTC! My main focus is building, programming and driving our robot. Robotics has played such a big part in my life and without it I don't know where I'd be! My favorite part of FTC is getting to work with my team and other teams because everyone has something new to bring to the table! Besides robotics I like to read, write and film. When I grow up I want to become an interior designer or part of the film industry! FIRST has not only taught me a lot about engineering but also teamwork, commitment, leadership and creativity. It's helped me to think outside the box and act fast in a crisis. Because of my experience in robotics I have been able to understand how the world around me works the way it does. I hope to inspire other girls to get interested in these kind of programs because I know it'll benefit them greatly! Working on an all girls FTC team has given me a chance to prove that girls enjoy engineering as much as anyone else! My main job on the team is programming and robot building and driving.

2.3 Maria

My name is Maria Kolattukudy, and I am a 7th grader at Meadow Park Middle School. I was born Portland Oregon and have lived here all of my life,though I have traveled to many places in the US, India, Canada, and Europe. I am 12 years old and I enjoy playing sports such as basketball, Track and Field and Soccer. I have played the piano for 6 years. I love to travel, hangout with friends and enjoy writing I have been part of First for four years, and this is my first year being in FTC. I hope to continue being a part if First for many years to come. FTC introduced me to design, building and programming- skills with great value for the future, but much more importantly it has trained me to become a better team member and a leader. Because of all my year in First, I have learned to use cooperation and Gracious Professionalism in in all my my daily activities. As for the future, I have a particular interest or passion in space, astronomy and architecture, and aspire to become and astronaut or to design a space rover. First has acted as a stepping stool to achieve my greatest aspirations.I really enjoy working with robots. I particularly like driving and competing with the robot, just like I have done in previous years doing FLL. I also like building robots, it's really interesting getting to now everything that makes up these complex robots, which is exactly why my main position on the team is robot building, and driving.

2.4 Rushali



Hello, my name is Rushali, and I am a thirteen-year-old and an eighth grader at Stoller Middle School. My hobbies include my affinity to draw, play basketball, participate in robotics, play tennis, and making crafts. This is my third year in the FIRST program, and I have enjoyed exploring the many aspects of robotics and meeting many new and amazing people. FIRST has taught me to work on a team, take ownership, and most of all taught me how to think outside of the box. All of these items have significantly helped me beyond FIRST. I can apply all that I have learned to sports, school and many other items. Throughout FTC, I have learned how to program and how to construct a robot with the essential parts. I really enjoy doing FTC with all of the girls on my team and enjoy all aspects of robotics. My primary position on this team is programming. Programming has always been a passion of mine and this year, I was able to start using Android Studio, which has pushed me to my limits. This year, I am really enjoying FTC and I am glad I joined the FIRST program. It has inspired me to continue to explore science, technology, engineering and math. I am anticipating on containing my journey through the world, no the universe, of FIRST. The FIRST program has become such an integral part of my life and I cannot stop participating in this wonderful STEM program.

2.5 Ramya

Hello, my name is Ramya Reddy and I'm a seventh grader at Stoller Middle School. I have participated in FIRST for 4 years this year being my fifth. I started at FLL, and this is my first year in FTC. I joined FTC because when I was in FLL, I always wondered how it would be building a bigger robot with actual metal pieces, and how it would be driving with controllers instead of running the robot with just programming. My favorite part about FTC is building the robot, and working as a team. My main hobbies are drawing and photography, and I play track and field. My favorite subject in school is science, and when I grow up I would like to become a veterinarian or a photographer. FIRST has helped me in my day to day life. It has given me a better understanding of how to work as a team, problem solve, and about leadership. These skills have helped me in school, and after-school activities. My main position on the Nano Ninjas is robot building.

2.6 Shamamah

I am in the eighth grade at Stoller Middle School in Portland, OR. I am of fourteen years of age, and was first immersed in the FIRST program in seventh grade. I only have one year of experience with FIRST, being part of the FLL World Class Challenge 2014-15, however I have been part of many other STEM programs in the past. FLL last year was a very impacting experience for me. I was introduced to so much robotics, technology, and programming that I had little to no acknowledgment toward prior to joining the FIRST program. But not only that, I learned the true meaning of working on a team and constituting to a whole. My team is like my family to me. I have a passion for science and uncovering the unknown. My hobbies include tennis and realism sketching. My lifetime goal has always to become a neurosurgeon. Through FTC, I hope to know more about technology and robotics, but most of all, about teamwork and working in large groups. My main position on the team is to work on CAD and the Engineering Notebook. Indeed, I am excited to see what the year holds, and hope to continue participating in FIRST.

2.7 Irene

My name is Irene George and I am 14 years old. I am an eighth grader at Hazelbrook Middle School. I like to read, bake, play volleyball and tennis, and embroider. I am also a black belt in Taekwondo. I am happy that I can now add participating in FTC to the above list. This is my first year in FIRST and FTC and I have already learned a lot about how to work with a team and how to act in a competitive setting. I joined FTC to get a firsthand experience in robotics and engineering. Through the Nano Ninjas, I've learned leadership skills and responsibility. Through FTC I hope to learn how to program a robot and become a better driver captain. When I first joined FTC, I had no experience with robots and the things they could do. I was amazed that with a couple channels, servos, motors, screws, and a little programming, we could make a fully functional robot. My role so far on the Nano Ninjas has been organizing the bake sale and being driver captain in a couple rounds of League, but I hope to be able to make a bigger impact on the team. I am very happy that I joined FIRST and I hope to continue to be in it.

2.8 Harini

Hello, my name is Harini. I am a seventh grader at Stoller Middle School. I like to sing, dance, draw, paint, write, and participate in FIRST and FTC. This is my second year in the FIRST program, and my two years in FIRST have been great. FIRST taught me how to problem solve and most of all to work with a team. I have learned a lot about robots and engineering and design in FTC. Last year with the World Class challenge, my eyes opened up to the world of education. I love how FIRST can so easily convey such pounding issues in the world in a package of fun and competition. So far in this season, I have been given more than I could ever ask for. I have gotten to know all these wonderful girls and continue to get to know each of them better. I am really enjoying my FTC experience. My main job this season is to work on building. I really love FTC and STEM and will continue to do it in the future. I am look forward to what the upcoming seasons have in store. I simply cannot wait!

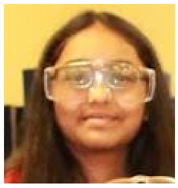
2.9 Shruthi

I am a seventh grader at Stoller Middle School. I have been participating in FIRST robotics events for the past six years at various levels, and was part of the team "Epic Legonians" that won the first place for demonstrating FIRST Core Values and Teamwork in 2014 and 2015 respectively at Oregon State FLL Championships. I aspire to make a positive difference in the world and save people's lives! Melinda French Gates' famous quote, "If you want to go fast, go alone; if you want to go far, go with others," crisply summarizes what I have learned so far by participating in FIRST seasons! Being part of a team has made me realize I can accomplish a whole lot more than what I could accomplish by just myself, especially when all team members are working towards a common goal! When I started in Junior FLL, that season topic "Body Forward", got me excited in medicine! One of the teams had a "special guest", their relative, who had Alzheimer. I got curious by talking to them, learned about Alzheimer's disease and its characteristics! At that moment was when I decided to work towards pursuing medicine as my field of study, specifically, neuroscience, so I can have the opportunity to save people's lives! I enjoy participating in school Math and Science competitions, in sports, specifically basketball and swim team; I also learn Indian classical music and play violin! All of the FIRST Core Values, I have learned them by heart and follow them every single second of my life, and truly hope that I can continue living under these governing principles of life forever. Core Values craft my life and I cannot thank FIRST and Woodie Flowers for all this. Being part of Nano Ninjas team gives me the opportunity to make a bigger impact! I am grateful to my coaches, parents and my friends for giving me the opportunity to learn and practice new skills every single day! This year, my main focus has been robot building.

2.10 Adithi

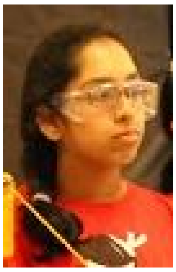
I am twelve years old and in seventh grade at ISB (International School of Beaverton). I have lived in Portland, Oregon for all of my life. I like to dance, sing, play tennis, swim, draw, hang out with my friends, read, and do FIRST. I started doing FLL in second grade and continued doing it for four years. In FLL I was part of The Epic Legonians and went to state in 2014 and 2015. In FLL we have won 1st place for the Core Values award both times we went to state. This is my sixth year participating in FIRST and my first year participating in FTC with The Nano Ninjas. On this team, most of my contributions center around the Engineering Notebook. FTC is a lot different from FLL. In FTC you have to take care of a lot more work, make a bigger robot, and program the robot using a different software, but both FTC and FLL are equally fascinating! Participating in FTC has taught me a lot about problem solving, responsibility, and engineering. From doing FTC I want to achieve more knowledge about technology and how it works. Most of all I want to learn more about working in a large team. My main position on the team is to work on computer aided design (CAD) and the Engineering Notebook. I really like the idea that we are transitioning to Overleaf. Overleaf is very fun to use and gives the Engineering Notebook a nice look. CAD has also been very nice to learn. I thought CAD was going to be very difficult at first, but I was so wrong! I really enjoy creating structures with CAD and cannot wait to master the program. FTC has been very exciting so far and is a great experience! I have gotten so much out of participating in FIRST and FTC this year. I hope to continue the FIRST program in following years.

2.11 Aishwarya



Hello, my name is Aishwarya and I am a seventh grader at Stoller Middle School. I was born in Portland, Oregon but have visited many places such as Canada and India, and all in all I simply love to travel. Drawing and reading are some of my favorite hobbies, I love books and I also like to write stories. My favorite genre is mystery and adventure fiction, I also love to swim and dance. I do Drawing and art related things such as competitions at a fair. Some of my favorite subjects at school are math and science. My ambition is to be a pediatrician. I have done four years of FLL and this is my fifth year in FIRST, and my first year in FTC. Both FTC and FLL taught me to work as a team and to problem solve. In FLL I was in the team “Epic Legonians” for four years which we learned about how to work as a team and to try out strategies that will help us solve certain problems or challenges that we may face in the real world. We won many awards such as the all star award. We also won the core values award in FLL. My favorite year in FLL was the World Class learning unleashed where we did many outreach activities that helped us learn a lot. Another one that was my favorite was when we built the eye sport, which was used to help blind athletes help them play sports. FTC was a lot of fun and taught me how to build and design. This year, my main focus for FTC is to work on robot building. Everything that FIRST taught me will be used when I grow up. This will certainly help me in the future and I am excited to do FTC again.

2.12 Navyatha

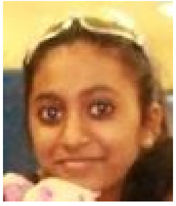


My name is Navyatha Buddi, and I am currently an 8th grader at Meadow Park Middle School. I have a strong passion for art, and my other hobbies include reading, baking, swimming, and playing the piano. This is my first year participating in FTC, and I have joined mainly because I was interested in exploring the many aspects of robotics in an interesting and creative way. My main job on the Nano Ninjas team is to use the CAD (computer aided design) software to create informational drawings of our team's robot, and work on the Engineering Notebook. FTC is definitely a fun learning experience, and not only did I gain more knowledge about programming, designing and constructing a robot, but I have also learned many valuable lessons. For example, I have learned it is important to have good organization and time management skills, along with working with your group in order to solve a problem, or come up with a new idea. Participating in FIRST and FTC has also taught me a lot about technology, problem solving, engineering and robotics in general. Overall, FTC has taught me many useful things! In the years to come, I definitely hope to continue participating in the FIRST program.

2.13 Sahana

My name is Sahana and I am thirteen years old and I have lived in Beaverton, Oregon for most of my life. Except for the two years that I spent in India. I enjoy the fine arts which includes dance, song, paintings, and antiques. Some activities I enjoy are sports, whether I am good at them, or not I thoroughly enjoy just playing and being active with my friends. This is one of the many reasons I love FTC. FTC gives me that feel of being part of an team and being able to face many obstacles with them. When I was on Jr. FLL I met a group of kids who thought robots were cool and wanted hands on experience, that common thought is what kept us together then and still keeps us together now. I was on the Epic Legonians for three years. My first year was in Jr. FLL, and it was just the beginning. We had just started with simple Lego Mindstorms programming and easy attachments. By our second year we had visited various places like Sweet Tomatoes and won the rookie award. This was a very motivating and took us to the rising star award during our third year. Unfortunately, my family and I moved to India and I could not continue with the Epic Legonians. On the other hand in India,and I was able to see my classmates introduced to NXT and programming through a program called stem. This showed me how technology spreads, and quite quickly. After coming back I was very excited to join and start FLL. Instead I met the Nano Ninjas, a team that brought me into the world of FTC. A new experience, actually that's not exactly the term I would use. A new world of robotics and technology. Concepts that I had never even thought of. So many things to learn, apply and discover. This isn't just an activity it teaches skills, whether it's leadership skills or programming. It teaches tolerance and acceptance and that is what I take from my time with first. My main job on this job is to focus on robot building.

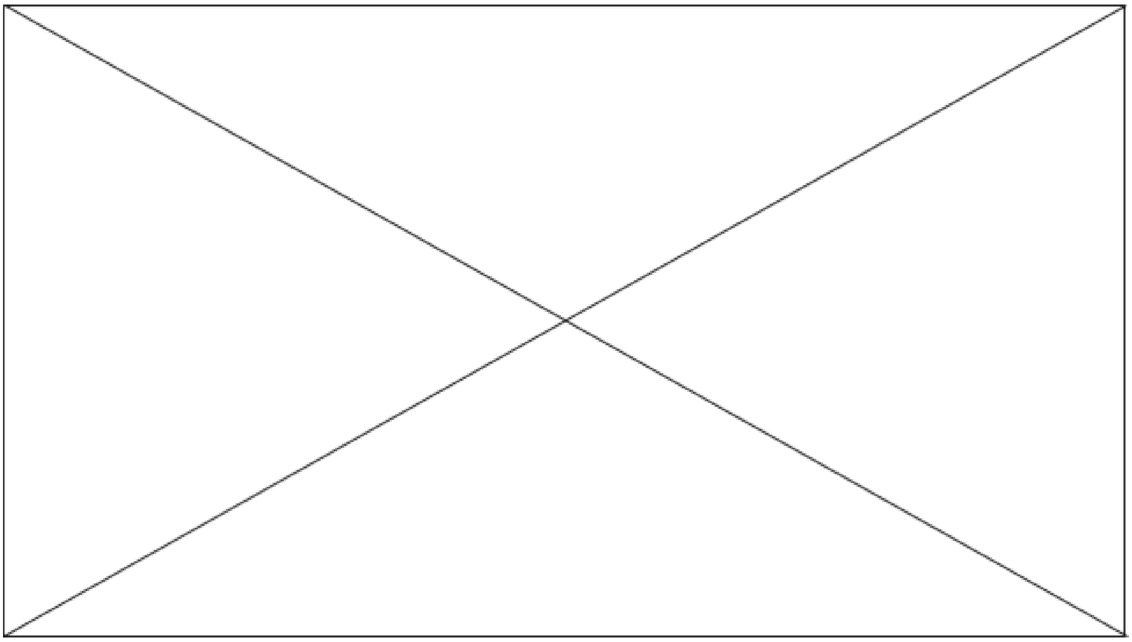
2.14 Esha



Hi my name is Esha Nagul and I am 12 years old. I am a 7th grader at Stoller middle school. Some things I like to do are read, paint,and cook. My passion is to dance and sing. I did khatak for a year and then I started learning kuchipudi for over 3 years. I joined FIRST and FTC because I like building things and because I wanted to try it out.This is my first year doing Lego robotics and I enjoy doing it. I want to do everything I can to help my team go further. I want to apply things I learn in school in various FTC activities and pick up new skills. In the short time that I've been in FTC I learned that because there is many applications of robotic devices in day to day life. FTC helps teach kids how engineering works. It also teaches kids how to interact with each other. It helps kids to plan and organize better and work towards achieving their goals. My main job on the team is to work on outreach.

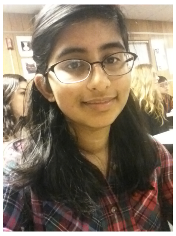
2.15 Rhea

My name is Rhea Oommen. I am thirteen years old and am in the 7th grade. I attend Stoller Middle School and live in Portland Oregon. There are many things I enjoy doing in my free time such as reading novels, and writing. I have been playing tennis for many years now and is a sport I enjoy, I also enjoy swimming. One of my favorite subjects in school is science. This is my first year participating in FTC and my first year participating in FIRST all together. I started FTC just wanting to expose myself to new experiences and I'm really glad I did. So far I have really enjoyed it. In just these few months I've learned a lot about working together as a team, and FTC has forced me to collaborate with others, which I think is an important skill. This experience has also increased my knowledge in engineering and technology through the process of building a robot. Engineering and technology are both things I hope to apply to my daily life in the future. Through FIRST I've also got opportunities to get other people interested as well. I hope to continue participating in FIRST for many more years to come. My primary task on the Nano Ninjas is robot building.



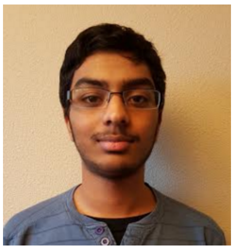
3. Nano Ninjas: Team Mentors & Coach

3.1 Anna



Hello, my name is Anna Nixon and I am a sophomore at Westview High School. I have participated in JFLL, FLL, FTC, and FRC and am the co-founder of the non-profit organization STEM4Girls.
I have won the 2015 Ant Man Micro Tech Challenge and am one of the youngest winners of the NCWIT (National Center for Women and IT) Aspirations and Computing Award. Throughout my many years participating in STEM activities, I have focused on inspiring the next generation of girls to become interested in STEM as a future career.
I have shared my learning and experience with my younger sisters' team, the Nano Ninjas, whether it has to do with our robot, program or engineering notebook, I will never step motivating and pushing them.

3.2 Chetan



Hello, my name is Chetan Dindukurthi. I am a senior in the twelfth grade at Westview High School in Portland, Oregon. I am glad to have participated in FLL for two years, FTC for three years, and now have recently joined my school's FRC team. I simply love robotics and learn so much from the challenges it puts in front of me at every step of my life. I hope to study in this field during my undergraduate and graduate studies. I truly appreciate the fact that FIRST has given an opportunity to many students across the world to learn skills that will ultimately be useful all throughout their lives. I hope FIRST may stay with me all my life. I would not mind the idea of being a coach of a FIRST team somewhere later in my life.

3.3 Nixon

Nixon is the co-founder and Chief Executive Officer of STEM4Girls, a 501(c)(3) non-profit organization aims to instill a love for STEM by bringing fun, educational workshops and camps available garner the interest of young minds in the hopes that it will help them throughout their lives.

Nixon is technology enthusiast with more than 25 years of experience in various industries and software technologies. He holds a bachelor degree in Electrical and Electronics along with certification in Project Management Professional (PMP).

He has been a Robotics coach for the past 9 years and has worked with multiple FIRST teams in JFLL, FLL, FTC and FRC programs in Oregon and guided his teams to state and super regional competitions.

He is a veteran in SAP technologies and has delivered a session at the SAP Sapphire event with a Robot as a co-presenter. He is an Innovator and a Patent owner for the PeopleFinder System which help users to manage their contacts while on the move.

He is an active volunteer at local schools and has helped build various clubs in the areas of Lego Robotics, Chess and Math, Science and History. He is also involved in the Beaverton School district WE program which help students to excel, innovate, embrace equity and collaborate.

II

Engineering Summaries: Pre-Season

4. Season Starter

Meeting Date: Mon, 05/18/2015, 5:00 PM - 8:00 PM
Personnel Present: Nandhana, Namitha, Maria, Shamamah, Harini

Tasks This Meeting:

- Recruit more members
- Discuss Engineering Notebook
- Work on funding and fundraisers
- Research robot building and parts
- Outreach planning
- Discuss new Android platform
- Discuss possible sponsors
- Start a Kickstarter

Reflections:

At the meeting we discussed the vague plan for this year, like roles and responsibilities. Each team member will need to spend at least an hour each day and we plan to divide the team into smaller sub-teams. Everyone will get a chance to try everything but they may belong to a sub team such as 'programming' or 'building', etc, based on their skills and interests. We also planned ideas for fundraisers and outreach events. We already have one sponsor, ScreenSteps and we need to reach out for more.

There is a lot to do but now we have a good idea where to start! Since we are a rookie team this year we started off by researching the main components of the FTC tournament. This is what we learned:

New Android Programming and Platform

- Key components: robot, programming, outreach, engineering log
- New Android platform

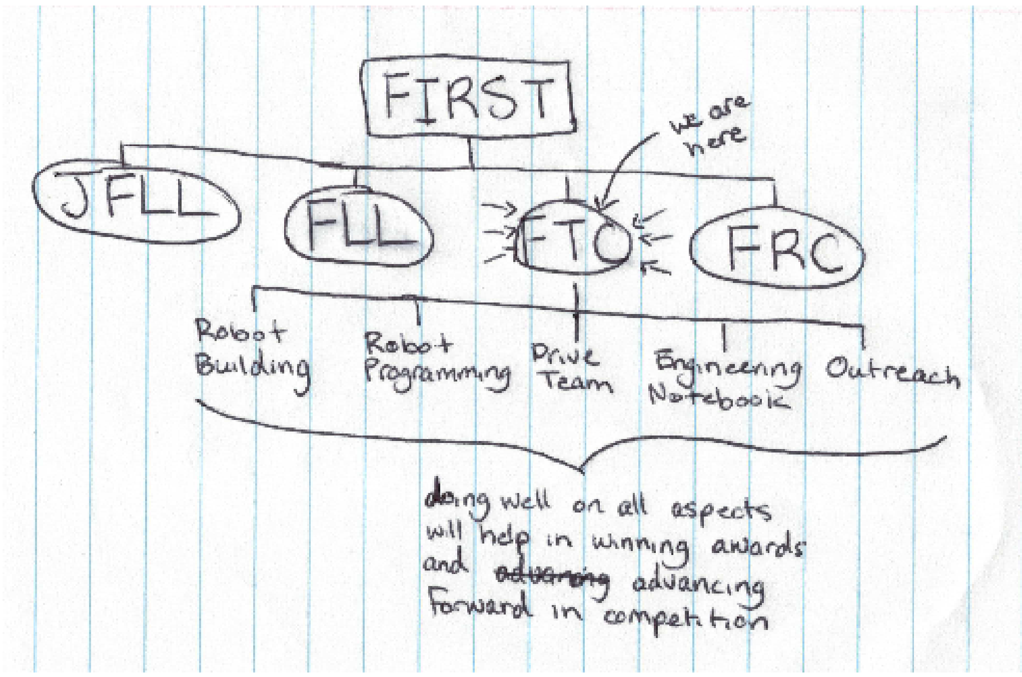
- Programming is now on Java
- One Android phone on robot, one in Driver Station
- Three programming options: Android App Development with Java, MIT App Inventor, simple movement download app

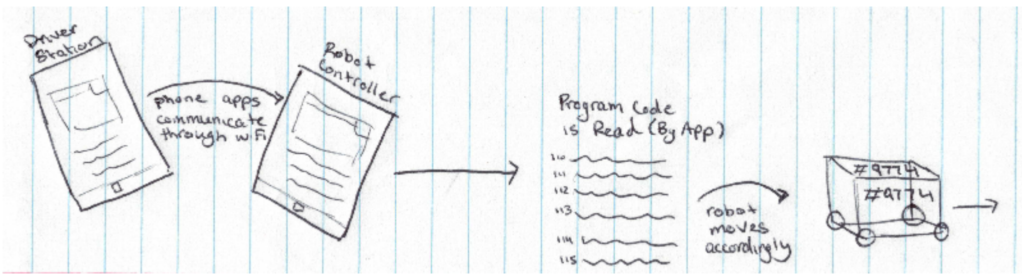
Engineering Notebook and Outreach

- Engineering log must be concise, include research and conversations
- Work on funding, fundraisers
- We need to reach out to the community for sponsors

Competition Stages

- League begins in January and is every Saturday (10 weeks), and works by achieving ratings and having eliminations until a certain amount of teams is left, which then proceed to Super League.
- Qualifier is single event, single elimination
- After League Championship and/or Qualifier next comes Super Qualifier, which leads to Regional then State, then National, and finally World





Submitted By Nandhana

5. Talking Through a Screen

Meeting Date: Fri, 06/19/2015, 6:00 PM - 7:00 PM
Personnel Present: Nandhana, Namitha, Maria, Rushali, Harini, Irene, Adithi

Tasks This Meeting:

- Sponsorship for FTC
- Work on Kickstarter page
- Explore MIT App Inventor
- Update Google calendar
- Discuss Engineering Notebook
- Navy Blue Angels Demo

Reflections:

Today was our first online meeting using AnyMeeting. Since it was our first time organizing a meeting using AnyMeeting we had some technical difficulties, but the overall experience was helpful. Any Meeting will be useful when it's not possible to meet in person that way we can make progress without being at a face-to-face meeting.

Sponsorship for FTC

In order to gain sponsorship and to spread the word about FIRST, we devised of a few possible options. ScreenSteps is a documentation company which allows one to create visual user documentation, including articles, how-to guides and manuals. Also, it helps with building a knowledge base for easy organization and maintenance. During FLL, we helped advertise ScreenSteps by doing a video tutorial about them and posted it on YouTube. If we can have them as a sponsor, it would be very helpful. Additionally, STEM4Girls is a nonprofit program that advocates young girls to achieve their dreams in STEM areas. In fact, it was co-founded by Nandhana and Namitha's older sister, Anna Nixon. As an all-girls team, it would mean a lot to

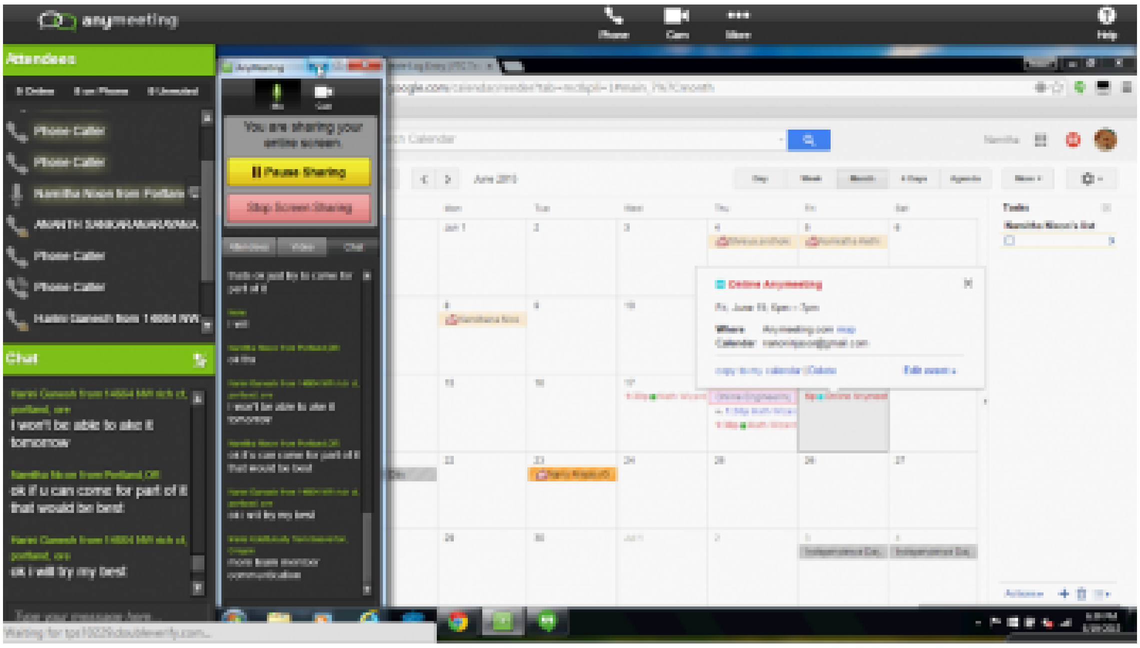
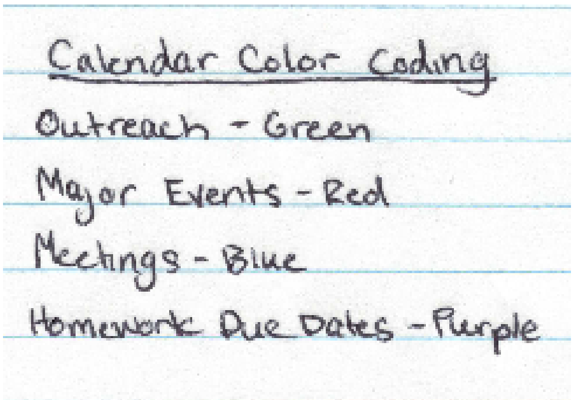


Figure 5.1: A screenshot of AnyMeeting in use.

us if STEM4Girls could support us in our mission to inspire girls (but not limited to) to embrace science, technology, engineering, and mathematics. Our last option was Math Wizard. Math Wizard is a proud partner of STEM4Girls and because we have volunteered there, we deemed it a good idea to ask them to kindly sponsor us.

Update Google Calendar
To organize which days people are free and important FTC-related dates, we are using Google Calendar. Rushali has taken up the responsibility of frequently updating the calendar and enforcing that everyone is using it.



Submitted By Namitha

6. Face to Face for the *FIRST* Time

Meeting Date: Sat, 06/20/2015, 12:00 PM - 3:00 PM
Personnel Present: Nandhana, Namitha, Maria, Rushali, Harini, Shamamah, Irene, Shruthi, Ramya, Adithi, Aishwarya

Tasks This Meeting:

- Meet the team
- Discuss goals for the year
- MIT App Inventor
- FTC Layout
- Sponsorship and volunteer match-ups
- Navy Blue Angels Demo event
- Schedules
- Understand the use of Google Calendar, Anymeeting, and Google Docs
- Outreach
- Plan for FTC Innovation Challenge

Reflections:

This was the first face-to-face meeting with the entire team. We are still getting to know each other but it was a good chance to meet in person. The meeting was a great opportunity to get everyone on the same page for the new plans we've come up with since some of our members have been active in coming up with new creative ideas and opportunities for this season. We could improve with more participation and interest from all sides instead of a couple of members taking the lead. Overall it was a good chance to bond and meet with our teammates, and we were able to come up with some great ideas and plans that some of our members have already started to take action on! More participation is necessary from our new members, also they need to be more open to conversation. Most of the talking during the meeting as well as during our break was a couple of team members trying to start a conversation,

Figure 6.1: Left to right, back to front: Shamamah, Harini, Rushali, Irene, Adithi, Ramya, Shruthi, Namitha, Maria, Nandhana

while the others kept to themselves.

We discussed our short-term goals and decided that we need to work out our STEM4Girls email IDs. Also, we need backup engineering notebook, just in case website is taken down; download or print weekly. Shruthi needs to find all team members t-shirt sizes. Everyone needs to look up sample engineering notebooks. The new members need to be more active and participate more in the conversation.

Nano Ninjas FTC Pixel Page

- Create a webpage with all teams' logos (like www.milliondollarhomepage.com)

- Give team name, number, email and location
- We need to reach out to the community for sponsors

FTC Resources (ScreenSteps)

- Everyone will start looking for videos that will be useful for other teams
- We can have other teams contribute to FTC Resources. We will reach out to nearby teams such as Batteries in Black, Hot Wired, Syntax Error 42, etc.
- We can have twenty member accounts. The more teams pitching in the better, we can have their team logos on the side. Anything from videos to links can be put on the page

Competition/Season

- Eighteen FTC awards
- Think Award for engineering notebook
- Compass and Promote Award for outreach
- Game Manual I outlines rules, Game Manual II is for robot play; released in July
- Scouter for understanding alliances and other teams

Programming

- Programming consists of three aspects: simple download and play app, developed by Snapdragon, partnered by Qualcomm
- MIT App Inventor partnered with Google, drag-and-drop Scratch system
- Snapdragon SDK Java; relying on second option of App Inventor, work in a bit of Java

Fundraising/Outreach

- Math Wizard is hosting a robotics summer camp program which encourages young ones to become involved in robotics; currently working with EV3 building and programming
- Work on fundraising; possible solutions include Kickstarter, producing and selling apps, GoFundMe, use strengths and talents to create product(s), local establishment, volunteering in tutoring math, grants, contribution match (when one's work hours are paid for accordingly, Intel does it; contribution match is when one contributes a specific amount and then an organization contributes the same, Nike does it)

Online Tools

- Google Calendar for future schedules
- AnyMeeting and Google Hangouts for future online meetings

Costume/Appearance

- Keep team logo, need t-shirt sizes
- Think of possible mascot

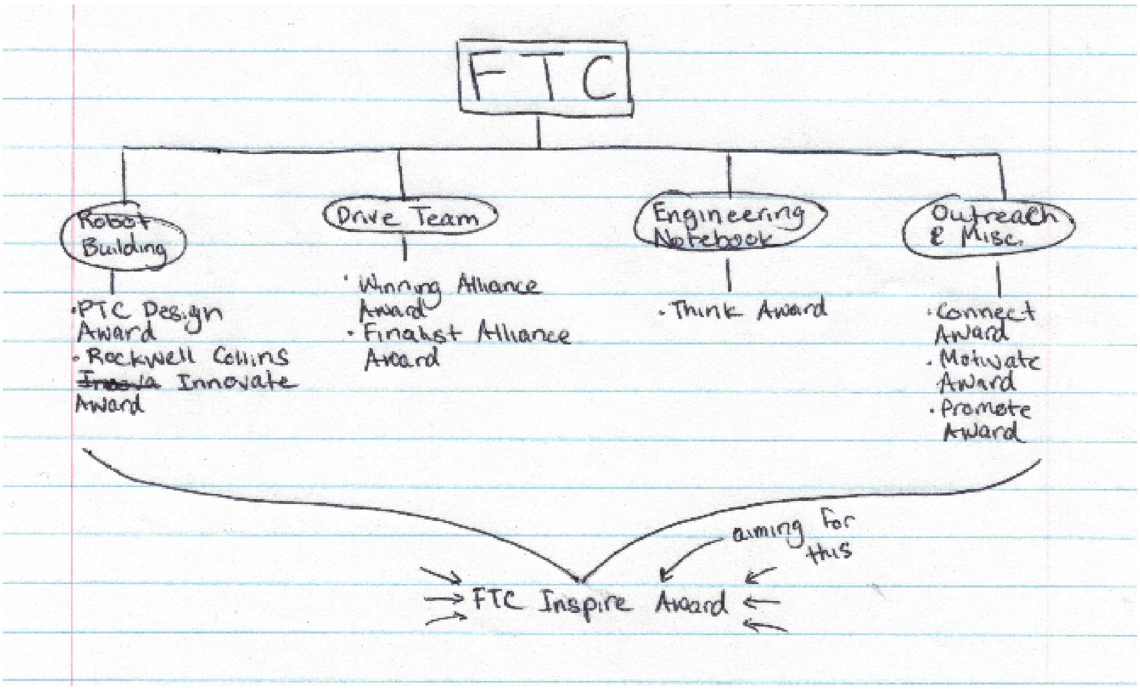
SAP Lumira/FTC Innovation Challenge

- SAP Lumira for data organization, possible foundation of Nano Ninja's project
- FIRST Innovation Contest covers three categories: water quality, healthcare,

Figure 6.2: A whiteboard on which we all wrote down everything we wanted to discuss this meeting.

and engineering tools; emphasis on health area

- Need system of data collection of other teams' scores



Submitted By Namitha

7. A Team of Fourteen

Meeting Date: Sat, 07/25/2015, 1:00 PM - 5:00 PM
Personnel Present: Nandhana, Namitha, Maria, Rushali, Ramya, Irene, Harini, Shruthi, Adithi, Navyatha, Rhea, Sahana

Tasks This Meeting:

- Meet new members
- Look at parts of the robot
- Discuss TIMS
- Discuss interest in FTC activities
- Discuss game manual

Reflections:

Today was our second meeting and we were able to meet our new members. The meeting was a great opportunity for us to discuss our interests in FTC and talk about the overall idea of FTC. We also received the basic parts of a robot and were able to take a look at them. This meeting was a good time for us to go over the game manual part one, so we know the rules about FTC, the parts of FTC and what FTC is. This time we had more participation from everyone which was excellent and gave a

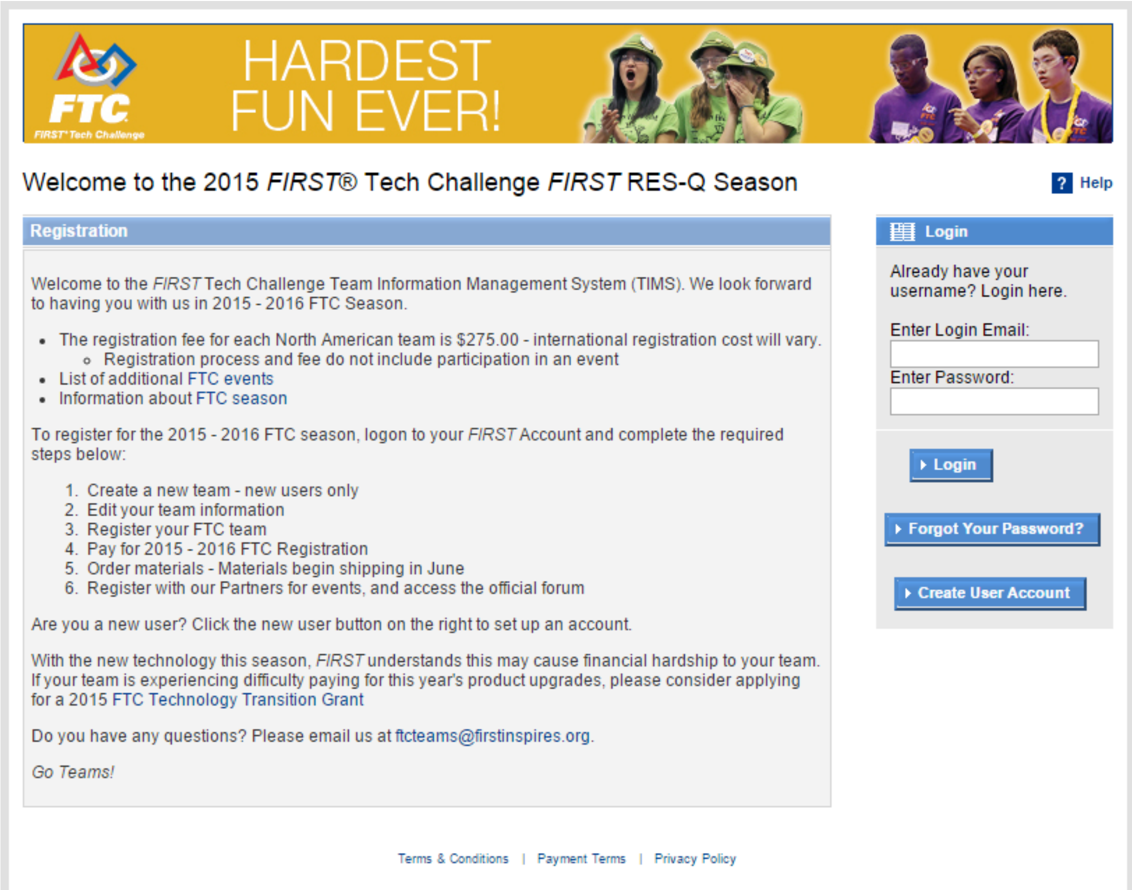


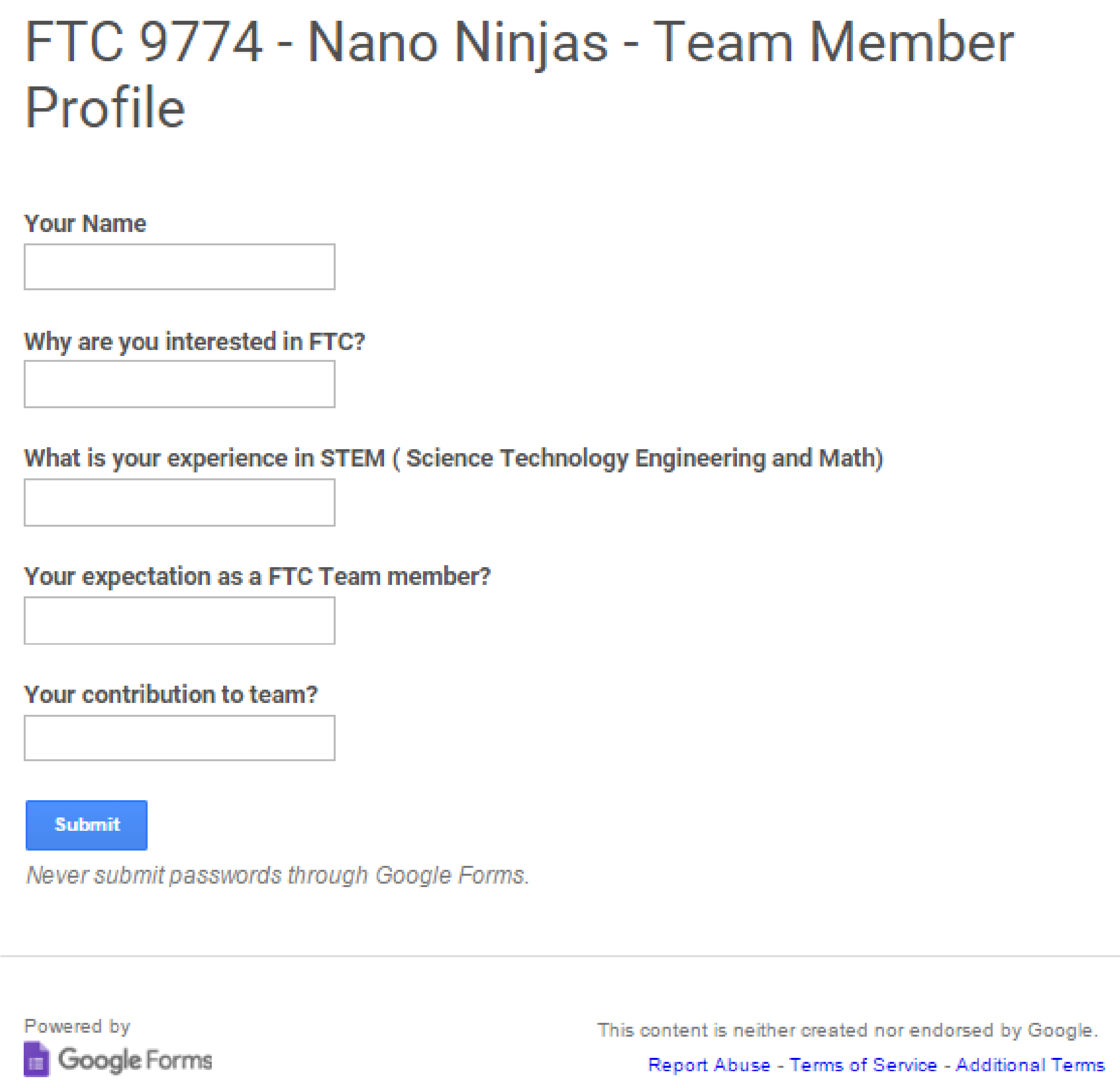
Figure 7.1: Screenshot of TIMS registration webpage.

chance for us to know everyone better.

At the meeting at the fire station, we met our new members, Navyatha, Rhea, and Sahana. Welcome to all of them! After having a round of introductions, we went straight to reviewing the TIMS instructions on how to apply for our Nano Ninjas FTC team. Below is the set of instructions every members has been needing to follow.

1. Create New Account *(returning users do not need to create a new account)
2. Login to Account
3. Complete Youth Information sections
4. Apply to your team (Team 9774)
5. Sign and submit FIRST Consent and Release Form – you are done
6. You will receive a confirmation from the coach/mentor informing you about the acceptance status of your child on the team. If you do not get an email, please contact your coach/mentor

After that, we got a great experience with looking at robot basic parts. Our coach, Nixon Uncle, had ordered them online and we were more than happy that they had arrived. We learned that the basic parts of a robot includes the wheel (in specificity we learned about the omni-wheel), the channel (all the different sizes, too), and the


FTC 9774 - Nano Ninjas - Team Member Profile

Your Name

Why are you interested in FTC?

What is your experience in STEM (Science Technology Engineering and Math)

Your expectation as a FTC Team member?

Your contribution to team?

Submit

Never submit passwords through Google Forms.

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Report Abuse - Terms of Service - Additional Terms

Figure 7.2: Screenshot of Google form.

gear (also went over the various sizes and tooth numbers).

We then discussed our FTC activities. It was more purposed so that our new members could have a taste of what FTC would bring them. We went over electrical, field setup, programming, Snapdragon applications, and outreach.

At home, we talked about the task of completing the FTC reflection on Google Forms. The form had been created be our coach to see each individual's reason for joining FTC, experience in STEM, and hoped contributions toward the team. We also set as homework everyone, especially our new recruits, to complete reading Game Manual Part I. Also, sponsor was a recurrent topic of discussion. Gladly we had STEM4Girls as a sponsor, in fact we were run through them, and also set as homework that everyone look through their "FTC Resources" page which STEM4Girls spent so much time on creating. Their FTC resources page includes almost everything a FTC team must need in order to make it through the season. We lastly established that we needed a team camera which would always be kept inside our regular meeting home so we could take photos without the hassle of trying to find a camera.

Below are the results of our questionnaire. To save space and make it organized, the answers will follow these numbers of the questions.

1. Why are you interested in FTC?
2. What is your experience in STEM (Science Technology Engineering and Math)?
3. Your expectation as a FTC Team member?
4. Your contribution to team?

Maria Kolattukudy:

1. I really enjoy working with robots. I particularly like driving and competing with the robot, just like I have done in previous years doing FLL. I also like building robots, it's really interesting getting to now everything that makes up these complex robots.
2. I have been doing FLL for the past three years, and have took a few Saturday Academy classes which focus on LEGO robotics.
3. During this FTC season I want to learn about robots and improve my programming skills. It would be great if we could be successful during the competition season and advance to the next level.
4. My major contributions to the team were done in past FLL years. During me three years of FLL i contributed to project and have programmed and ran the robot during competition.I have been a part of most of the FTC meetings and helped create an engineering logbook entry.

Sahana Inteti:

1. Learn building robots and having fun in the process!
2. Have been part of Lego robotics for few years and during that time learned to build models with LEGO and program the model to do tasks!
3. Become a fun and strong team willing to take up any challenge that come our way!
4. Be a good team player and do what ever task that is required to win as a team!

Shamamah Khan:

1. To learn more about teamwork and STEM.
2. I have done FLL for one year and have done several STEM camps in the past.
3. To cooperate well and contribute as much as possible. I shall put forth all my experience and knowledge.
4. Help form ideas, building, engineering notebook. I will do as much as I possibly can to ensure that our team has the best experience as possible. I am committing myself to this program.

Irene George:

1. To learn about robots.
2. None.
3. To build a robot.

4. Programming.

Adithi Mahankali:

1. I am interested since I have been doing FLL for the past 4 years and I really enjoyed it. So I wanted to go to the next level.
2. I have done a lot of science experiments and they were really detailed.
3. To help build and program a robot from scratch.
4. We all help each other build the robot and program it.

Rushali Desai:

1. I am interested because I would like to see how programs work and how the robot is built to run our programs.
2. I have used AppInventor and am going to do the ant man micro tech challenge.
3. I expect everyone does and equal amount of work
4. I will do my best while learning and also do an equal amount of work.

Harini Ganesh:

1. I like spending time doing things hands on and ftc gives me that chance.
2. Not much. Our class was lectured on STEM by a parent volunteer in fifth grade.
3. To become a good programmer.
4. N/A

Shruthi Ananth:

1. Continue to learn and contribute back to FIRST and our communities worldwide.
2. 1 year JFLL, 4 years FLL, QT Champions winner, First place in "Core Values" twice in a row at OR state FLL championship; 1 year Technovation pre-finalist; Bethany math club award winner.
3. Would love the opportunity to be one of the drivers; Enjoy the opportunity to work on electrical/mechanical as well as programming tasks.
4. Engineering notebook, Building/Programming.

Namitha Nixon:

1. N/A
2. I have participated in FIRST programs from JFLL to FLL and now FTC. Through these years I have also been involved in other STEM related competitions and programs, as a host and/or participant. Over the course of my time exploring STEM I have had experience in all the aspects from programs such as NSF, Math Kangaroo, FIRST, and others.
3. I will put all my effort into this year, as I hope i have done the 4 or 5 years i have been doing this. I plan on committing myself to my best capability.
4. N/A

Sahana Inteti:

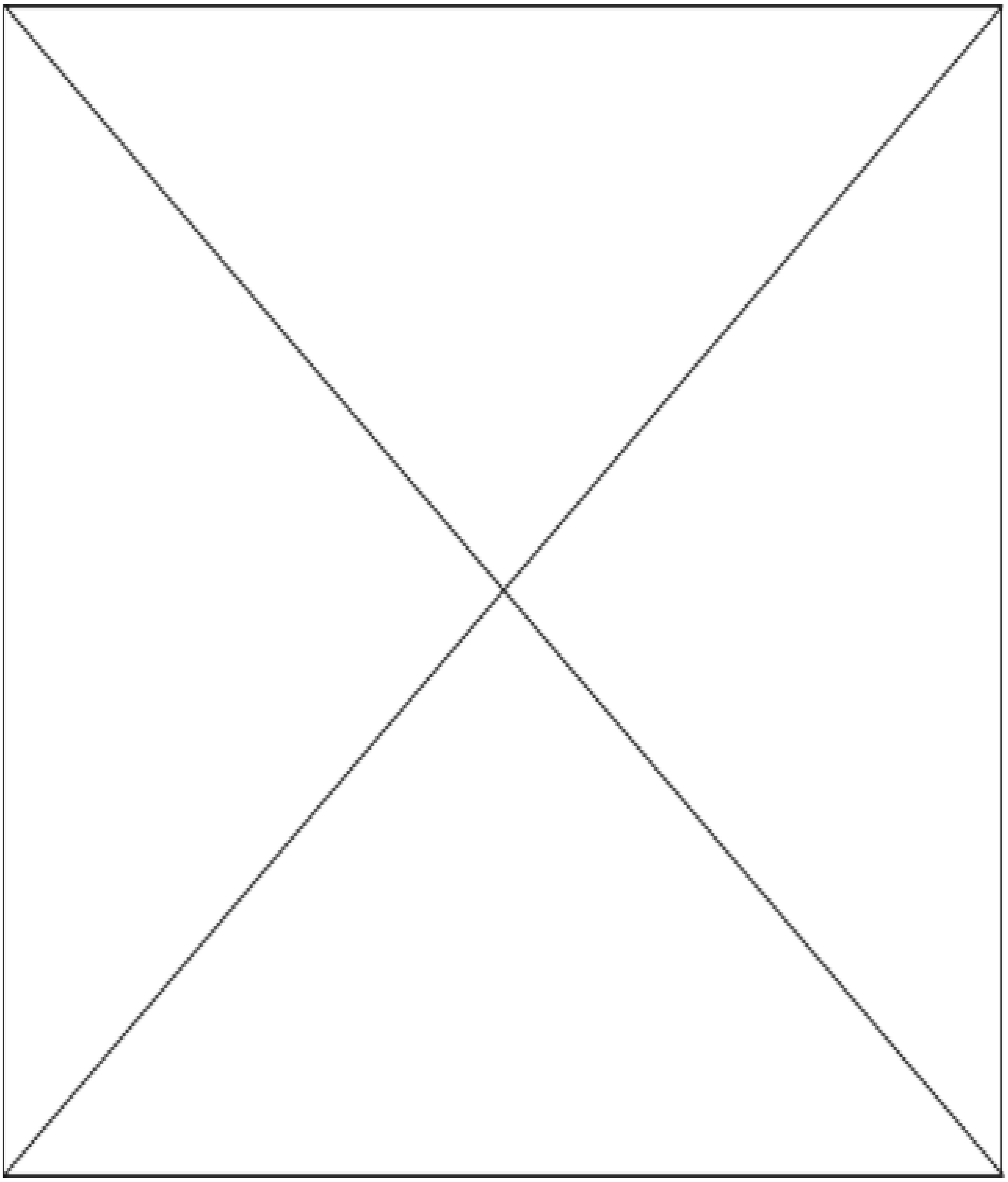
1. I want to learn some thing out of the box ... Something new and exciting.
2. My school has taught me about these things and I am hoping to learn more through FTC.
3. My expectation for myself as a FTC Team member is to contribute as much as I can and gain knowledge about the four things that STEM stands for.

4. I will help when opportunities arise.

Rishitha Chandra (later decided not ready for FTC, but we are still including her submission):

1. I have participated in FLL and would like to participate in FTC also.
2. N/A
3. N/A
4. N/A

Submitted By Rushali



8. Our First Look At Android

Meeting Date: Wed, 07/29/2015
Personnel Present: Maria, Nandhana, Namitha, Rushali, Harini, Irene, Shruthi, Rhea

Tasks This Meeting:

- Go over the basic components of a FTC robot
- Learn FTC Robot Wiring
- Introduce Android Software Programming
- Plan our next meeting

Reflections:

Today was our second online meeting using Anymeeting. Since most team members were familiar with the tool, the setup ran extremely smooth. Anymeeting was really helpful and convenient for us, and is definitely something we plan on using in the future. During this meeting we had a guest speaker, Johnson Vincent, a professional Android software developer. He gave us some great tips and links to get started with Android programming.The team really enjoyed him and would really enjoy it if we continued inviting more guests to our meetings.

Nandhana, Namitha, and Nixon Uncle have set up the robot station as well as the driver station. This means the two android phones are connected to both each other and the robot itself. We have a good head start on the Android platform and we plan to explore more during our Saturday meeting. For Saturday, we hope to bring basic tools to starts building the base of a robot and print our building instructions for K9 test robot.

Basic Components of a FTC Robot

- Core Power Distribution Module
- Core Motor Controller

- Android Phone
- Robot Controller
- Battery
- DC Motor Controller
- Sensor Controller
- Legacy Controller

Core Power Distribution Module
This is what is connected directly to the 12 Volt Battery Pack. This module is what sends power to all the different modules. It is the most important part because without it, nothing else will get power. It also has a 20A fuse which means that it can control the power it gets. This is more of a safety aspect so that no one gets shocked.

Core Motor Controller
This module is what gives power to the DC motors. These are what give power to things such as wheels or arm lifts. Two motors can be connected to one of these modules. We have been given two Core motor controllers, which means we connect four motors total. But their is no limit to amount of motors so we can use as many as needed.

Core Servo Controller
This module gives power to the servos. The servos are basically smaller DC motors and they can be used for tasks with less energy required. An example is turning a pipe to raise a flag, like in the Block Party FTC challenge. You can connect six servos to this module.

Core Device Interface
This module supplies the sensors. It has 26 slots for things like touch sensors, color sensors and IR sensors. There is a certain way you need to place the sensors, each row is for a different type.

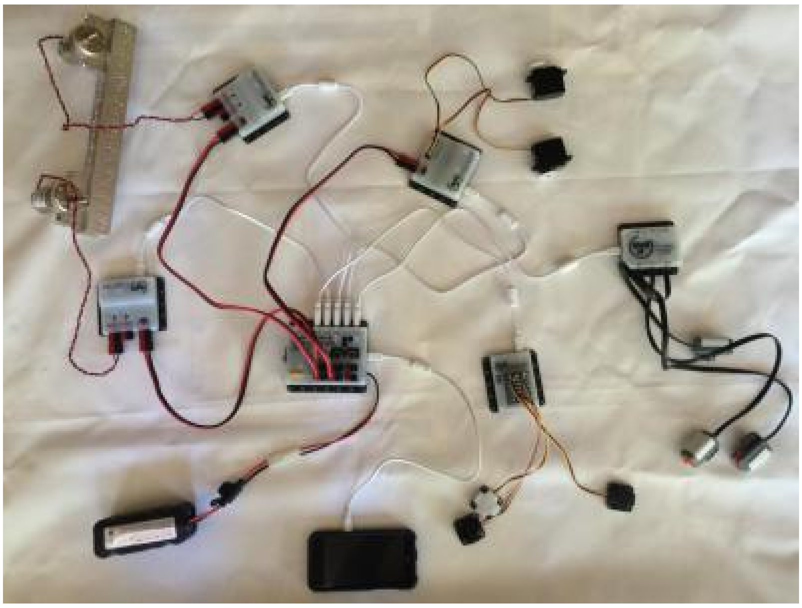
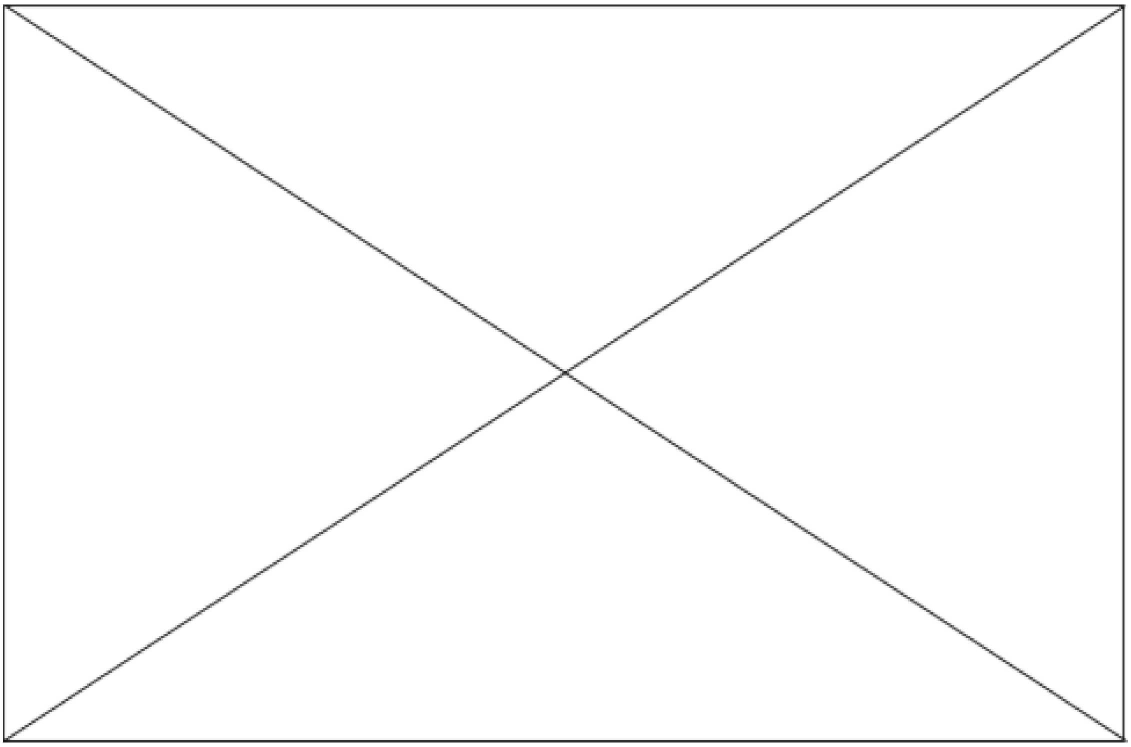
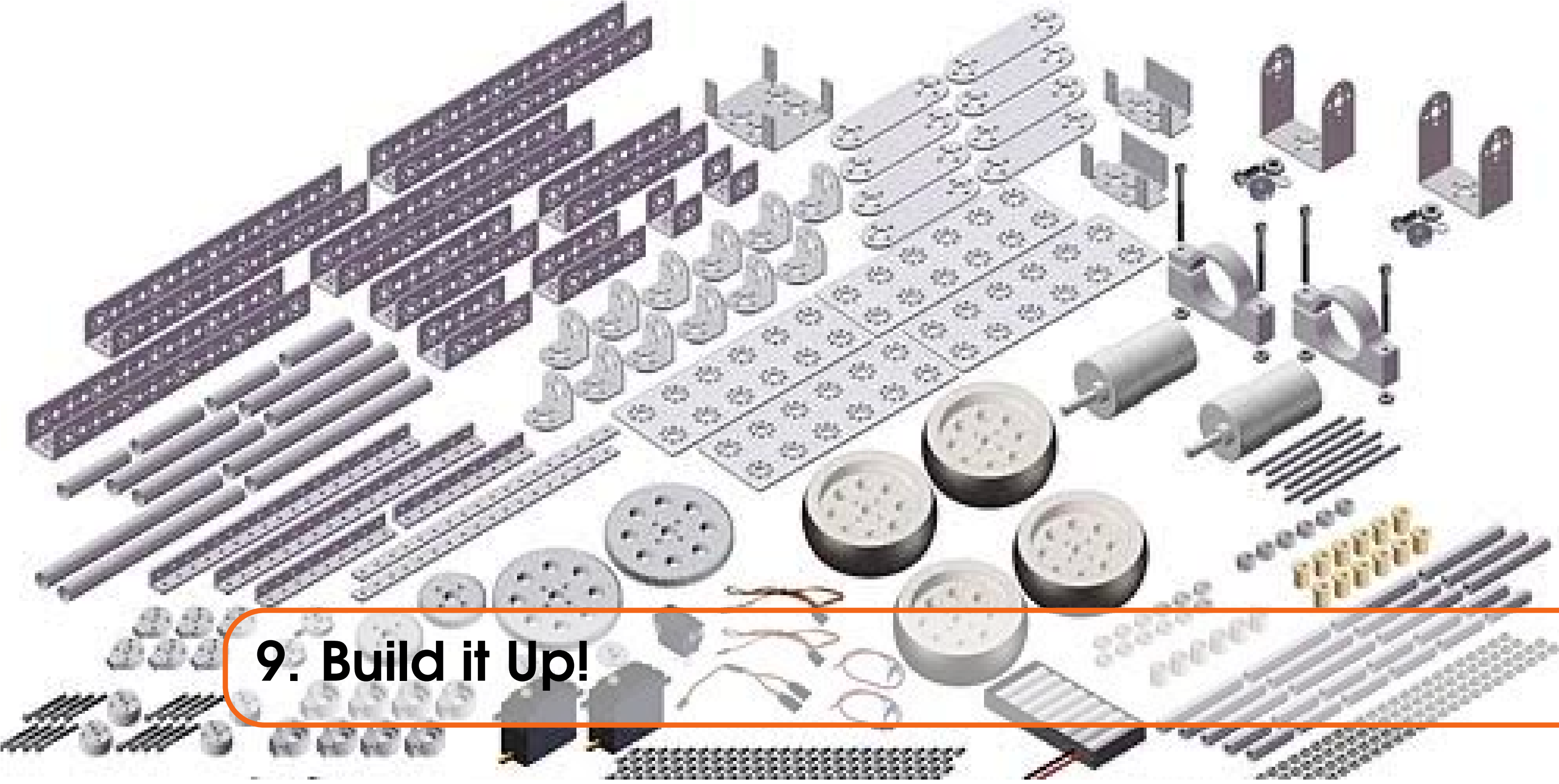


Figure 8.1: All the basic components connected.

Core Legacy Module The last module is for older types of sensors and motors. By this it means NXT motors and sensors. This way you can use both TETRIX pieces and NXT pieces.

Submitted By Maria





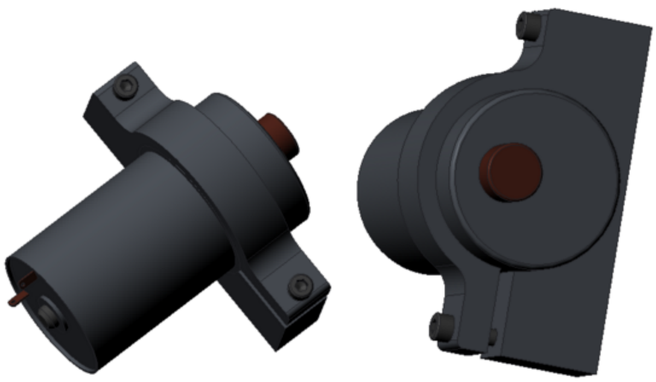
9. Build it Up!

Meeting Date: Sat, 08/01/2015
Personnel Present: Shruthi, Nandhana, Namitha, Maria, Rushali, Adithi, Sahana, Navyatha, Rhea

Tasks This Meeting:

- Learn wire configuration
- Look at K9 robot
- Mount DC motor onto DC motor mount
- Test DC motor

Reflections:



Today was our second meeting with the newer members. We started off the meeting with a demo on the interface components and how the phone's connected with each other. Then we split the team into two groups. One group looked at the K9 bot. The other group focused on programming. The programming group used phone configuration and setup on the android phones to test the DC motor.

We had some trouble while mounting the DC motor onto the DC motor mount, and we had trouble at some points while testing the DC motor. But with a bit of perseverance, it all worked out in the end. The issue we had was that we were holding the DC motor incorrectly in perspective of the motor mount, and that the mount had already been tightened. We resolved them by holding the elements more carefully and loosening the DC motor mount.

During the meeting we had a chance to experiment different reasons for which the motor could and could not work.

App Inventor
MIT App Inventor allows one to develop applications for Android phones using either a emulator or connected phone and a web browser. App inventor is a very simple tool which only allows you to make a base and doesn't allow you to explore different options.

Android Studio
Android Studio is used for developing on an Android platform. Android Studio is far more complex than App Inventor but it allows you to explore different options instead of making it simple.

We hope to test out both App Inventor and Android Studio and see which mode suits us best for the competition.

Submitted By Rhea

10. Learning One Screw at a Time

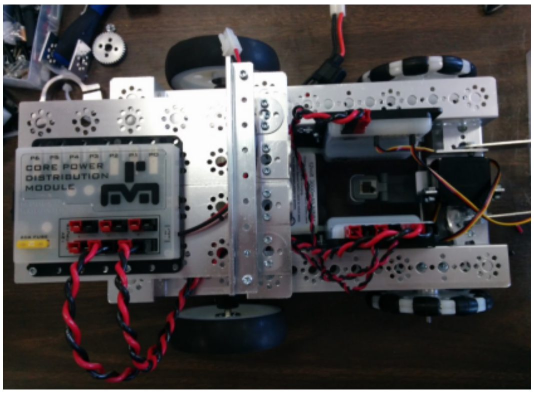
Meeting Date: Sun, 08/09/2015, 1:00 PM - 5:00 PM
Personnel Present: Adithi, Harini, Irene, Namitha, Nandhana, Navyatha, Ramya, Rushali, Sahana, Shamamah, Shruthi

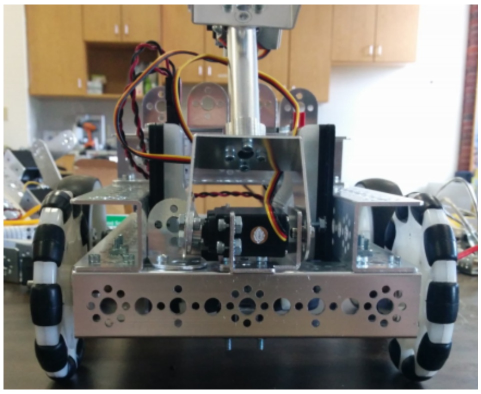
Tasks This Meeting:

- Learn how to attach wheels
- Learn different parts
- Learn different tools
- How many motors?
- Promote Video
- Compass Video
- Parody Video

Reflections:

This meeting was a great success. Today we were mainly working on the robot. We made a similar version of the K9 bot, thanks to Adithi we already had the base ready, but during the meeting we used our imagination to build the rest. We worked on attaching the wheels and motors. Through the process we learned a lot about the different TETRIX parts such as Allen Keys etc. Additionally we were able to test out the equipment using for the first time. We noticed that our robot was unbalanced because the Core Power Distribution module (including everything connected to it) was making one side much heavier, so we plan on adding more weight later to balance it out. Speaking of balancing things out, we also spent some time on the android side of things. We have been able to download Android Studio and even play around with it a little. So far we have made lot's of progress on the robot/building side as well as the Android programming side.





Additionally today was our first day at our new permanent meeting center. We are using the community room at a nearby church and we found the place perfect for our needs.

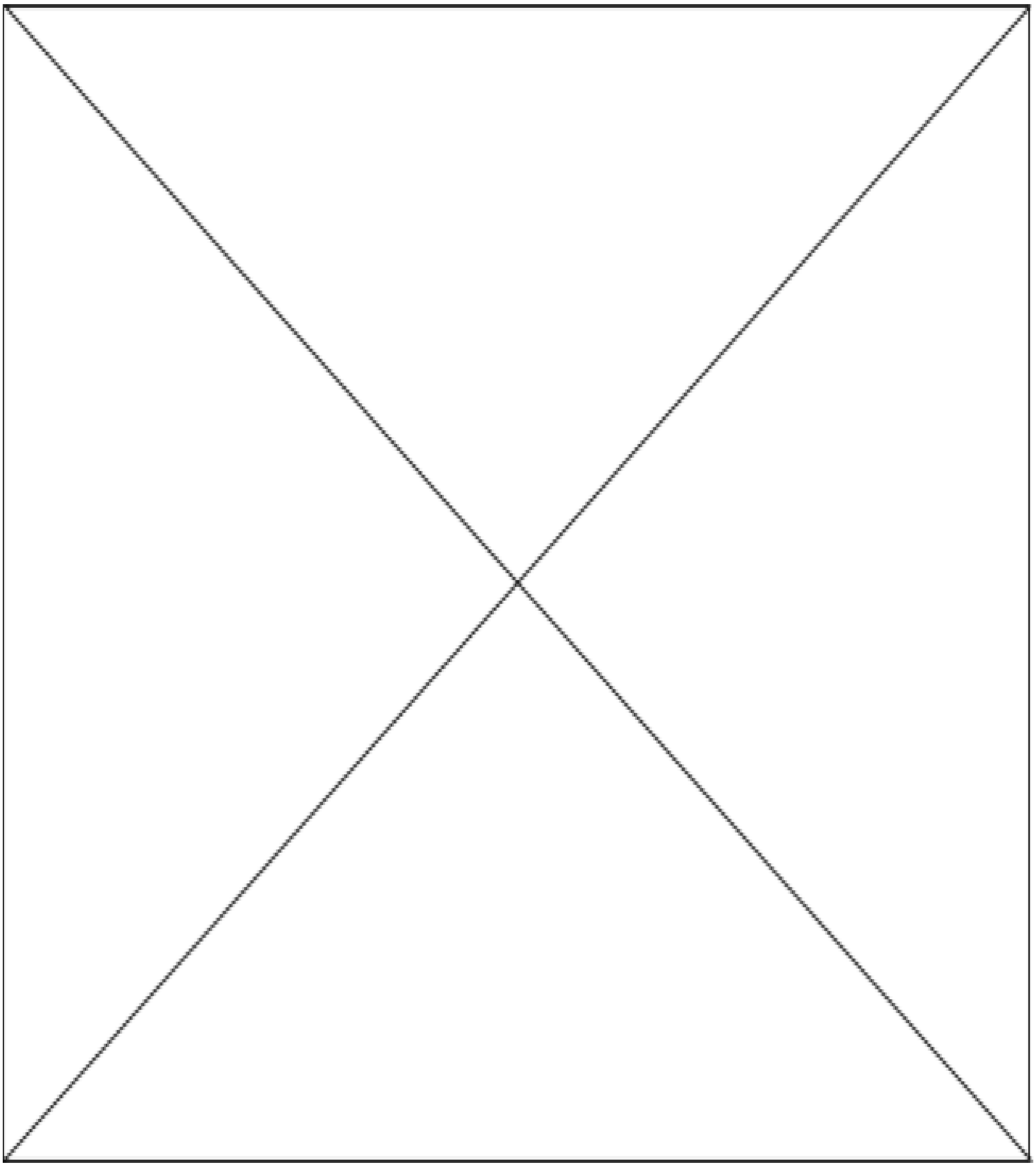
Robot
Today we learned a lot about the different types of parts and tools. We did a lot of building by splitting into a couple teams. We are working on a similar version of the K9 bot, which is a very simple bot. It has four wheels, only two are connected to motors though. This practice robot also has two sensors that, for now, don't do anything. We also learned that the robot needs to be balanced so their can't be more weight on one side and less on the other. The problem for us today was that we did not balance the robot, all the modules plus the battery were in the back, while the front is empty.

Tools
- Allen Key: This is a small piece that helps close and open a type of bushing. The Allen Key is found in three sizes and is kind of like a screwdriver.

- Zip Tie: This is a plastic wire-like thing that can hold items to our robot. It is also used in day to day life.

Parts
- Nuts and Bolts: These are used to 'tie off' a screw. They can be found in many shapes and colors, each with its own specific name.
- Bushing: Similar to nuts and bolts, bushings are used on rods, similar to axles, and can be opened and closed by Allen keys.

Submitted By Nandhana



11. Learning From the Experts

Meeting Date: Wed, 08/12/2015, 6:00 PM - 8:00 PM
Personnel Present: Rushali, Adithi, Sahana, Rhea, Shruthi, Ramya, Harini

Tasks This Meeting:

- Meet Hot Wired
- Learn basic parts of robot
- Start building a small robot

Reflections:

Today, we had our first mentoring session with Hot Wired. We got the chance to meet all the members and the coach. All the members were high-schoolers and were very friendly with us.

We started off the season with learning and establishing the other basic parts of the robot such as the hub, C channel, bushing, kep nut, socket head cap, and much more.

After that, we split off into two teams and then began building a small robot. We started off with a very sturdy base made out of four C channels. Then each group had to decide how we wanted to put on the motors using gears or put on the wheel directly. Next time, we will continue building our robot.

Hub

There are two types of hubs: the axle hub and the motor shaft hub. The axle hub is comparatively thinner and smaller and is purpose to attach gears and wheels to axles and axles to structural elements. The motor shaft hub is utilized to attach wheels and gears to DC motor shafts.

C Channel

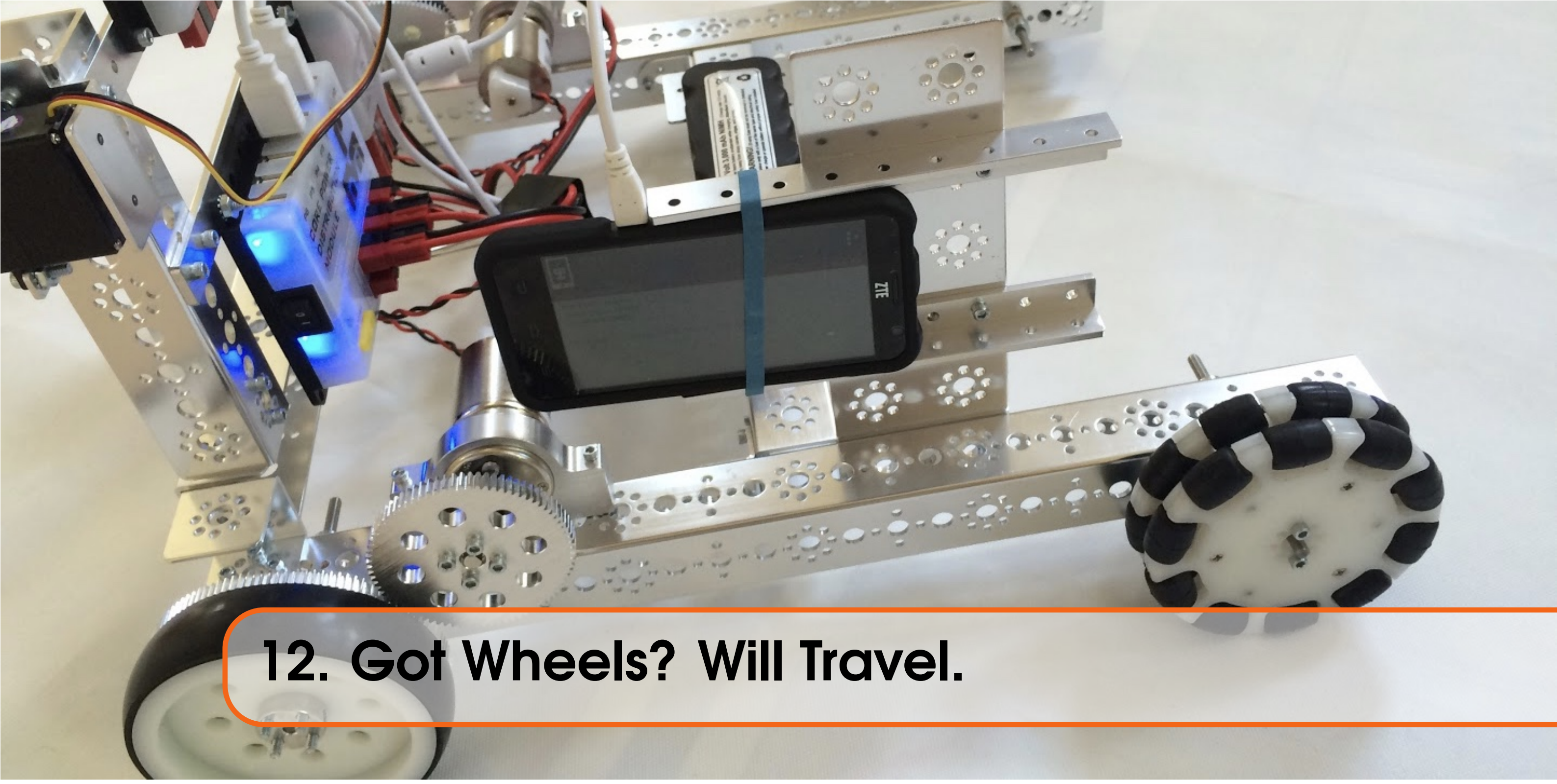
The C channel, or just channel, is the most basic part of any robot. Channels are structural elements which are used to building heavy-duty bases and building other components. There are five sizes of channels. The 32 mm, 96 mm, 160 mm, 288 mm, and 416 mm. They are all imperative toward creating a stable and strong robot.

Bushing
A bushing is used to reduce the friction which is felt by axles. Why decreasing the amount of friction is crucial is because friction is a negative force which slows movement down. It is helpful when the robot is needed to stop, but for the most part, we want to eliminate as much friction as possible. Duly noted, friction can also wear down the motors and axles, and that surely would not be good for the robot.

Kep Nut
The kep nut features a star washer which locks down on structural elements for additional strength. This ensure the two elements which are to be kept intact stay intact.

Socket Head Cap Screw
The socket head cap screw is purported for the aspect of connecting structural elements. There are two sizes of these screws: 1/2 inch and 5/16 inch (indicated the length of the horizontal screw). Whenever a socket head cap screw is used, a kep nut is always then used to keep the screw intact and make certain it does not fall out.

Submitted By Rushali



12. Got Wheels? Will Travel.

Meeting Date: Fri, 08/21/2015
Personnel Present: Navyatha, Rushali, Sahana, Harini, Adithi, Ramya, Rhea

Tasks This Meeting:

- Learn about the wheels and motors
- Build and attach 4 wheels to the base robot
- Add motors to the base robot

Reflections:

Today we had our second mentoring session with the Hotwired team. After learning about the wheels and motors, we split into two groups and continued building our robots. Group #1 attached the motors directly onto the wheels, while Group #2 decided to do a more complex design by using gears to attach the motors.

Something that went well for Group #1 was that they were able to finish adding the motors and the wheels quickly, and didn't have that much trouble. For Group #2, they were able to successfully attach the motors and wheels to their base robot. The main problem that occurred for the second group was finding the correct screws and other pieces, along with correctly attaching every piece since the design was more complex and struggles was spacing the wheel and the gear, so they would be equal on both sides. However, Group #1 had trouble working with the side screws on the motor shaft hub. Both Groups are looking forward to adding more to their robot, along with taking less time to build next time.

Design #1 (Robot Without Gears)
This class we added the motor in the motor mount. We also added the wheels directly to the motor without using any gears.

- Parts Used
  Wheel - 4
  Kep nut
  Socket head cap screw
  Washer
  Motor
  Motor shaft hub
- Pros
  It won't skid
  Simple design
  Easy to fix any problems
- Cons
  If a motor wasn't working you would have to take the whole wheel out and put it back again
  Might get knocked over easily since wheels are too close

Design #2 (Robot With Gears)
For the second design, we decided to use gears to attach the motors to the base robot.

- Parts Used
  Wheel - 4
  Gear

Bushing
Axle
Gear hub spacer
DC drive motor
Motor mount
Socket head cap screw
Axle hub
Motor shaft hub
Kep nut

- Pros
  Easier to fix any problems with the motors/wheels
  An efficient design
  More sturdy
- Cons
  Complex design
  It might skid
  It might be harder to fix problems

Overview of Gears

Gears are simple machines which transmit power from one part of a machine to another. Any number of gears of all shapes ans sizes can be fitted together to do one of the three following options:

- Increase Speed
  If the first gear has more teeth than the second gear, the second one has to turn round much faster to keep up
  This arrangement means the second wheel turns faster than the first one but with less force
- Increase Force
  If the second wheel in a pair of gears has more teeth than the first one, it turns slower than the first one but with more force
  Also known as increased rotational torque (describes later in more detail)
- Change Direction
  When two gears mesh together, the second one always turns in the opposite direction
  Specially shaped gears can be use to make the power of a machine turn through an angle

Ways to Use Gears

- Gears for Speed
  As explained above, if the gear ratio is greater, the greater the speed will be
- Gears for Force
  Also mentioned above, the lower the gear ratio, the more increased the force and torque
  Torque is defined as the tendency for something to produce torsion or rotation
- Worm Gear
  A worm gear is comprised of an electric motor and a screw-like gear to drive a large gear wheel

It reduces the speed of the motor to make the large wheel turn with more force, but it's also useful for changing the direction of rotation in gear-driven machinery

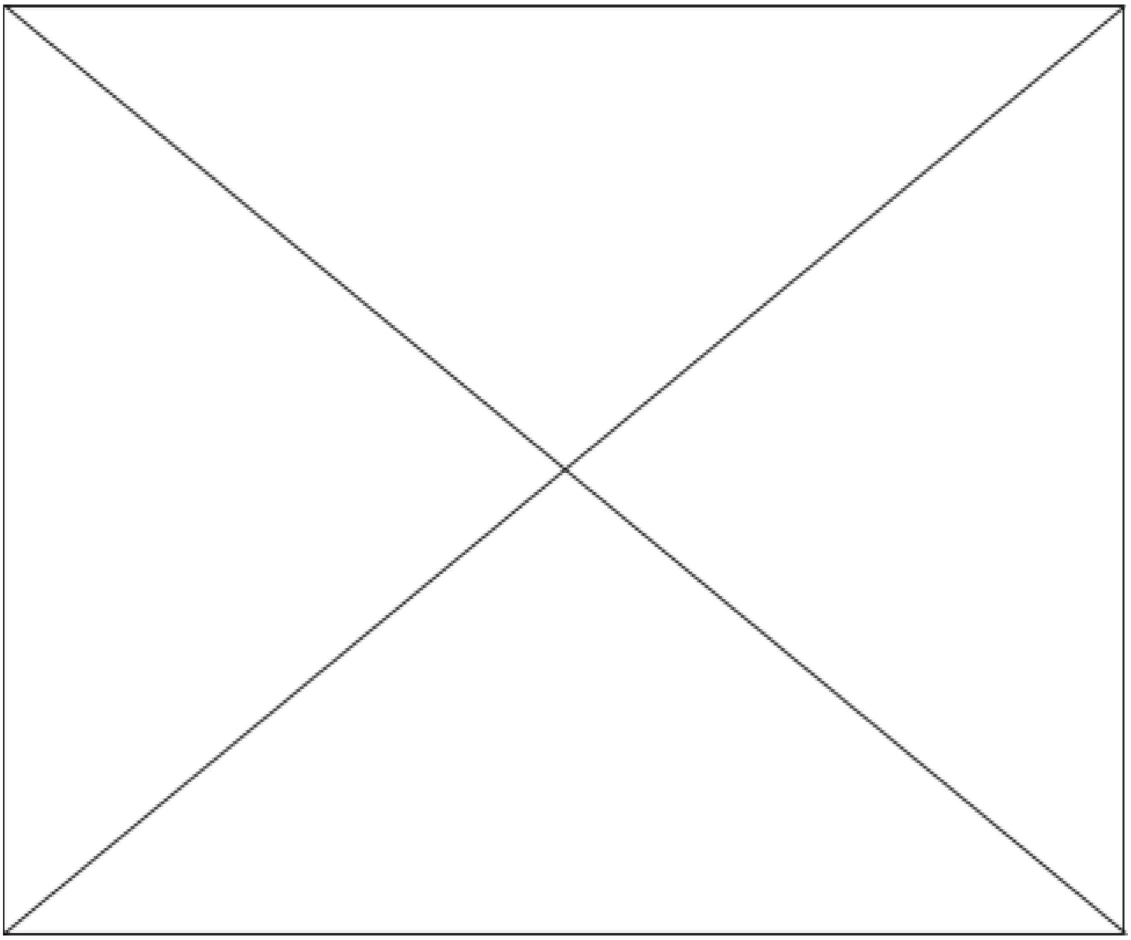
- Rack and Pinion Gear

  In a rack and pinion gear, a slowly spinning gear wheel (the pinion) meshes with a flat ridged bar (the rack)

  If the rack is fixed in place, the gear wheel is forced to move along it

  If the gear is fixed, the pinion shifts instead

Submitted By Navyatha



13. Need an Arm?

Meeting Date: Wed, 08/26/2015
Personnel Present: Shruthi, Sahana, Nandhana, Namitha, Maria, Shamamah, Rushali, Ramya, Navyatha

Tasks This Meeting:

- Learn various arm building techniques
- Pros and cons of various arm designs

Reflections:

Depending on each year's challenge the arm design will need to be customized, however, it is safer to assume, arm should have two components: one that moves up/down, and the front end (like our fingers) that can collect or dump objects from the field, such as balls or blocks.

Figure 13.1: Mister Zhinquin teaching us about robot arms (left) and our team intently listening (right).

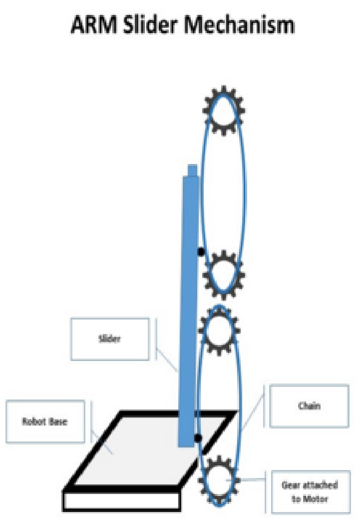
A system that Hot Wired uses to measure the height at which the arm of the robot extends is expressed by 1X as the Height of the robot, 2X as two times the height of the robot, and 3X as three times the height of the robot.

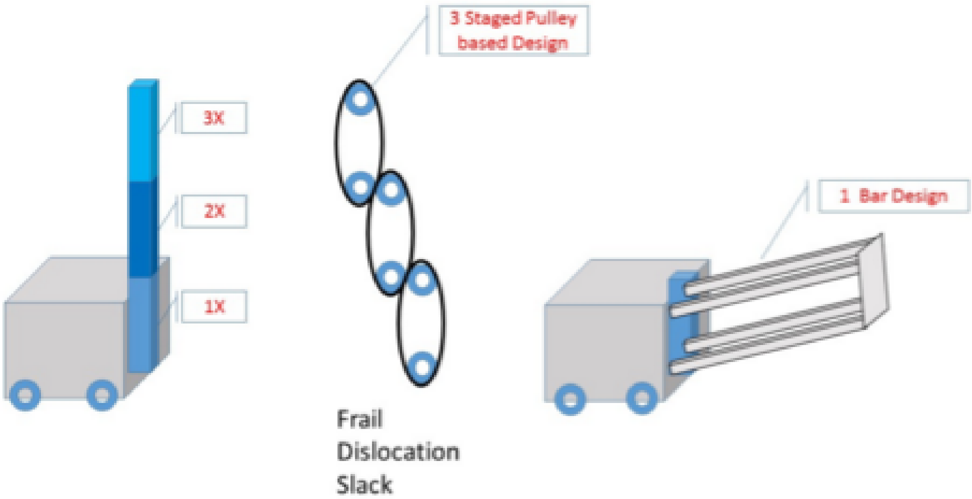
Techniques

- Pulley-based
  Advantages include the simplicity of the design, easy increasing of lifting distance, and ability to apply force in any direction
  Disadvantages include the frailness of the design, possible dislocation of the pulley elements, and slack due to the reliance on friction
- Chain-based
  Advantages include the simplicity of the design, ability to withstand slipping, and aspect of compactness
  Disadvantages include the ability for the structure to only span a short distance, requirement of precise chain placement, and need of frequent lubrication
- Flat gear (Rack/Pinion)-based
  Advantages include simplicity of design and need of a little space
  Disadvantages include ability to only span short distance and low possibility of other applications
- Bar Design (One-Bar, Two-Bar, Three-Bar)
  Advantages include simplicity of design, ability to span longer distances, and aspect of compactness
  Disadvantages include low stability and need of a lot of space

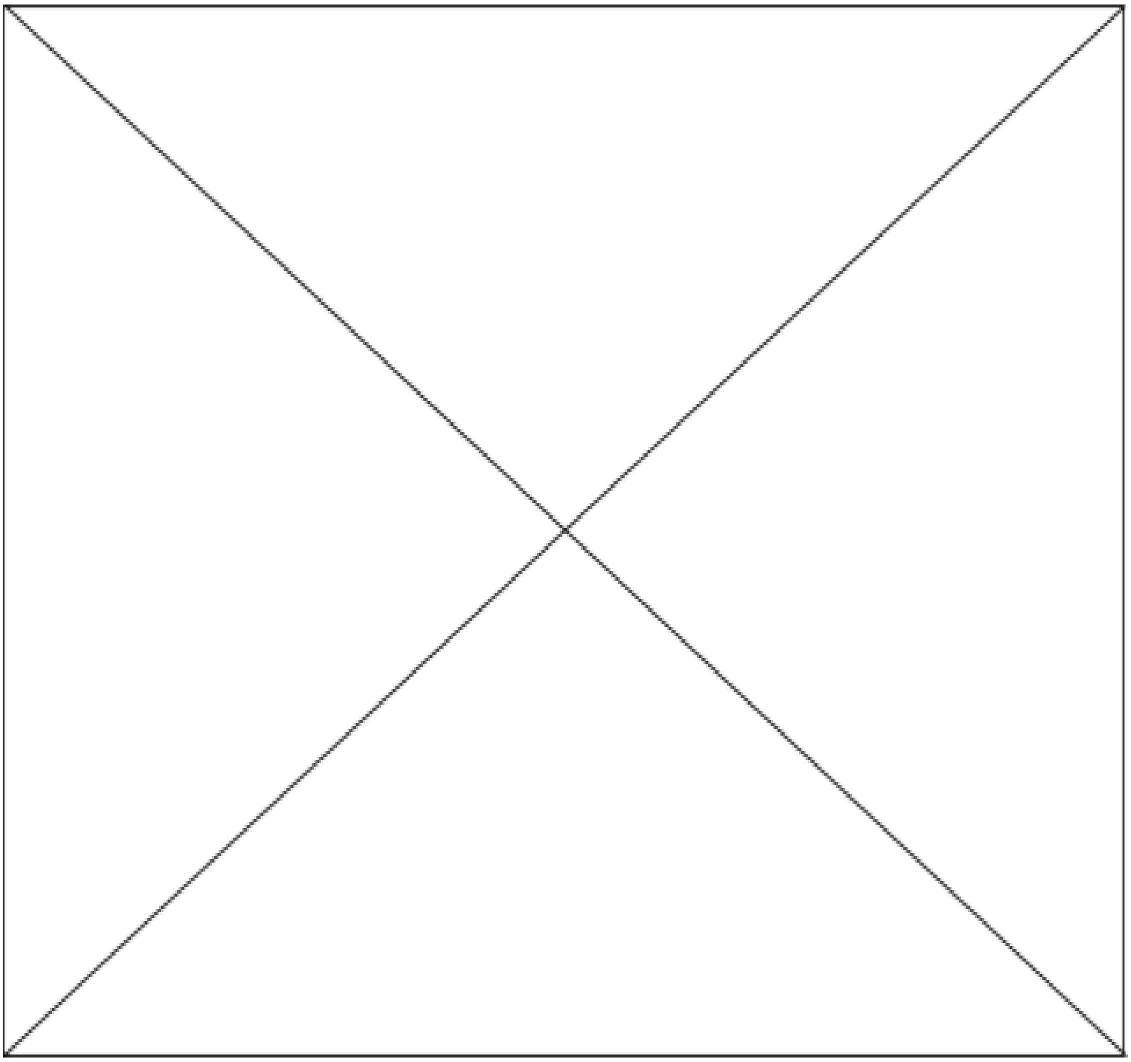
Slider

- Almost in all cases a slider is a requirement to build an arm that can move up 2X or 3X the height of the robot
- Sliders can be expensive as high as several hundred dollars
- However, we can also use the slider we can get at home depot (the one that's used for cabinet sliding drawers)





Submitted By Shruthi



III

Engineering Summaries: Early Season

14. Up for a Challenge?

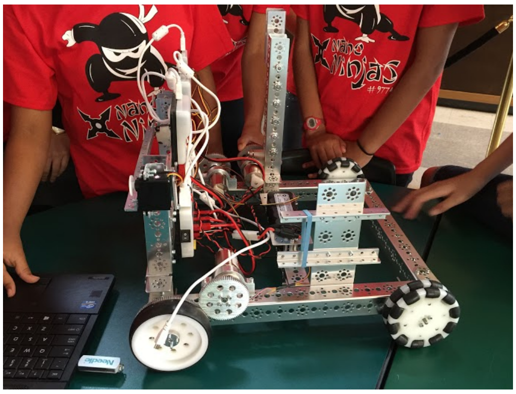
Meeting Date: Sat, 09/12/2015, 8:30 AM - 12:00 PM
Personnel Present: Adithi, Aishwarya, Harini, Irene, Maria, Namitha, Nandhana, Navyatha, Ramya, Rhea, Rushali, Sahana, Shamamah, Shruthi

Tasks This Meeting:

- Attend the FTC 2015-2016 FTC Kickoff event at Tigard High School
- Showcase our prototype robot
- Learn about this year's Game and have a chance to see the Playing Field up close
- Gain further insight to the technological changes to the Game (replacing NXT and Samantha Module) and programming options (App Inventor, Java)
- Have a meeting to briefly discuss thoughts about Game and strategies
- Test robot

Reflections:

The Kickoff at Tigard High School was a very enriching event for us. Before the actual Kickoff, we showcased our robot prototype. Many teams came to our table to ask about our robot, and we gladly answered their questions. During the Kickoff, we learned about this year's Game, RES-Q, as well as see and touch the Playing Field and its elements to get a greater understanding of what the Game elements will be like. After that, Volunteer of the Year Dale Jordan, gave us a quick overview of the changes made to the Game and the ORTOP experience with those modifications. Learning about the strong points and weak points of the system will really help us with constructing and programming the robot. Soon after, we went through a PowerPoint about the programming options for FTC, App Inventor and Java. Later, when the Kickoff ended, we went back to the cafeteria to have a small meeting. We talked about our thoughts and opinions about the Game, and all of us said that we really interested in this year's idea. Then, we practiced running our robot. We had a few troubleshooting, though it was all cleared, and we managed to run the IR Seeker and TeleOp programs successfully without any issues.



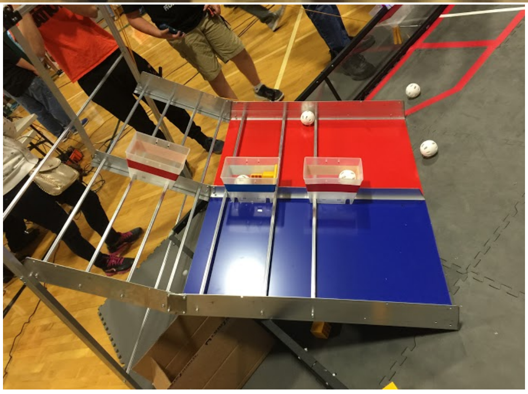
Overview of the Game
This year's Game, RES-Q , consists of climbing Mountains (two on opposing corners as illustrated above), rescuing a maximum of fourteen Climbers which are human-shaped, gold-colored Scoring Elements, alerting authorities with Rescue Beacons by activating the correct color, and clearing Debris represented by thirty white plastic spheres and fifty gold-colored cubes.

Autonomous Period
The game begins with the usual thirty-second Autonomous Period, with the Robots supplied with two Climbers. One thing that is different this year is that the Robots may not cross the blue-and-red line separating the Alliance Areas before ten seconds is over. This is so defensive play does not occur so early in the Game, and if it purposely happens, it is worth a Major Penalty of forty points awarded to the opposing alliance. Points are achieved by (i) activating Rescue Beacons (each press twenty points), (ii) relocating Climbers to Shelters (each ten points), (iii) climbing Mountains (a. on the Playing Field tile floor and the Mountain: five points b. Low Zone: ten points c. Mid Zone: twenty points d. High Zone: forty points), and (iv) parking in a Rescue Beacon Repair Zone or Floor Goal (five points).

Driver-Controlled Period
During the two minute Driver-Controlled Period, the drivers may control their robots to achieve the tasks of (i) cleaning up the disaster Area by placing Debris Inside Alliance-specific Mountain Goals or Floor Goals (a. Floor Goal: one point per Debris b. Low Zone Goal: five points per Debris c. Mid Zone Goal: ten points per Debris d. High Zone Goal: fifteen points per Debris), (ii) releasing Climbers to ride a Zipline to safety (twenty points each), and (iii) relocating Climbers to Shelters (ten points).

End Game
The End Game is the last thirty seconds of the Driver-Controlled Period. Points are achieved by (i) the Robot hanging from the Cliff Pull-Up Bar (eighty points), and (ii) triggering the All Clear Signal (twenty points).

ORTOP Experience with the New System



ORTOP this year hosted several outreach events to demonstrate the new system replacing NXT and Samantha module, using six 3D printed robots. The robots were run both inside and outside in one hundred degree weather, running continuously up to eight hours. Things that went well for them was the WiFi Direct as it generally stayed paired, and if not could be easily reconnected. The TeleOp program also ran very well. Though, the complications included that the USB connections to the Driver Station and Robot Controller were buggy. To fix these issues, they advised that we reboot the whole system and unplug and replug the joysticks. Other issues encompassed problems with slow feedback rates and that the HiTechnic Gyro could not be made stable. Our team relied heavily on feedback systems such as PID in the past in FLL, though that may not be the best option for this year.

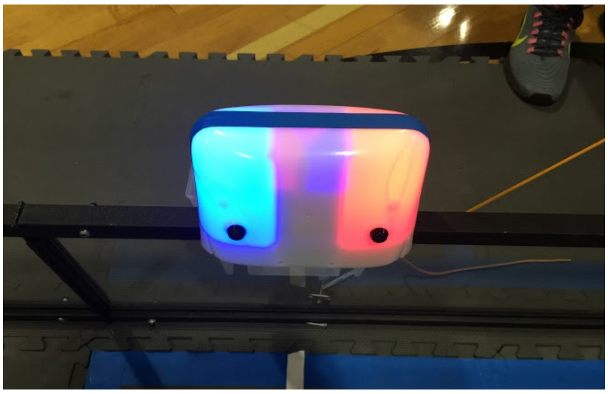
Programming Options

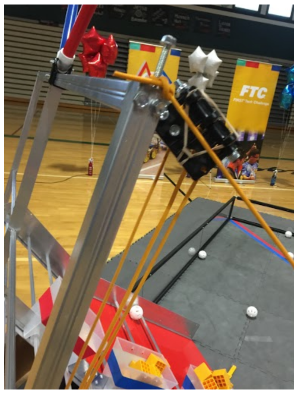
- MIT's App Inventor is rather simple to learn as it is similar to FLL's drag-and-drop block programming. Though issues with it were that navigating through the program would become more difficult as the program grew larger. Also, it has its limitations. This year, we are planning to rely on App Inventor as our main programming language.
- Java, a fully text-based programming language is the most popular programming language in the world and opens up many job opportunities and allows customization. The presenter additionally went over a few Java sessions that we are looking into to join. We hope to look into Java and incorporate it into our programming.

Testing the Robot

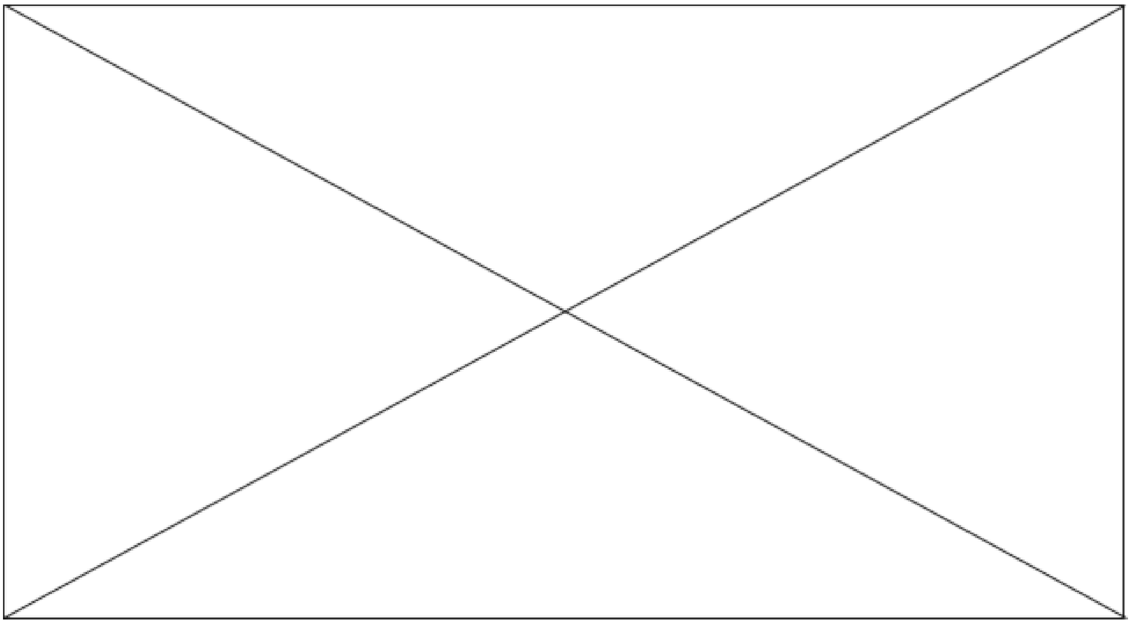
After having our brief meeting about our thoughts on the Game, we attempted at testing our Robot. The first few tries did not prove successful so we had to restart the robot and devices and do everything over. After a few more times, we had finally connected the Driver Station phones to the Robot Controller. The reason for the troubleshoot was not clearly understood however, so it is our task to research more about it. We first ran our IR Seeker program and it proved successful. The TeleOp program also worked as planned, the only issue was that the up and down control were reversed.

Next Steps
Now that the second Game Manual has been released, our main focus for now is to go through the Manual very thoroughly and make certain we understand the Game inside and out. Also, because of the Game, we will be expecting to make a few adjustments to our existing foundational robot prototype. Strategy is also a major concept. As of now, we have agreed upon decreasing the weight. Other thoughts have come up concerning points and other mechanical options.





Submitted By Shamamah



15. Starting On Strategy

Meeting Date: Sun, 09/13/2015, 6:30 PM -8:00
Personnel Present: Adithi, Sahana, Ramya

Tasks This Meeting:

- Discuss mission strategies
- Think of designs for the robot
- Take note on the etiquette of Hot Wired members during meetings

Reflections:

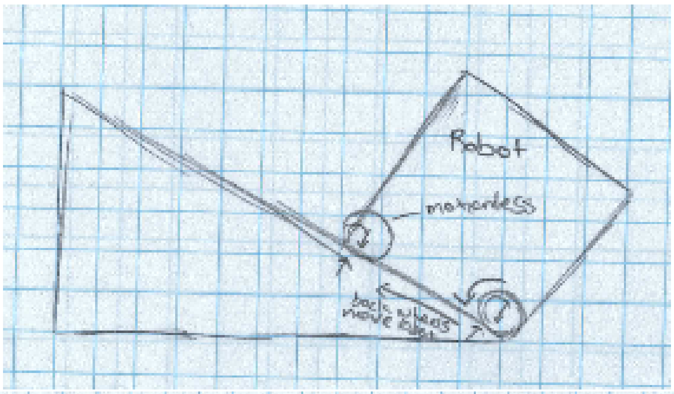
Today we went to Hot Wired's meeting place and looked at how they discussed mission strategies and robot designs. When the team was discussing, no one was goofing around and everyone was paying attention. Everyone was really focused and participating in the discussion. They all added onto each others ideas and never said anything bad about them. Since they were working together, they got a lot done in their meeting. In our meetings, our team should participate, be focused, add on to each others ideas, and not goof around, so we can get a lot done.

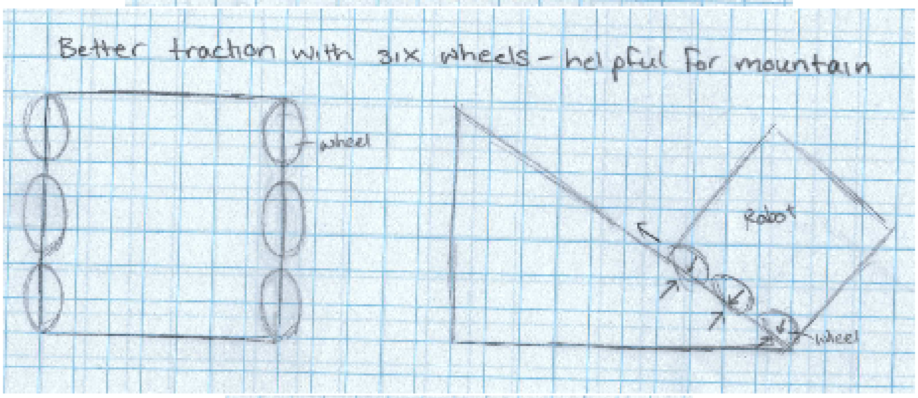
During the Hot Wired's discussion, we discussed some possible designs for the robot.

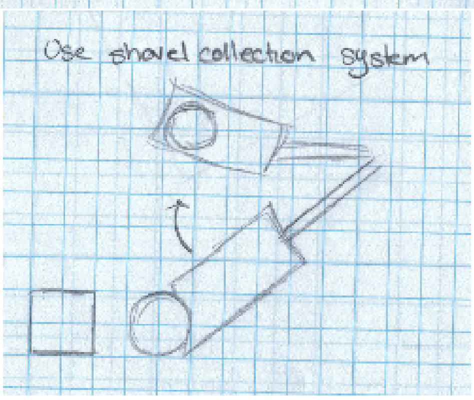
Here are some possible designs:

- We could make a robot with six wheels so it would be easier to climb up the mountain
- We could have a shovel design for the arm so getting debris would be easier and they wouldn't fall out
- We could make a robot with four wheels, but the front wheels would stay still and the back wheels would move kind of like arms, so it could climb the cliff area better

We also discussed some mission strategies. On idea was that if we collected twenty pieces of debris (that's how much can fit in a bucket on the mountain) and put them in the buckets on the mountain, then the maximum points for each bucket would be, in the bottom bucket 100 points, in the middle bucket 200 points, and in the top bucket 300 points. (This is because the bottom bucket equals five points, the middle bucket equals ten points, and the top bucket equals fifteen points.)







Submitted By Adithi

16. On the Game Field

Meeting Date: Mon, 09/14/2015, 7:00 PM - 9:00 PM
Personnel Present: Nandhana, Namitha, Maria, Rushali

Tasks This Meeting:

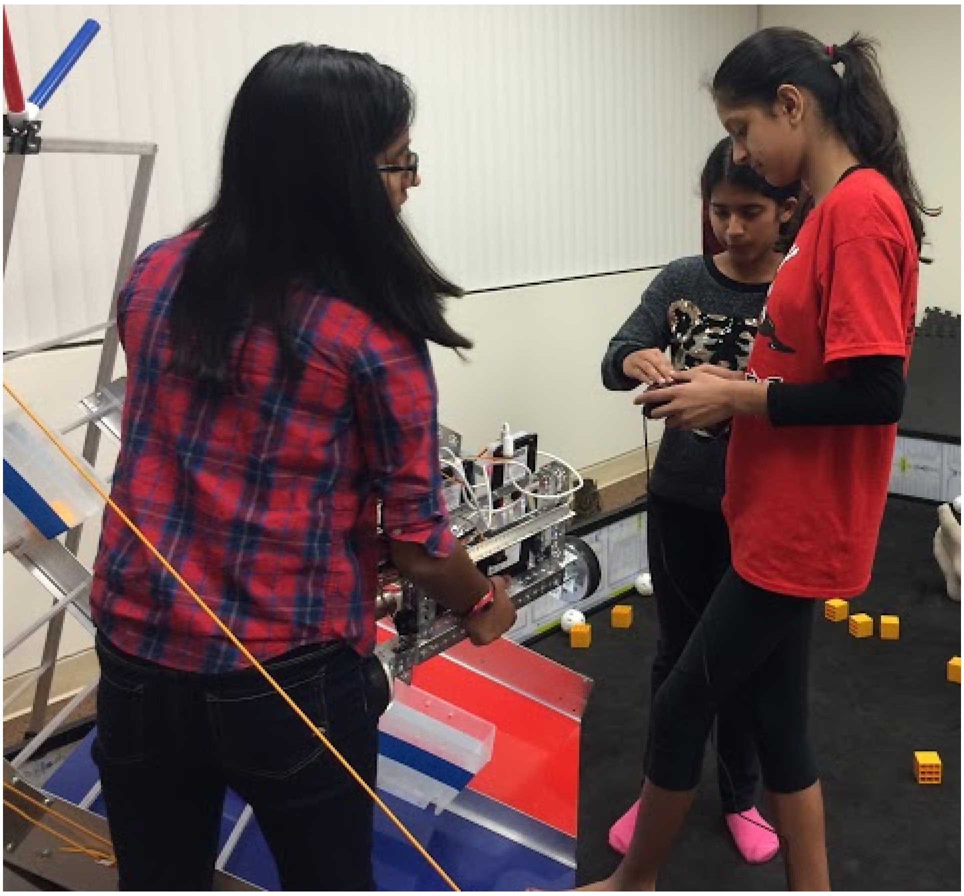
- Learn from the experts
- Get to know the playing field
- Create a game strategy

Reflections:

Today four of us went to the Batteries in Black Week One session. It was a great time to get used to the new playing field as well as learn from a team which had lots of experience. We tested out our robot on the mat as well as tested some new ideas. We also got a chance to discuss and learn from Batteries in Black. They showed us how to connect a Anderson Power Pole Connector using various tools. In addition they described and gave examples to possible wheels and treads we could try. We now have a basic strategy as well as some new ideas for the autonomous and Driver-Controlled period. Since the members that represented as that day had almost finished reading the game manual part 2 it went more smoothly. We also did some brief planning to what missions we wanted to do in autonomous. But, we now know that reading the game manual and fully understanding it is vital for our next practice.

Anderson Power Pole Connectors
Anderson Power Pole Connectors are the black and red clips attached to the black and red wires.Though most if not all of us know how to connect a Anderson power pole connector to a module we needed some help connected the wire from our Neverst motor to our Anderson Power Pole connector. Batteries in Black showed us how involving a series of steps. I have copied the link to find the same information.

Game Strategy
As a rookie team it is important that we do not push ourselves to something we can't do. Krishna the BIB coach told us that it's better to be consistent in something rather than try and fail at everything. One of our important discoveries is the mountain. The Mountain Low Zone is the only one without any slightly raised bars. The other zones are all very tricky to drive on. We have decided to stick with the Low Zone for now but we have created a helpful attachment to make sure that is consistent.

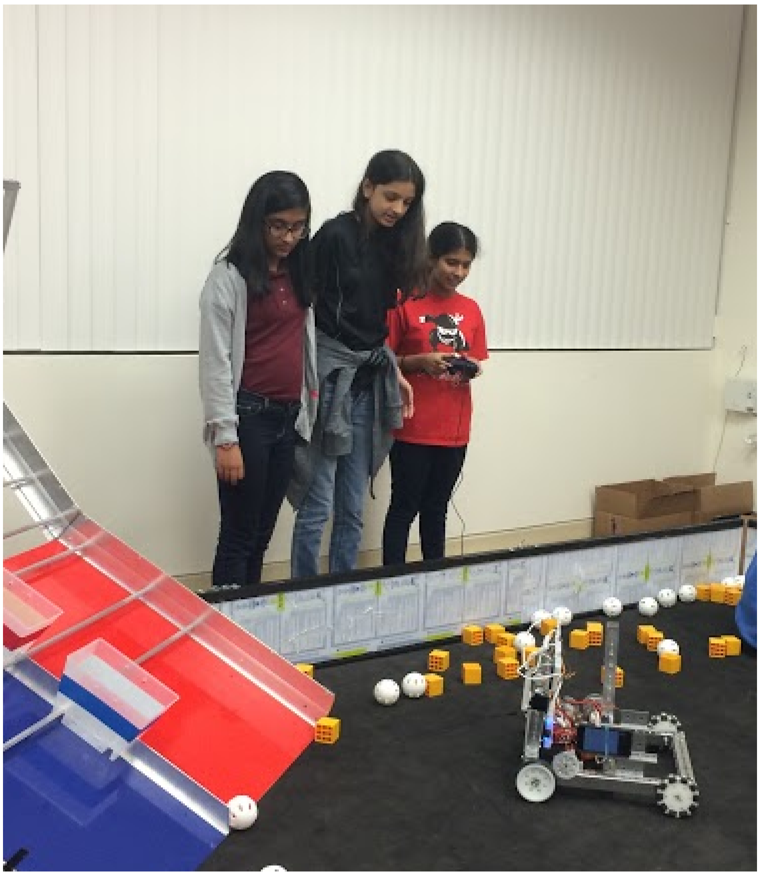


Autonomous Period
We have decided on a pretty well strategy. We start on the wall closest to our Driver Station then drive towards the Rescue Beacon Repair Zone, while staying on our side of the tape. From there we will push our Alliances corresponding button and dump our two Climbers in the Shelter. From there we have a choice of either ending in the Alliance Floor Goal or ending at the Mountain Low Zone. We are going to go the the Mountain Low Zone as well as releasing the first Zip Climber on our way up.

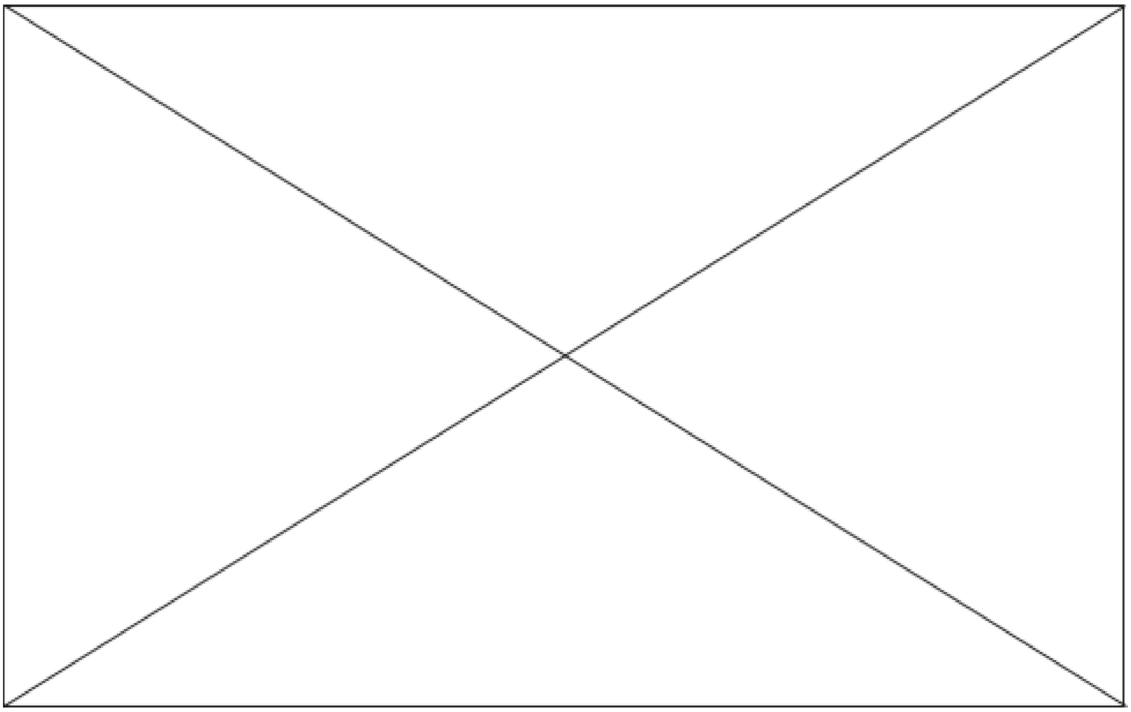
- Rescue Beacon: twenty points
- Climbers in Shelter: twenty points (plus additional twenty if still there in End Game)
- Mountain Low Zone: ten points
- Zip Climber: twenty points

Driver-Controlled Period
We have got a decent idea on what missions we will do but not as clear as the

Autonomous Period strategy.



Submitted By Nandhana



17. Ninjas in Black

Meeting Date: Tue, 09/15/2015, 7:00 PM - 9:00 PM
Personnel Present: Nandhana, Namitha, Rushali, Maria, Rhea, Aishwarya

Tasks This Meeting:

- Learn from Batteries in Black
- Show people who joined the game field
- Start working on the arm
- Tested our robot
- Finish reading Game Manual Part II (if not done)
- Make a plan of what missions to do on paper

Reflections:

Today we continued from where we left off yesterday, which was constructing the robot. We started off this meeting by showing the people who weren't here yesterday the game field. Then, we started working on the arm so we could hold on to the rungs while climbing the mountain. Our first time, we made the arm too small and it couldn't go low enough to hold on to the rungs. Soon, we moved the arm to the edge of the C channel and then it was able to hold our robot on the rung. Meanwhile, other team members were observing Batteries in Blacks' robot and the different methods they were using to conquer the mountain. They were using a total of 8 wheels which was an interesting strategy and we wanted to observe to see if it works. Since we had more members today, we decided we would make sketches of how each of us thought our strategy should be. Later we would all share our ideas.

Robot Arm

1. Constructed L bracket, a flat bracket, and a 32mm C channel and servo motor
2. Servo connects to flat bracket
3. Flat bracket connects to L bracket

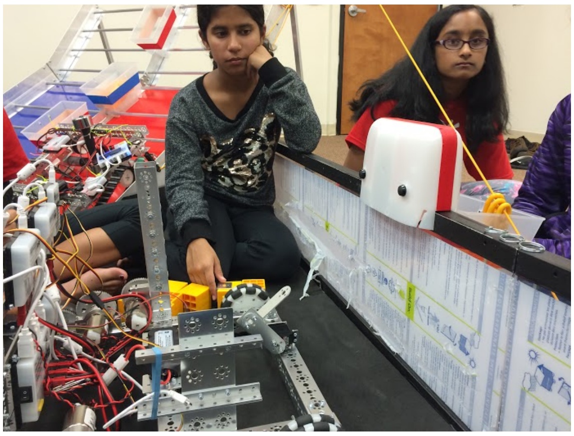


Figure 17.1: Namitha deeply pondering what to do for the IR Beacon Repair strategy.

4. L bracket connects to 32mm C channel

Observations
- Treads kept slipping off and breaking
- Extra wheels help while going over rung
- Treads make robot very unstable on field
- Two or eight wheels elevated helps when robot is tipping
- Type of tire grip is important

Robot Test
- Able to push debris out of the way while moving
- Able to stay in low zone
- Arm is able to help robot stay in low zone

Submitted By Rushali

18. Mission Accomplished

Meeting Date: Fri, 09/18/2015, 7:00 PM - 9:00 PM
Personnel Present: Harini, Irene, Nandhana, Namitha, Maria, Rushali, Ramya, Shruthi, Shamamah, Aishwarya, Adithi, Navyatha, Sahana

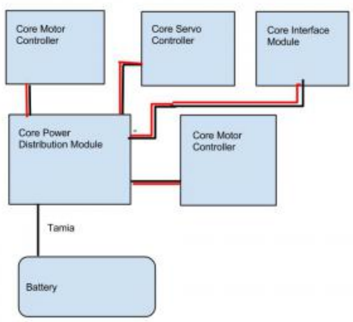
Tasks This Meeting:

- Test out stealth wheels
- Electrical wiring - add encoders
- Connect the Anderson powerpole connectors
- Duplicating the hanger mechanism

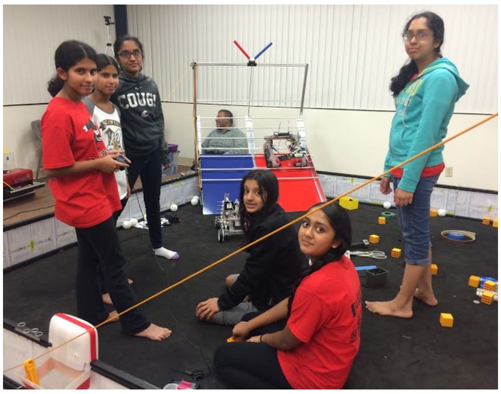
Reflections:

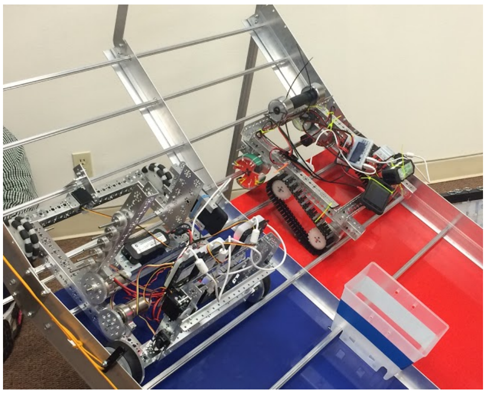
We divided into groups and worked on different parts of the robot. One group tested out our new Stealth wheels. Another group did the electrical wiring. The rest of the group duplicated the hanger mechanism to activate the climbers as well as connect the Anderson power pole connectors. We learned a lot about the electrical wiring and some specifications about the encoders. Today was a very productive meeting.

Electrical Wiring



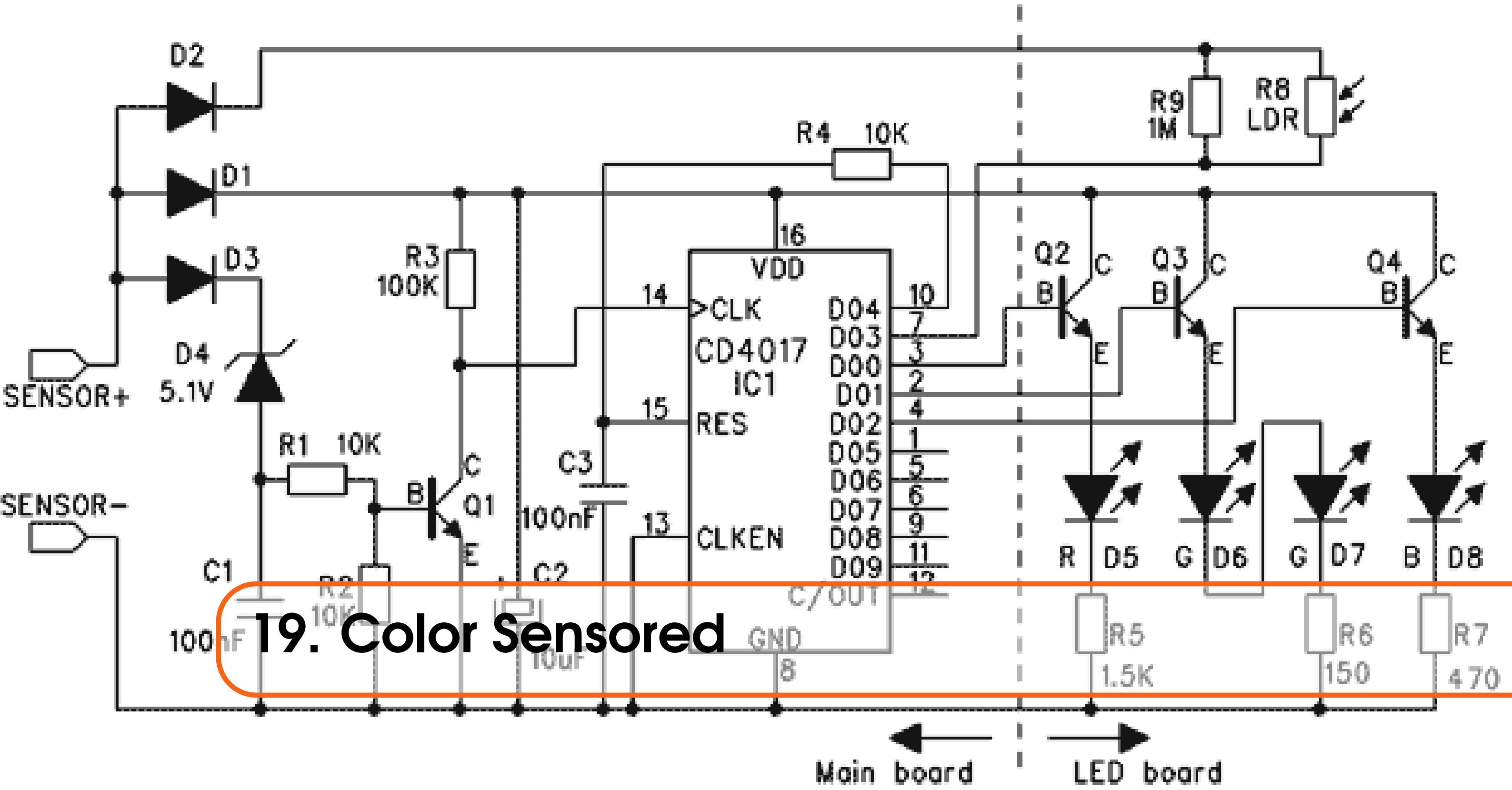
Duplication of Allen Wrench
There are three main types of Allen keys used for our robot: Small, Medium, and Large. Small is for motor tightening, medium is for tightening wheel locks, and large is for tightening screws. Why we must differentiate these three sizes is because if we use the incorrect size for screwing something, it hurts the grooves of the screw. The Allen wrench rubs against the grooves as it does not fit properly, and wears down the grooves.





Anderson Power Pole Connectors
Anderson Power Pole Connectors are one type of wire we used on our robot. We also use Tamia connectors, however because of their low reliability, we do not use them when Anderson power pole connectors are available.

Submitted By Irene



19. Color Sensored

Meeting Date: Sat, 10/03/2015, 6:00 PM - 8:00 PM
Personnel Present: Rushali, Ramya

Tasks This Meeting:

- Attach color sensor
- Test out color sensor
- Connect wires to ports
- Test two-hand robot control
- Understand color sensor code

Reflections:

This meeting was a great success. We kicked of the meeting by attaching the color sensor to the robot and plugging the wires into the correct ports. The people who attended got a chance to understand how the color sensor works. We went through the code and learned what each part ment. After we configured the robot using correct names and tested the color sensor. While we had the robot on, we also moved our robot around because we changed the controls to two hands. After, we tested the color sensor with other colors that weren't blue and red to see what the color would be. Today was a very efficient and helpful session. We got lots of one-on-one time to explore the many aspects of the color sensor.

Robot

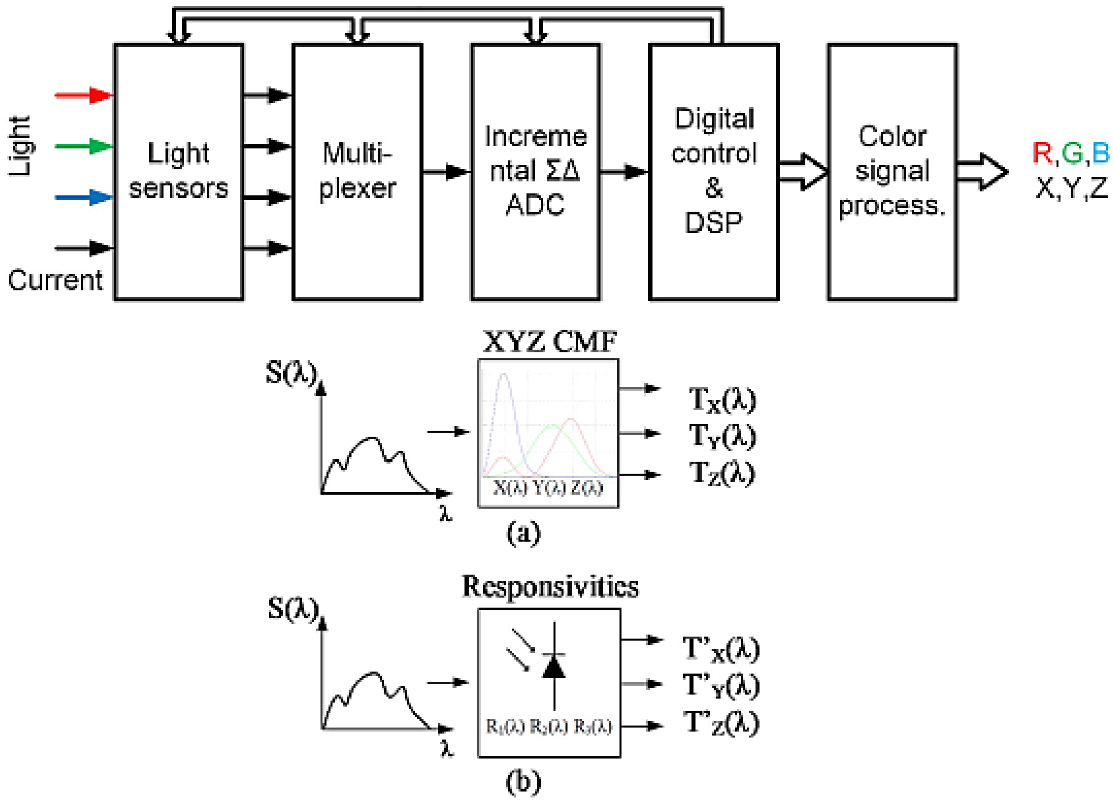
We added the color sensor to our robot so later we could test it. We were able to explore color sensor and see what it does and if it works. The color sensor was able to sense the two colors we wanted it to: Blue and Red. Also, we were able test out the 2-hand controls which we changed previously.

Programming

```
public void calibrate()
{
    blackLightValue = read("black");
    whiteLightValue = read("white");
    greenLightValue = read("green");
    // The threshold is calculated as the median between
    // the two readings over the two types of surfaces
    blackGreenThreshold = (blackLightValue+greenLightValue)/2;
    whiteGreenThreshold = (whiteLightValue+greenLightValue)/2;
}

public boolean black() {
        return (ls.readValue()< blackGreenThreshold);
}

public boolean white() {
    return (ls.readValue()> whiteGreenThreshold);
}

public boolean green() {
    return (ls.readValue() > blackGreenThreshold && ls.readValue() < whiteGreenThreshold);
}
```

Figure 19.1: Piece of color sensor code which enables the color sensor to read different colors.

We were able to go through the code and understand what it meant. We were learned how to name things in the configuration so it would match the names in the code.

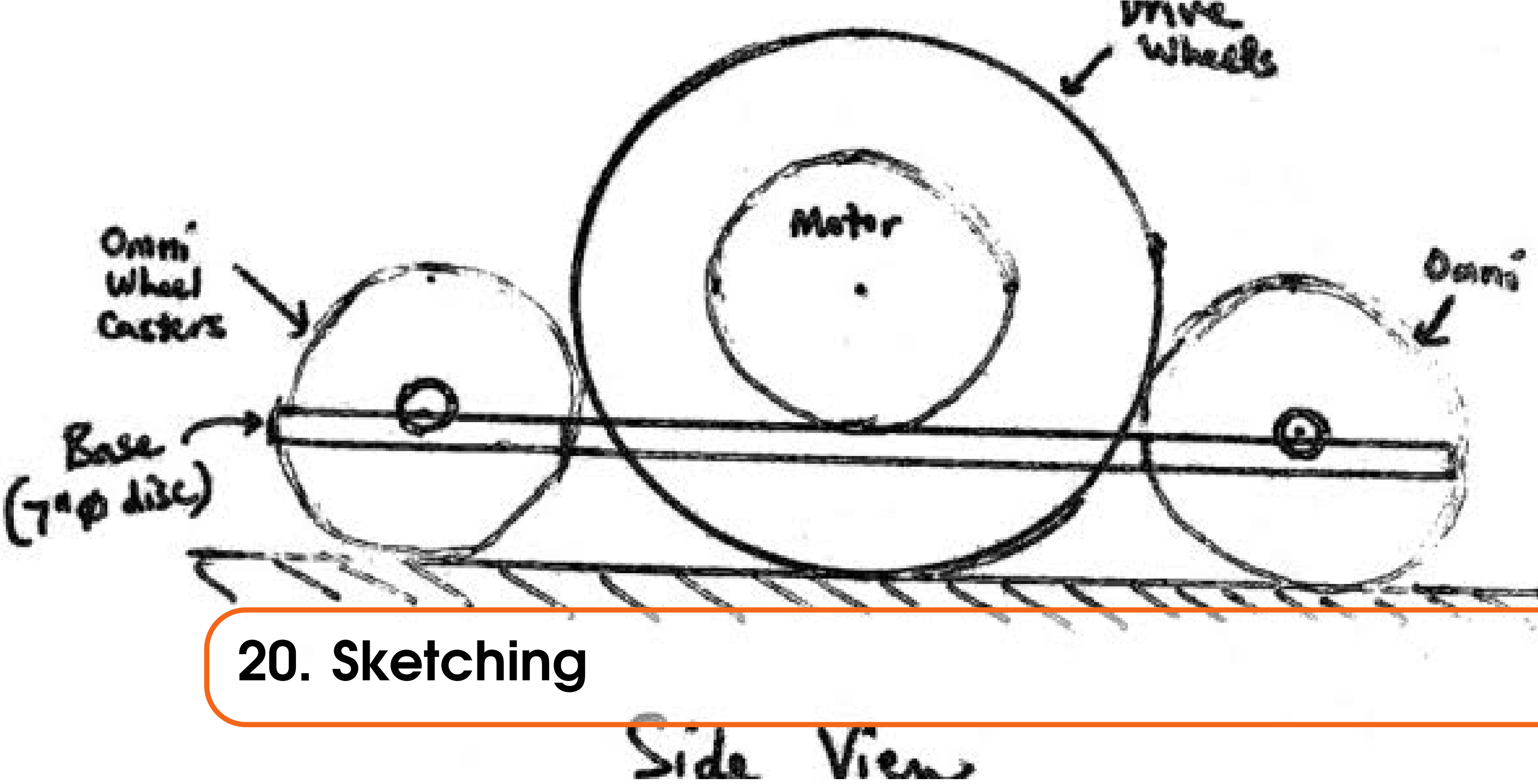


[1]

Submitted By Rushali

[1] Drago Strle, Uroš Nahtigal, Graciele Batistell, Vincent Chi Zhang, Erwin Ofner, Andrea Fant, & Johannes Sturm, "Integrated High Resolution Digital Color Light Sensor in 130 nm CMOS Technology," 2015.

20. Sketching



Meeting Date: Sat, 10/10/2015, 2:00 PM - 5:00 PM
Personnel Present: Adithi, Namitha, Nandhana, Irene, Rushali, Ramya, Rhea, Navyatha, Shruthi, Shamamah, Maria, Esha, Aishwarya, Sahana

Tasks This Meeting:

- Go through the color sensor program
- Talk about new format of the engineering log
- Go through engineering log entries
- Go over napkin sketches

Reflections:

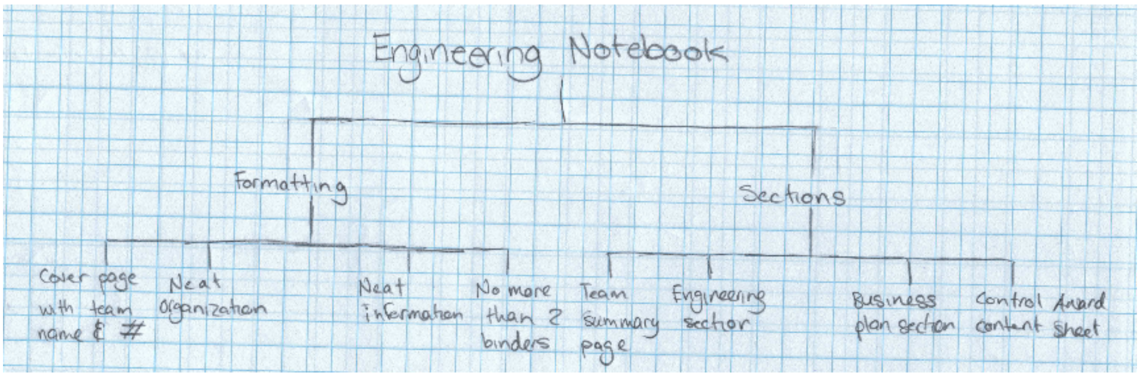
Today in the meeting everyone shared their napkin sketches. Everyone had wonderful and amazing ideas. One idea was after you pick up the debris, you can have something like a conveyor belt that picks up the debris then drops it off in the bucket. Another thought was that you could use a shovel type attachment, where it picks up the debris and then drops it into a container on the top of the robot (like a garbage truck). We also went over the color sensor program for the robot. We talked about how to use it and how it works. Another topic we went over was the engineering notebook. We talked about the new format and looked through some of the entries we made. All of us discussed how to make the entries better. Overall the meeting went great and by the end everyone knew something new!

Ways to Make Engineering Notebook Better

- Add pictures of sketches we have made
- Go through entries and see if you can add anything
- Make people who haven't done engineering log do an entry

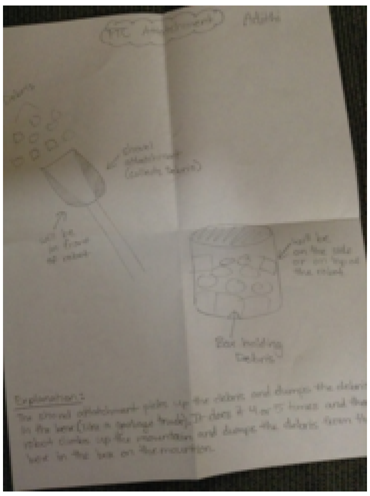
New Engineering Notebook Format

- Create cover page
- Create table of contents
- Gather chronology of meetings and important design aspects covered so work done so far can be documented
- Add headers, footers, page numbers, etc.
- Fill in sections: base robot, week 1 build activity, self-training on robot building (reflections), brainstorm discussions, prototypes, base build, coding conventions, OMSI makers fair, farmer's market

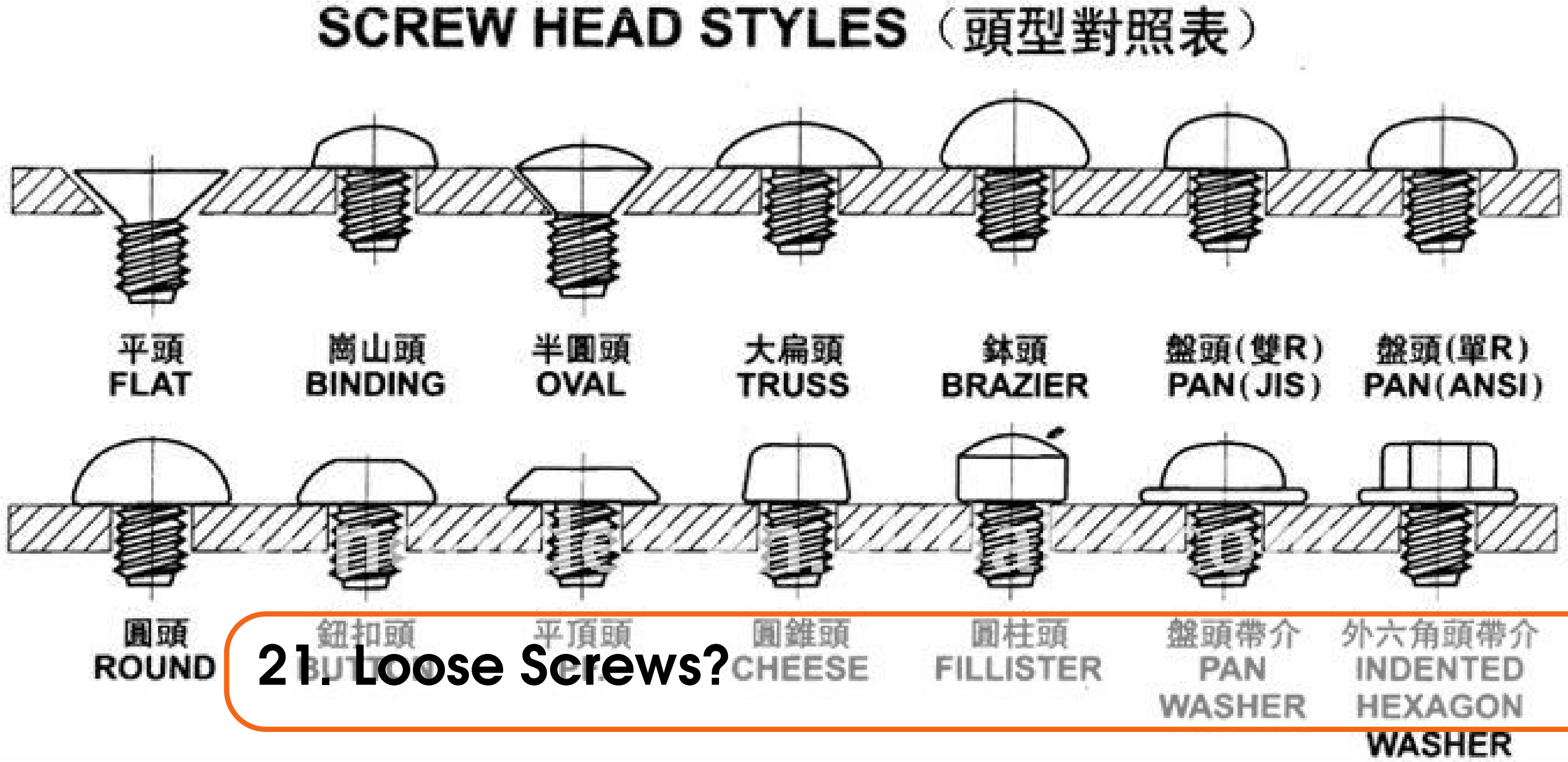


Napkin Sketches

Something we learned about were napkin sketches. They are defined as "a slang term that refers to the representation of the basic components of a business model excluding any fine details. It incorporates only the core ideas and success factors of the business." Our prior-to-the-meeting homework was to create napkin sketches of at least one task. Shown below is an example that shows possibles solutions to collecting the debris and scoring them in the medium and high-zone buckets. Here is a picture of a napkin sketch which explains a possible debris depositing system:



Submitted By Adithi



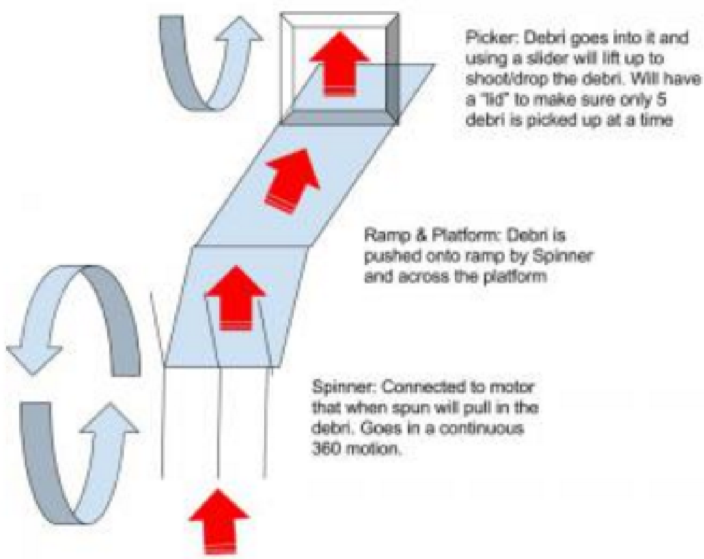
21. Loose Screws?

Meeting Date: Wed, 10/14/2015, 6:30 PM - 8:00 PM
Personnel Present: Nandhana, Namitha, Ramya, Rhea, Harini

Tasks This Meeting:

- Clear the front structure of robot and put a debris collecting mechanism in it's place
- Exchange the two motors at front for servos in identical hold
- Make the phone holder firm
- Disassemble the back of robot

Reflections:



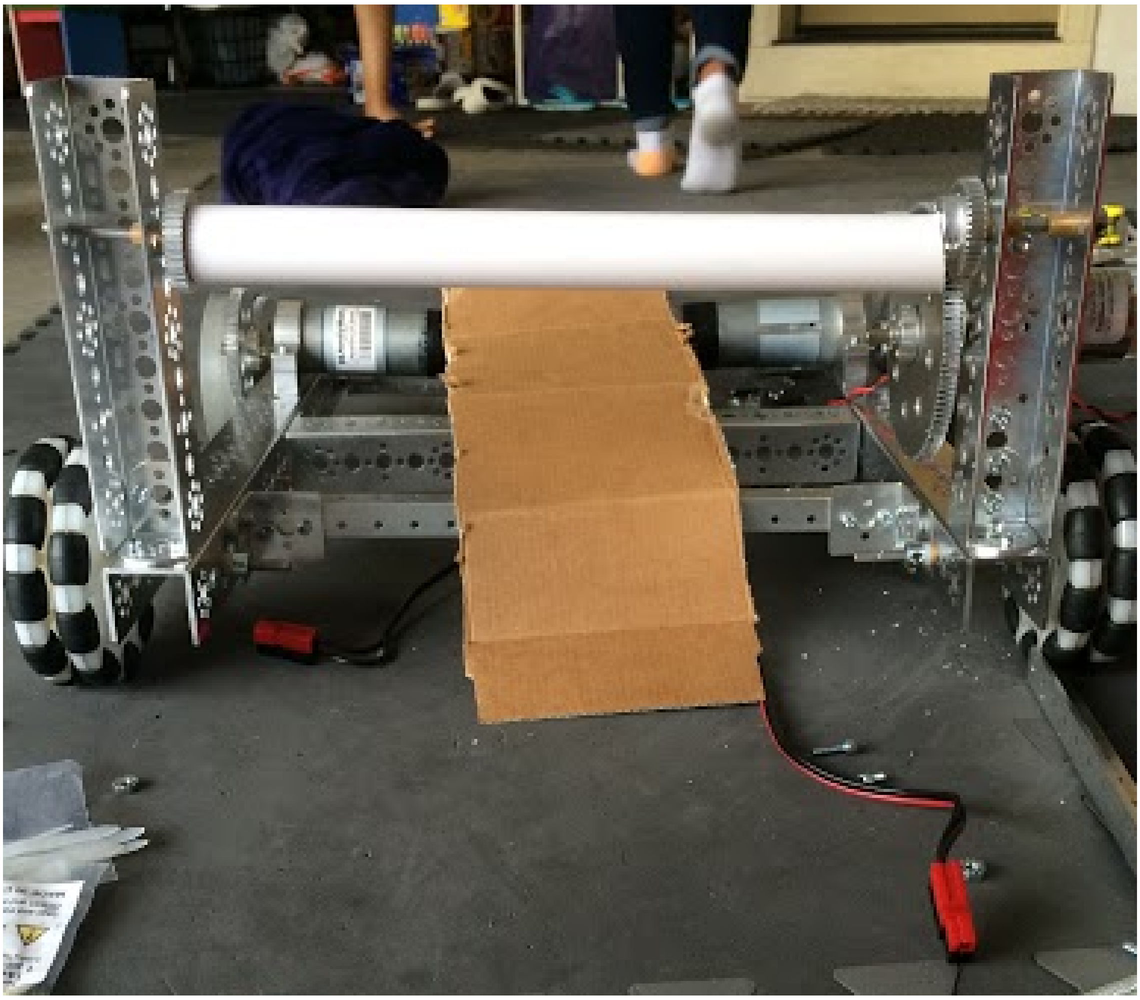


Figure 21.1: Beginning to create our debris collection system.

Today we did a lot of planning for our debris-collecting system. We had some structures on the front of our robot that we needed to remove before implanting any new systems because they were blocking areas that were needed to complete certain missions. We wanted some free space because the balls and cubes would be entering through the front and our shooting mechanism would be located in the middle.

Our plan for the debris-collecting system was to:

1. Create a ramp where the balls and cubes would be pushed into
2. Use a "sweeper" to gather the debris out of garage insulator
3. It would be held into a bucket with a max capacity five balls/cubes. This is maintained by a stopper of some sort
4. Shoot the debris forward into mountain buckets in front of the mountain

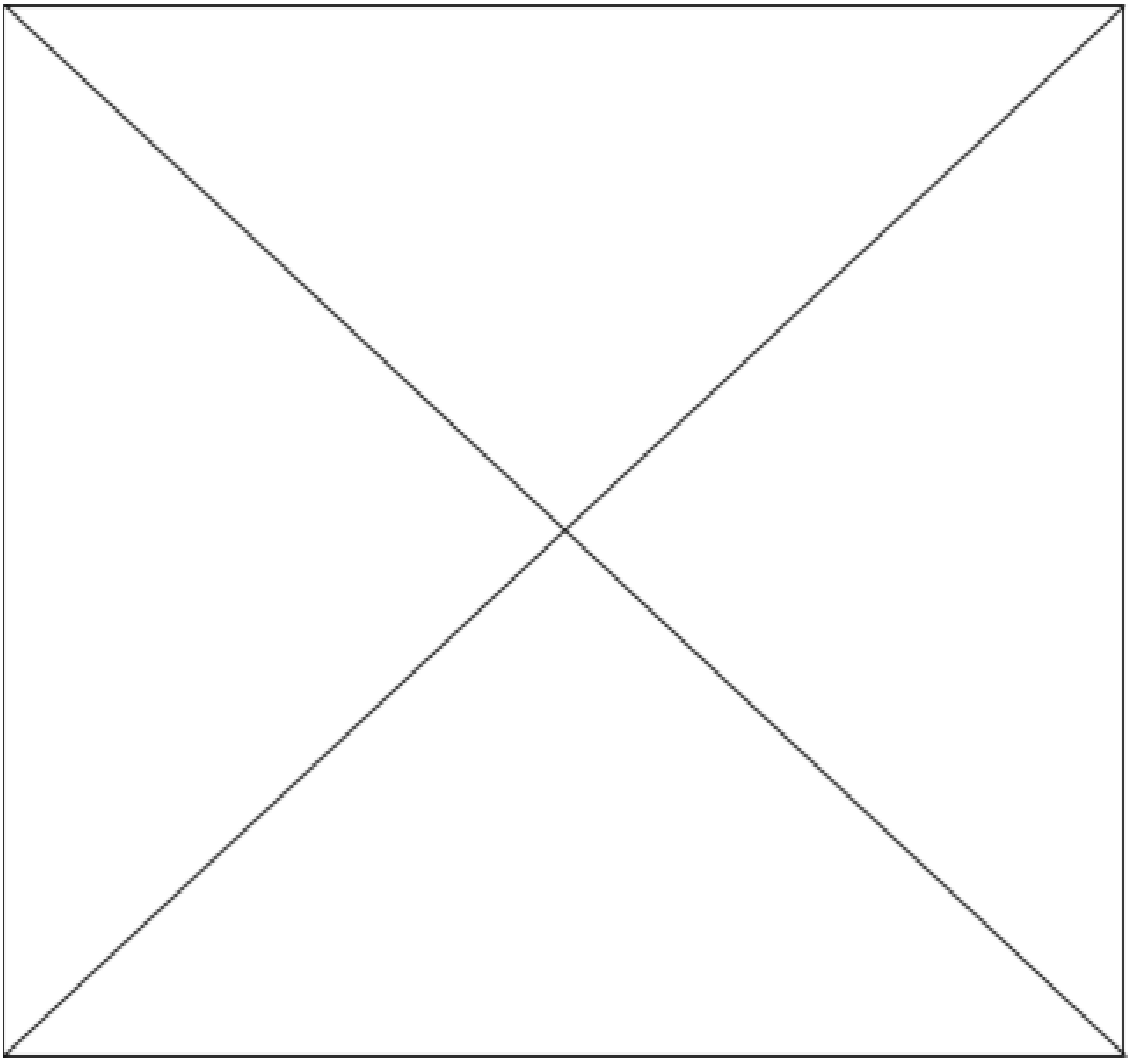
During the meeting we also worked on re-engineering our robot to make it more strong and sturdy. Also, since a main part of the challenge is climbing the mountain we needed to maintain the center of gravity by balancing out where we placed the weight. This also means that our robot has to be very lightweight, something our robot has been struggling with due to its build and structure.

We prepared the robot for some new designs by removing several large structures in the front of robot and started collecting ideas and modeling for the debris-collector. This was a good opportunity to organize the components of our robot and plan what things would go where.

We were able to create a model ramp using TETRIX parts, this helped us understand what we needed to include for the final design is that:

- The ramp needs to be made out of sheet metal not TETRIX plates
- Should not be very steep
- Wide enough to fit both cube and ball debris
- Might need a railing to keep debris from falling out

Submitted By Namitha



22. Tasking and Asking

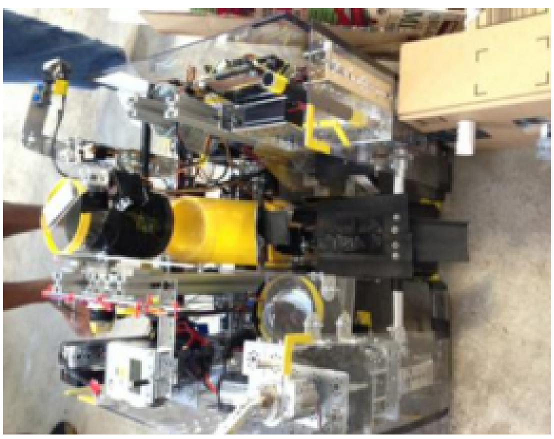
Meeting Date: Sat, 10/17/2015, 2:00 PM - 5:00 PM
Personnel Present: Nandhana, Namitha, Maria, Shamamah, Rushali, Rayma, Irene, Aishwarya, Navyatha, Shruthi, Harini, Adithi

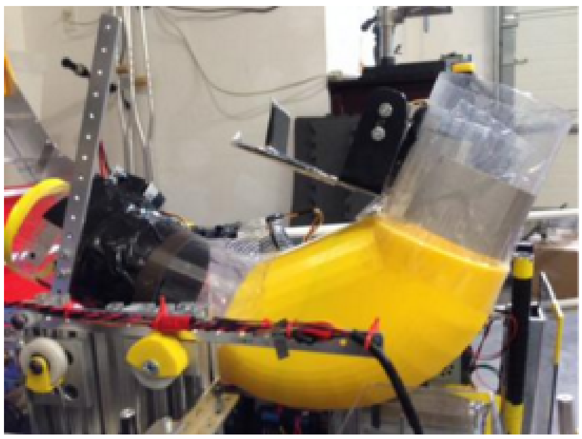
Tasks This Meeting:

- Go over last week's homework and progress
- Look at team Paradox's robot
- Make robot sketches
- Assign build and electrical homework

Reflections:

While inspecting team Paradox's robot, we made the crucial observation that the center area of the robot was left rather open and not compact. This led us to make the task of clearing the middle section of our current robot design, which was occupied by the battery.

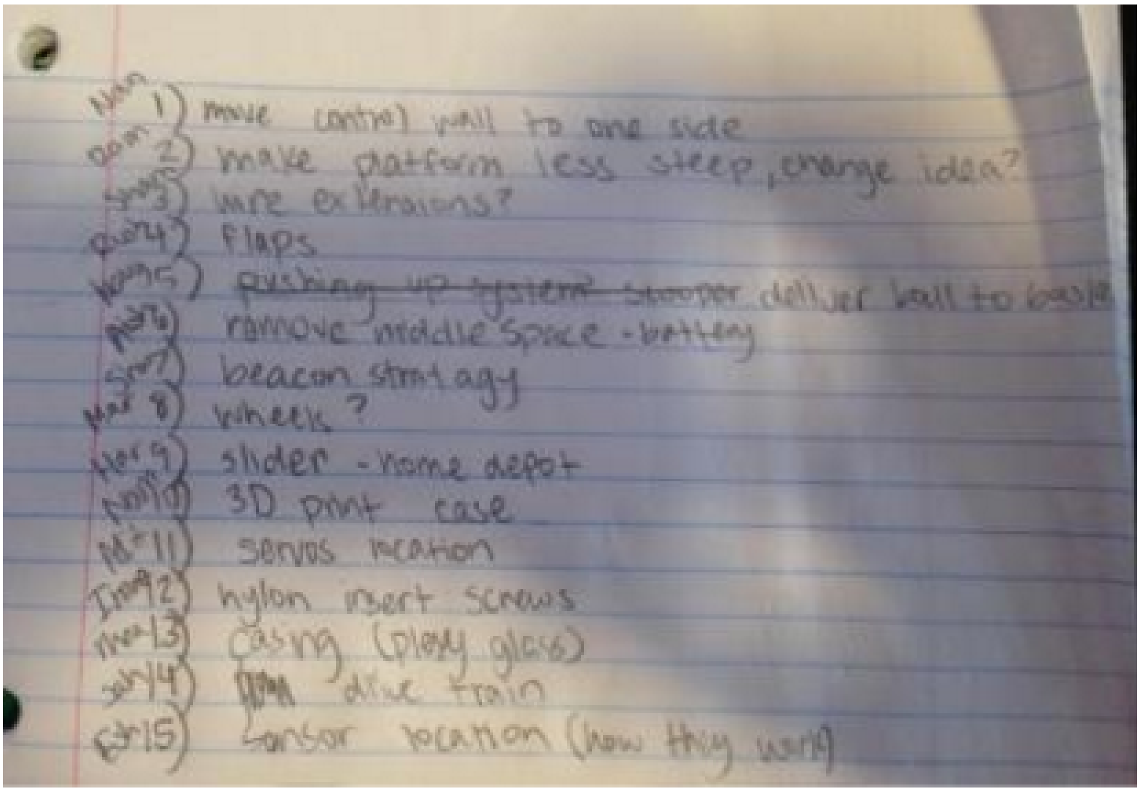




When looking at their scoring mechanisms, we took note of their debris-catching mechanism. The system consisted of a flap made of garage insulation that rotates by a shaft powered by a motor. As the power of the motor powers the shaft, the flap subsequently moves and captures the debris, moving them inside the robot and into a tubular compartment. The tube collects the debris, a maximum of about five which can fit in, and is connected to a system of sliders. Something interesting about the tube is that there is a flap made of duct tape that closes over the opening of the tube. This closes over by a servo motor so that the debris cannot fall out once it enters. The slider system is comprised of a line of draw-sliders that distribute power from slider to slider and henceforth increase the height of the reach-distance of the robot. Once extended, a motor rotates the tube and allows the debris to be dumped into higher scoring areas.

When we ran the robot, we come across the issue that as the flap rotated, sometimes the debris would go into an opening in the left side, getting stuck there and affecting the drive movement of the robot.

Assignments
To ensure better progress, we thought of fifteen tasks, one task for each of the fifteen members, that each person is to responsible for and become an expert on. These assignments all revolve around building and electrical facets of the robot.



Submitted By Shamamah

23. Thinking Outside the Box

Meeting Date: Sun, 10/18/2015
Personnel Present: Nandhana, Namitha, Maria, Adithi, Ramya

Tasks This Meeting:

- Design a new structure for our robot
- Clear out the center
- Clean up the scooping mechanism
- Change the electrical wall

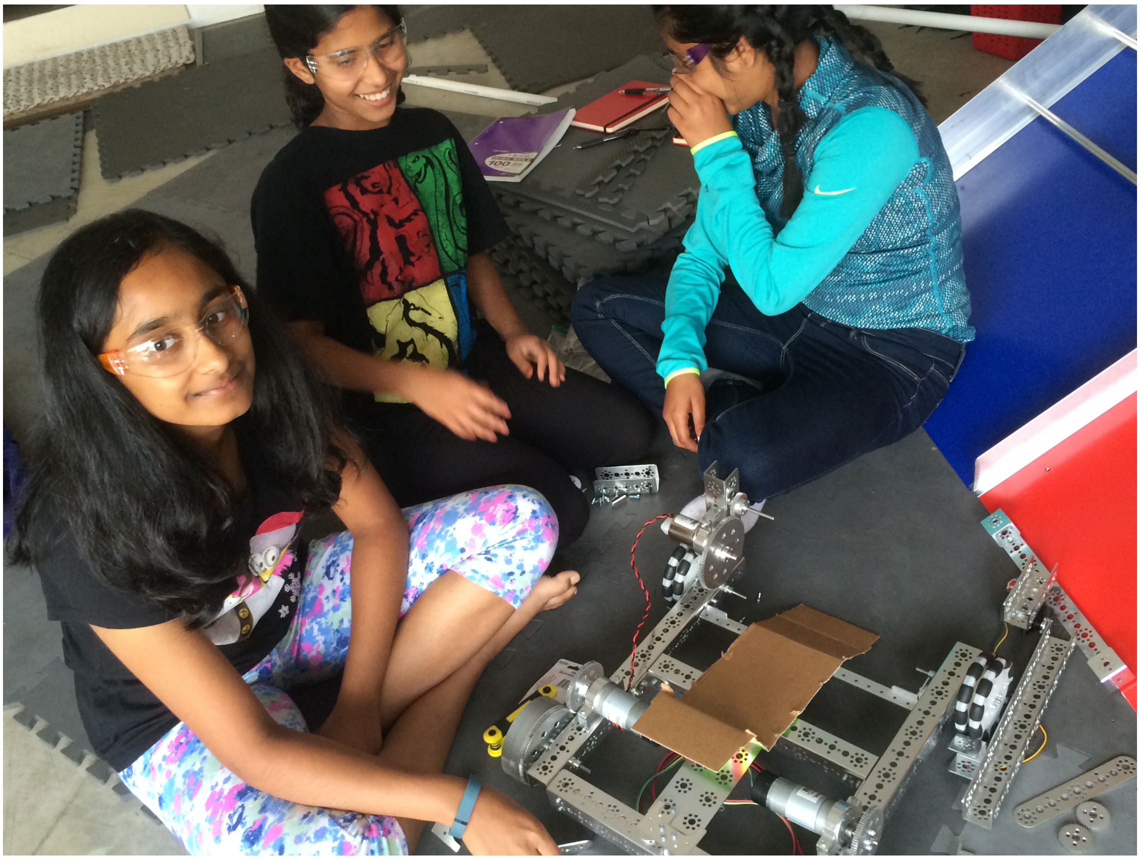
Reflections:

Today is a follow-up from yesterday's meeting, and we hope to finish the robot ideas and concepts we discussed.

We found that working in a smaller group worked much better. We accomplished a lot more than all fifteen girls trying to work on the same robot. Our robot has changed, especially with our new additions, based on a similar scooping concept from Paradox's Cascade Effect robot. Our strategy is to scoop up the balls with a rotating device then send them up a chute in which we can score into the mountain goals.

Some challenges we faced was making sure we fit the eighteen inch by eighteen inch by eighteen inch limit. We tried to put as much things inside the robot to save space. Another challenge was the wiring wall. The Core Power Distributor on switch had to be accessible.

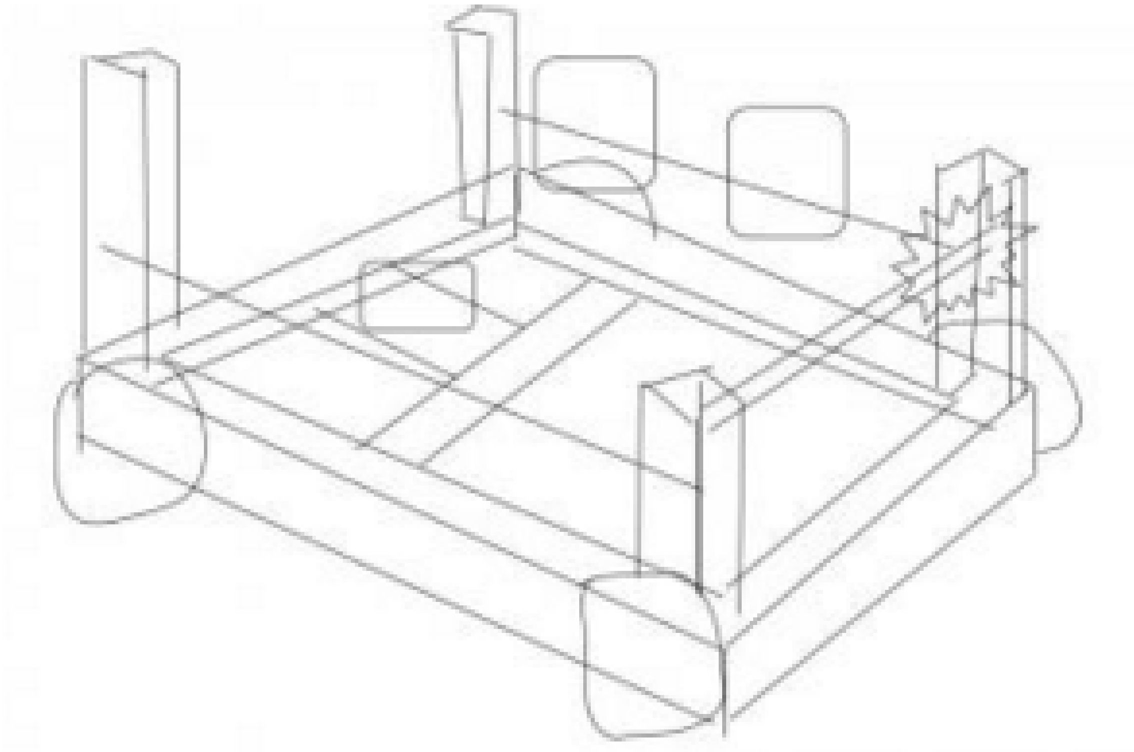
Our robot is currently being built upward, not only to save space, but also to pick up our scoring elements. It might be risky since we don't want to topple over while climbing upward.

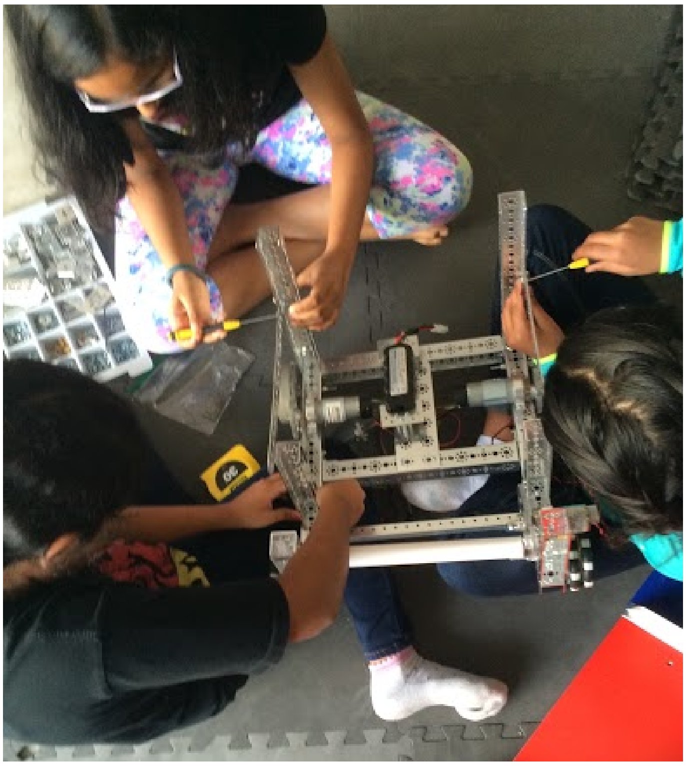


Objective
Following is our idea for the structure of the robot. This includes of a sweeping mechanism. The goal for this is to take out most of the center channels and replace it with a ramp that acts as a pipe for the balls and cubes. We removed the current ramp and added a DC motor to the front left to turn the (temporary) PVC pipe that will sweep the scoring elements. Keeping in mind the fact that we have to pick both cubes and balls. Our original idea of a garage insulator material might not be able to work with both shapes.

Materials
We are using a thin sheet metal for the ramp ("pipe") so it does not added too much weight to the robot. This is important because we can't add too much weight if our robot is to go up the mountain. For the spinning part we have not finalized our material but it will be either plastic rings or a spongy garage insulator.

On the next page is a visual of our robot.





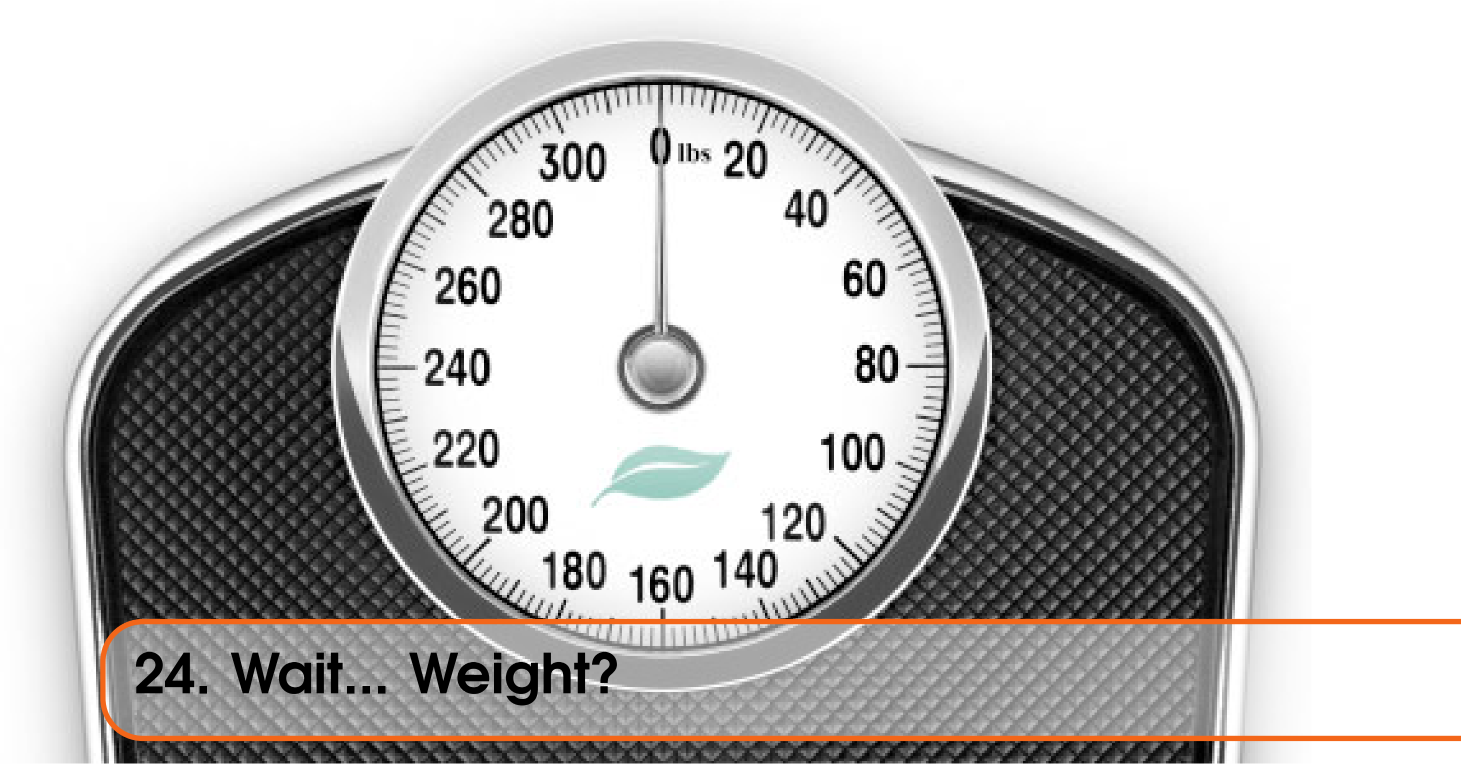
Torque
Torque is described as the tendency of a force to move an object in a rotational manner. All objects of rotation revolve around the pivot point, and the distance from that point to the exact placement of the object at the time is known as the moment

arm, or **r**, a vector. The equation is given by

$$\tau = \mathbf{r} * F$$

where τ is the torque in units of Newton-meters, **r** is the moment arm in meters, and F is the force measured in Newtons.

Submitted By Nandhana



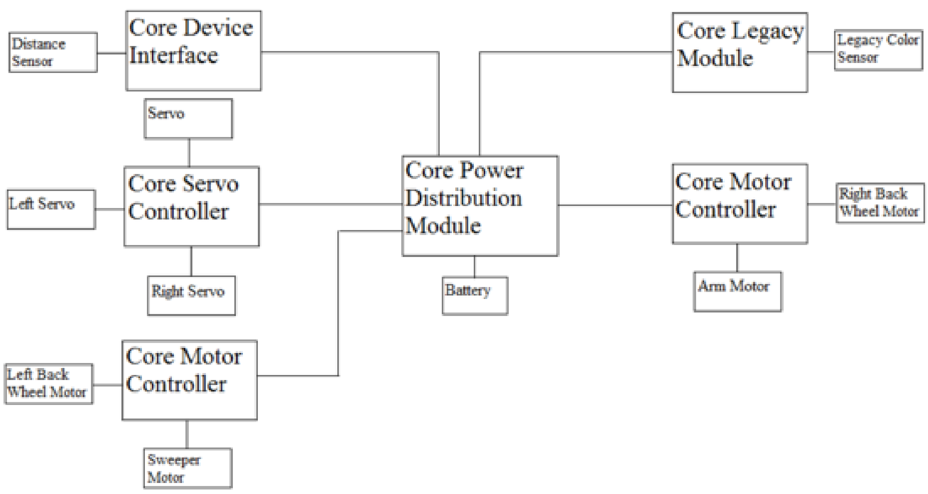
24. Wait... Weight?

Meeting Date: Sat, 10/24/2015, 2:00 PM - 5:00 PM
Personnel Present: Harini, Sahana, Ramya, Shamamah

Tasks This Meeting:

- Fix any basic issues on our robot
- Fix any inconsistent or loose screws
- Move the Core Motor Controller, the Core Servo Controller, and the Core
- Power Distribution Module
- Rewire the motors
- Find a spot to put a servo for pushing the climber levers
- Test weight and motors efficiency

Reflections:

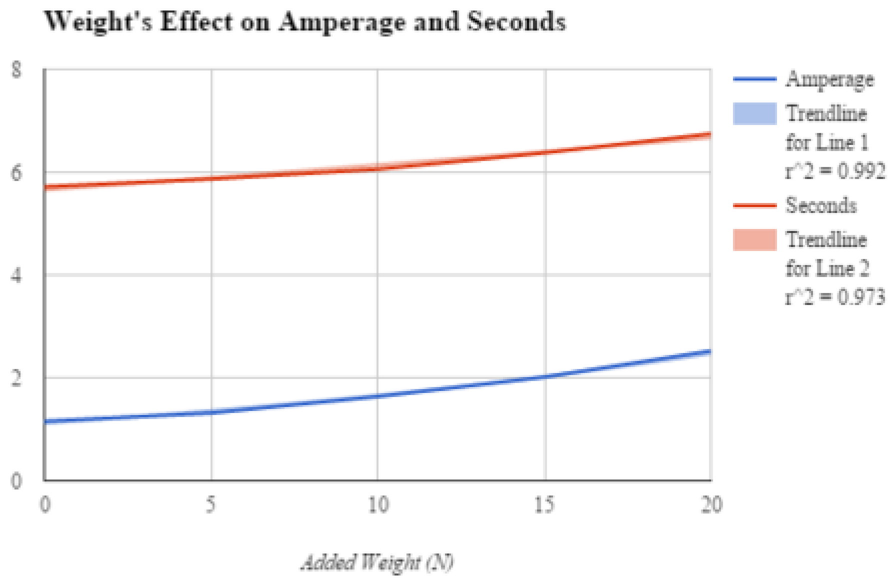


Today was really just a day to clean up the robot and see which areas needed fixing. As we discussed last meeting, weight is a very defining factor of our robot. We cannot add too much weight to the robot because it may cause the robot to not be able to climb the mountain. Additionally, it strains the motors and leads to increased battery consumption. Below I will explain further this correlation and the results of a related experiment. Duly noted, center of gravity and mass are very important when it comes to climbing up elevations suchlike the mountain. Therefore, we chose to change the placement of the Core Motor Controller, the Core Servo Controller, and the Core Power Distribution Module so that the weight could be distributed and the center of mass could be altered.

Due to the replacement of the modules, we were entailed to rewired the wires, sensors, and such. We closely followed our wiring protocols which address that we make sure the wires are taut and tied strongly with zip ties. Above is a diagram of our new electrical configuration.

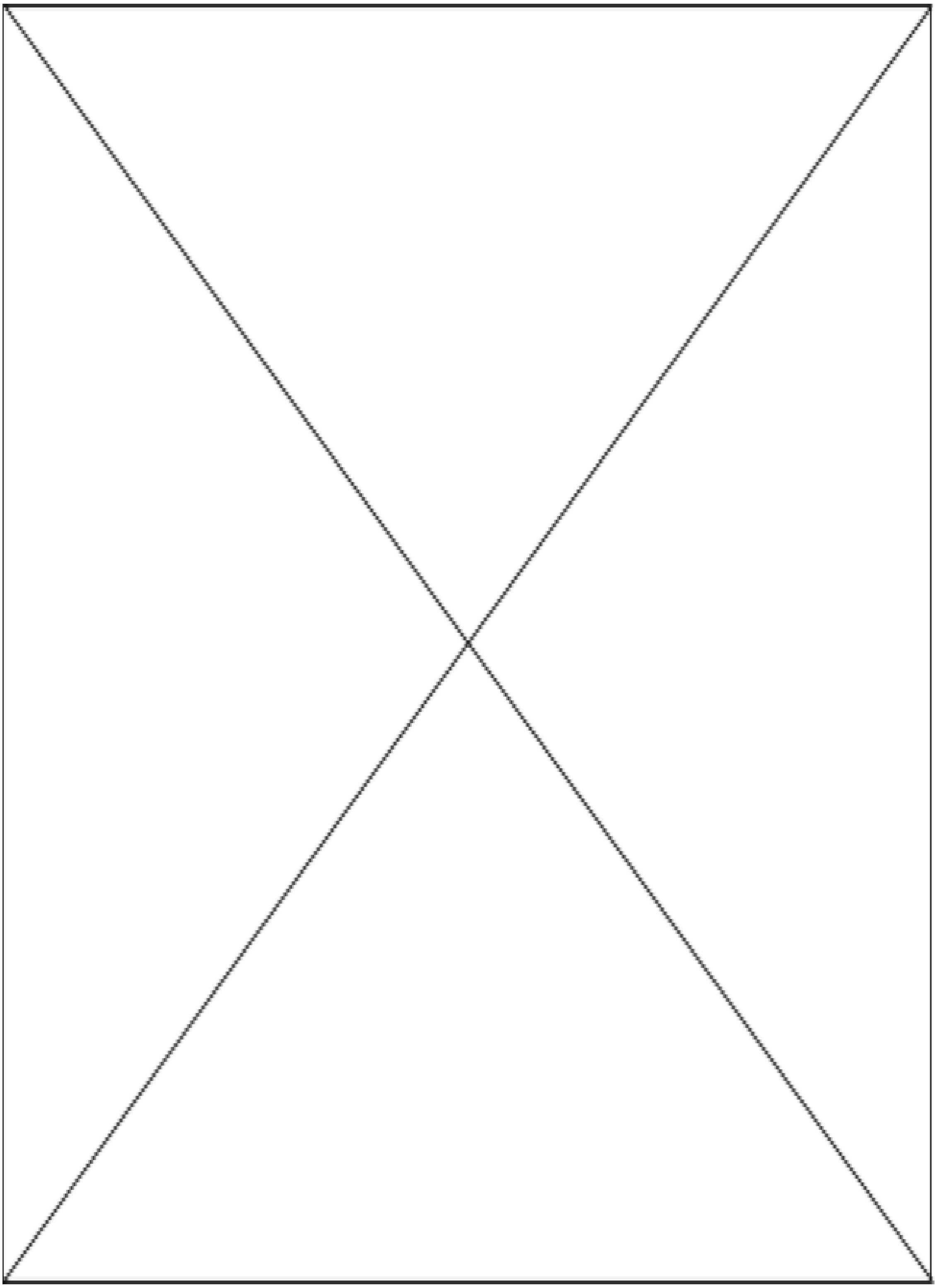
Returning to the topic of weight, we conducted a test that observed the effect of the pull of gravity versus the efficiency of the robot in traveling in straight line for a set distance. Here, our independent variable was weight (measured in newtons), and the dependent variables were time and amperage expressed by the Core Power Distribution Module. The controls included a distance of 7 m and all procedural means. We conducted ten trials per added weight test, and average everything.

Below is a graph of our averaged data.



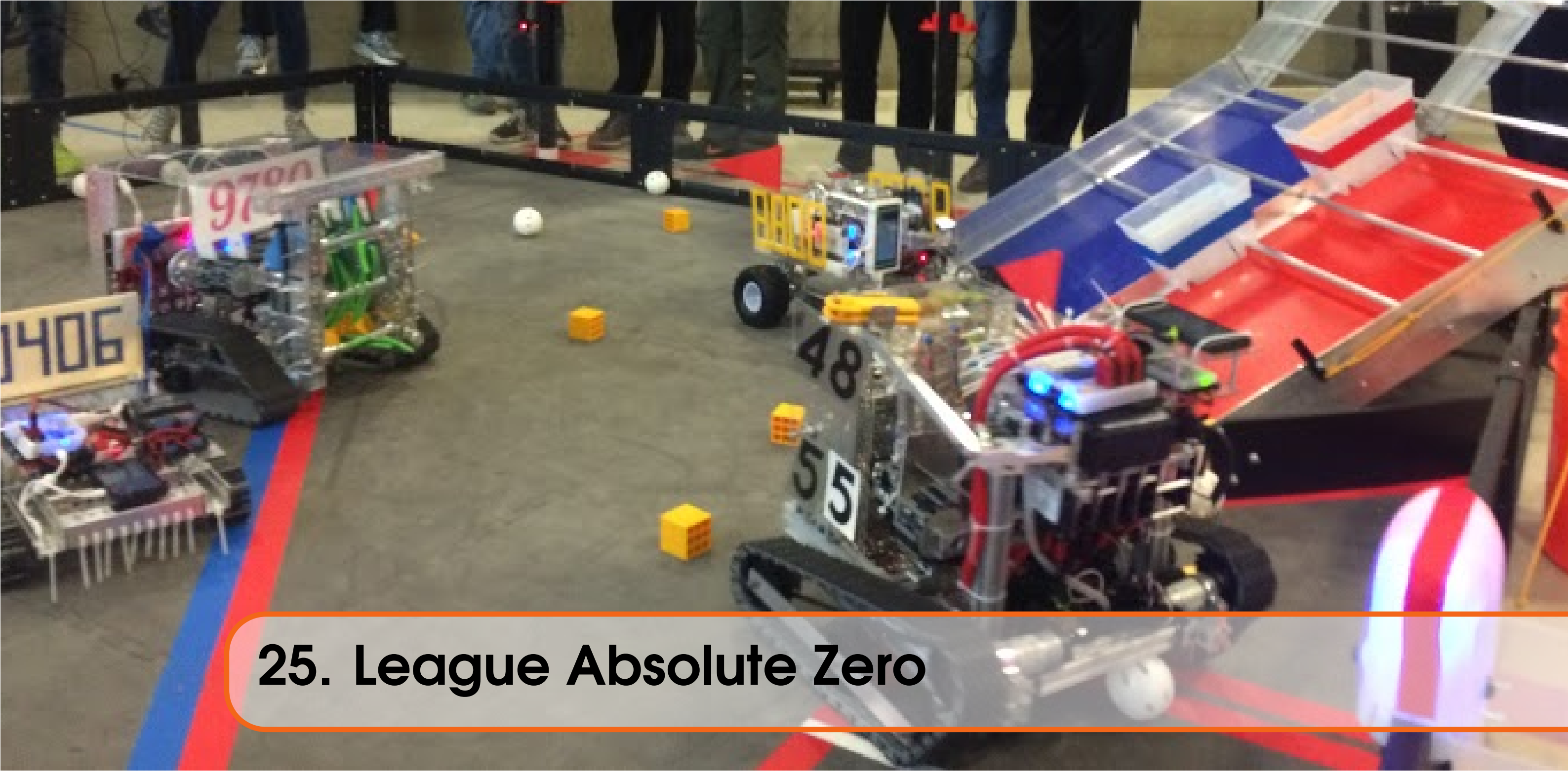
As seen from the data, the effect of weight on amperage and time needed for the robot to travel a distance of seven meters followed very strict exponential curves. Taking note of R-squared values of 0.992 and 0.973 for the best-fit lines, it can be concluded that the correlation is indeed very clear and the data achieved was very precise.

Submitted By Shamamah



IV

Engineering Summaries: League Season



25. League Absolute Zero

Meeting Date: Sat, 11/07/2015
Personnel Present: Nandhana, Namitha, Rushali, Navyatha, Adithi, Sahana, Maria, Aishwarya, Esha, Ramya, Shruthi, Irene, Shamamah, Rhea

Tasks This Meeting:

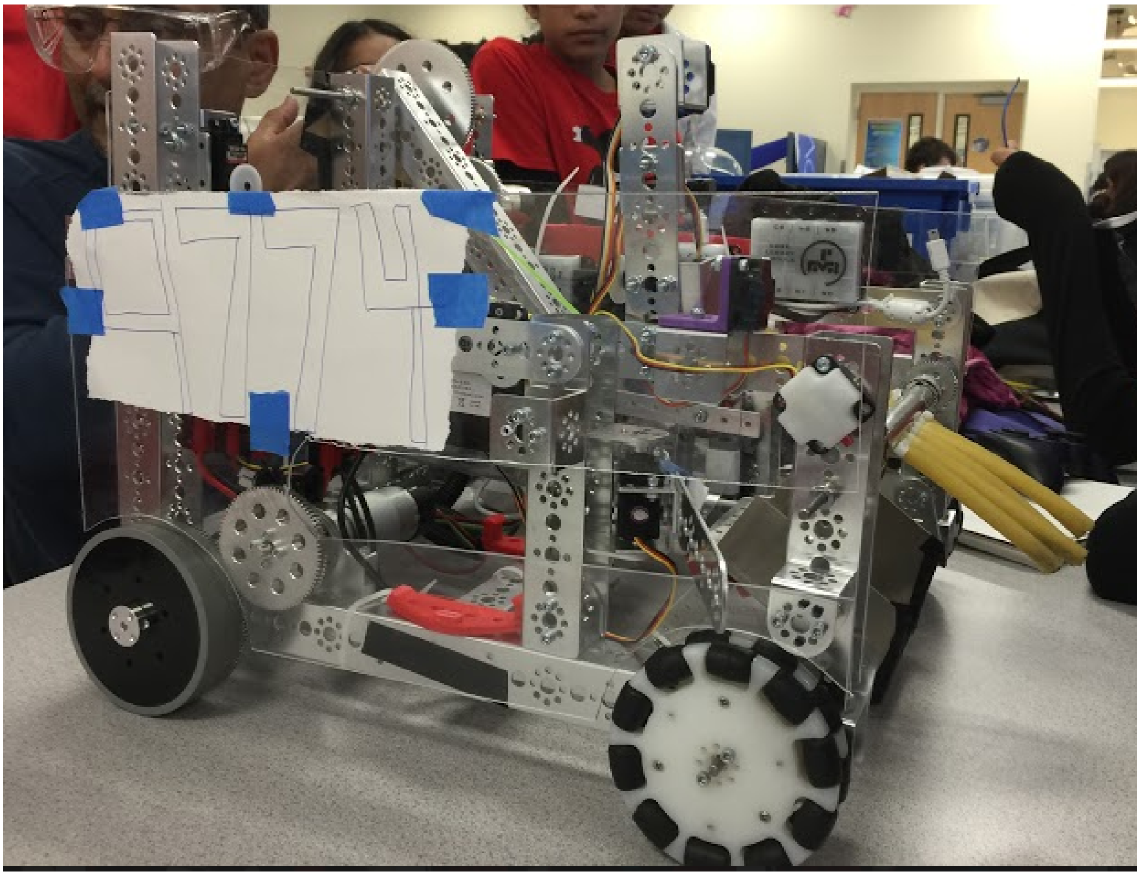
- Get our robot inspected
- Inspect peer robots
- Do three matches well
- Have fun!

Reflections:

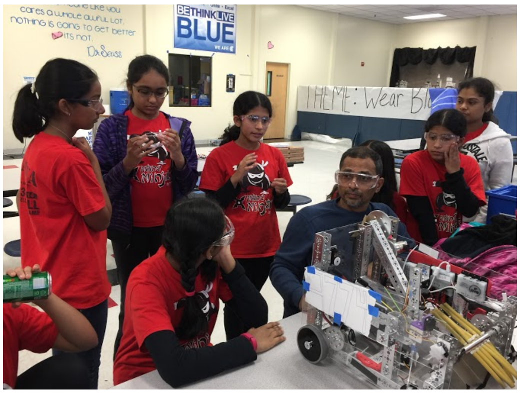
Today we had our practice league. There were twelve teams in total. We got to feel how our real league would be like. When another team inspected our robot, they found that our edges were a little sharp and we also had to cover the gear that was sticking out of the plexi-glass on the back. We also had to put our android phone on the outside of the robot so that it was more easy to access. Other than that our robot was pretty good.

For all the three matches there was a problem with the wifi-direct. A lot of teams had problem with the wifi since a lot of electronics were connected to the wifi. We tried going outside and connecting to the wifi, but it still didn't work. For the first and second match we couldn't do anything since the wifi didn't work. For the third match the wifi finally worked, but when we got to the game field, we had a problem with the configuration. But on the third match we still won since the other team pushed some of the debris in our floor goal.

Overall we weren't that prepared because we were borrowing all of the materials from other teams and a lot of team members didn't have anything to do. This practice league was a good learning experience because now we know we have to plan what people are going to do so we get more done.



During the match we had trouble defining the roles such as drivers, so one of our first action items was to create a spreadsheet containing what each member's role was during and in between matches.



What We Have to Fix on the Robot

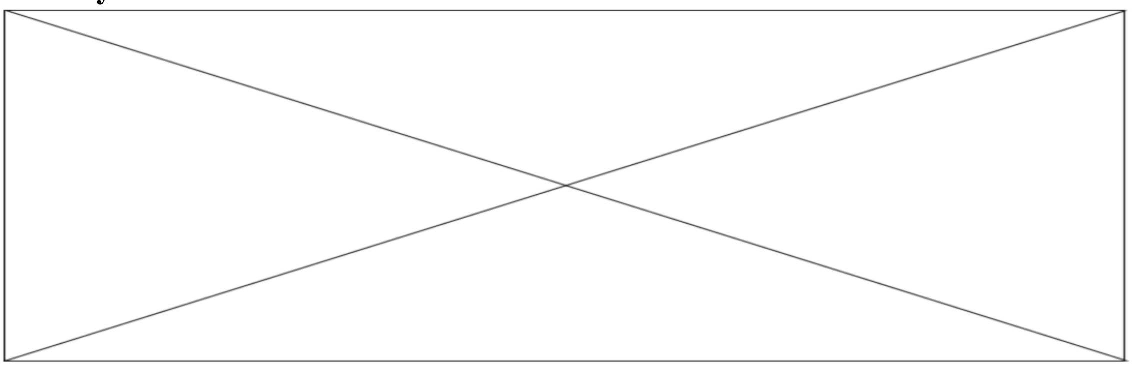
- Make the edges less sharp
- Put phone on the side of robot
- Cover gear on the back
- Put team number on two sides of the robot

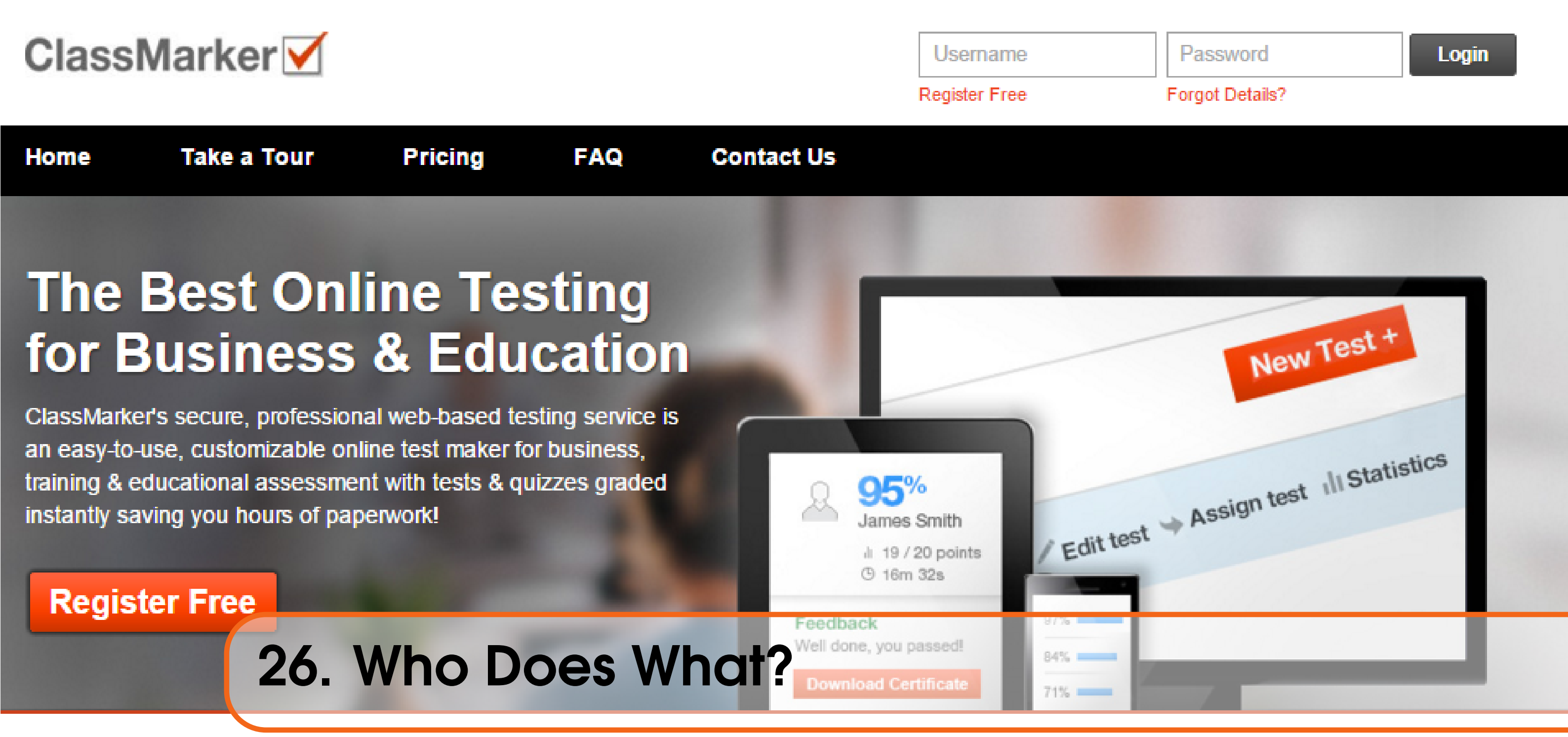
Figure 25.1: Our table marker sign.

What We Have to Do for Our Next League

- Make autonomous program
- Decide team roles
- Fix wifi and USB problems
- Remember Bill of Materials

Submitted By Adithi





26. Who Does What?

Meeting Date: Sat, 11/14/2015
Personnel Present: Aishwarya, Sahana, Navyatha, Rhea, Adithi, Nandhana, Namitha, Maria, Rushali, Harini, Shruthi, Ramya, Irene

Tasks This Meeting:

- Last League we decided to define roles during the tournament, we will distribute responsibilities during this meeting
- Game manual Test results will help decide the above task
- Re-do plexiglass
- Bake sale planning
- Discuss schedule and upcoming league

Reflections:

We had been given a seven minute test with twenty-five questions on the game manual to partially decide who could make fast-and-correct decisions on the game field. The test was taken through ClassMarker, and we received our test results immediately after finishing taking the test. The scores were called out and we used this information to know where we were with the program, and if we needed more review. From this also, we were able to see who were the best fit as a driver who knew both the Game Manuals inside-and-out and could use their knowledge quickly and efficiently.

We later split into sub-teams where some of us worked on cutting plexiglass, and others continued fixing up our robot. We had to make sure our robot was in its best condition in order to bring it to the League Competition. We filed any sharp edges and made sure everything was safe and not in danger of tangling.

We also came up with a plan for who is responsible for what at our next competition.

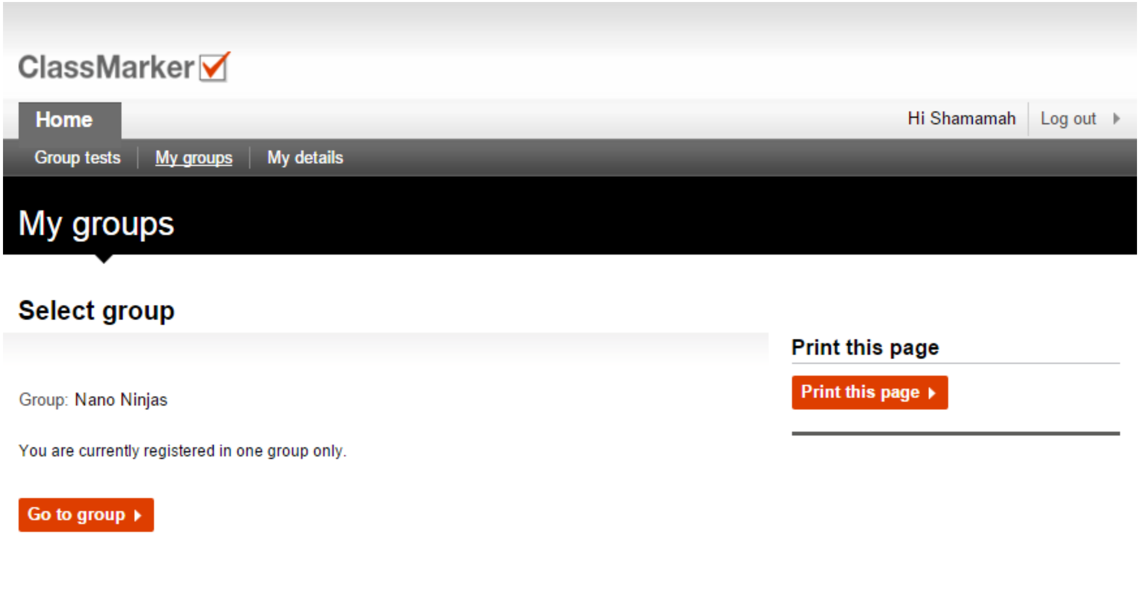


Figure 26.1: Screenshot of groups page.

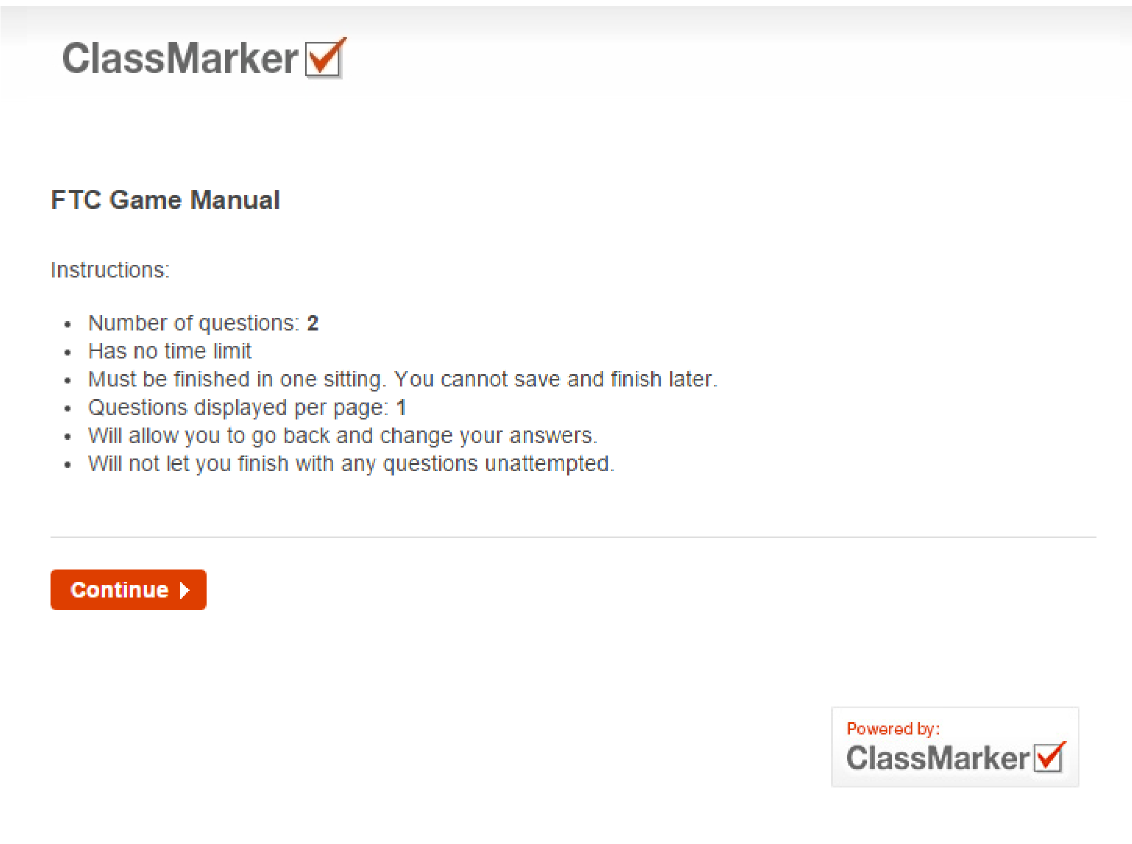


Figure 26.2: Screenshot of test page.

Question 13 of 25

Can we create a Robot alignment structure (guide) to set the robot in place for initial autonomous run?

Correct answer: **C)**
You chose: **C)**
Note: This question displayed answer options in random order when taking this test.

A) Yes, if it is within 18X18X18 size

B) Yes, if it is within 18X18X18 and part of the Robot

✔ **C)** Yes, if it is made with legal components within 18X18X18 and part of the Robot

Points: 1 out of 1

Question 14 of 25

Select all correct answers:

During a driver controlled period,

Correct answer: **A) B)**
You chose: **A) B)**

✔ **A)** Floor Goal - one point per Debris.

✔ **B)** Low Zone Goal - five points per Debris.

C) Mid Zone Goal - Fifteen points per Debris.

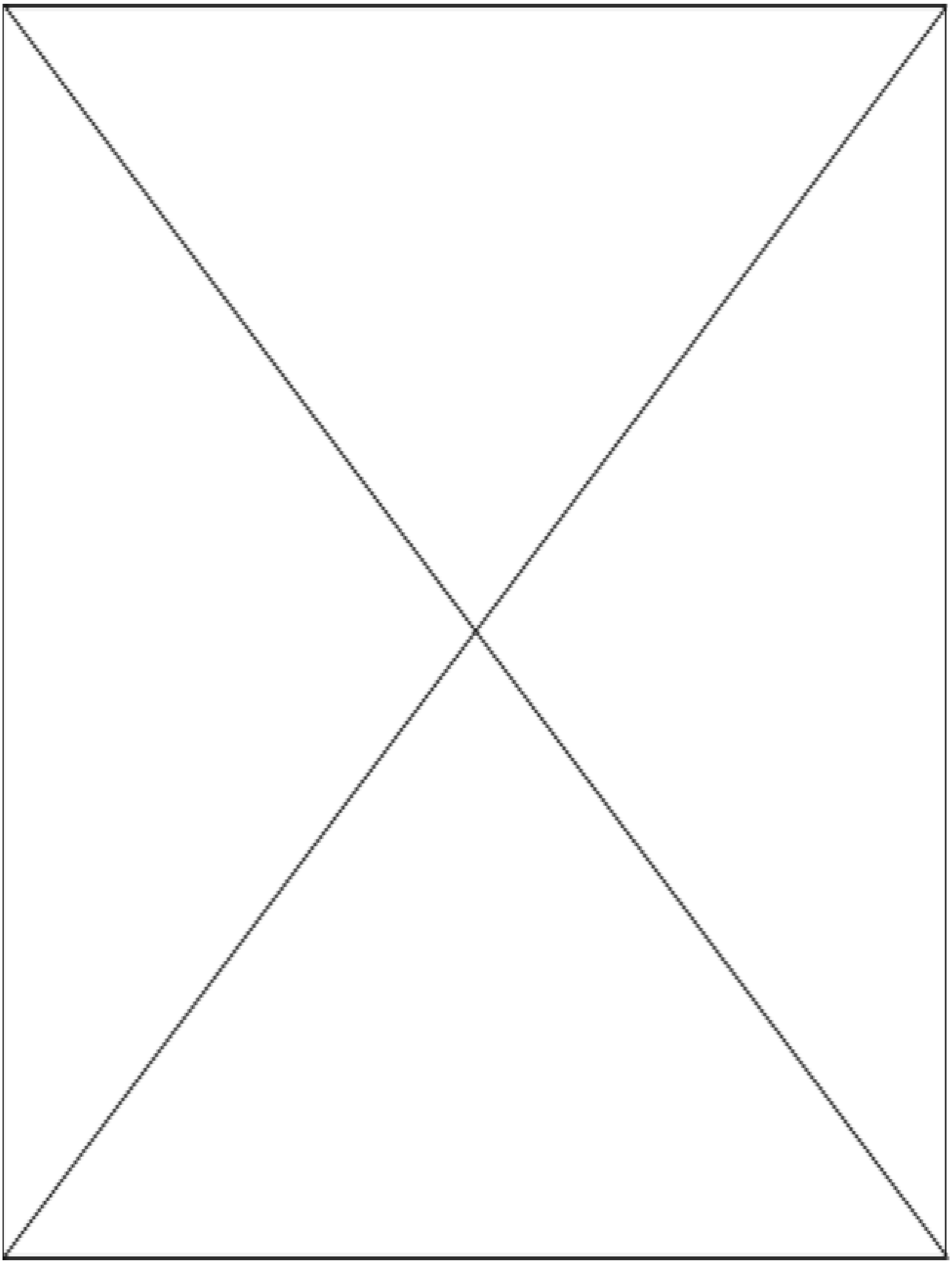
D) High Zone Goal - Thirty points per Debris.

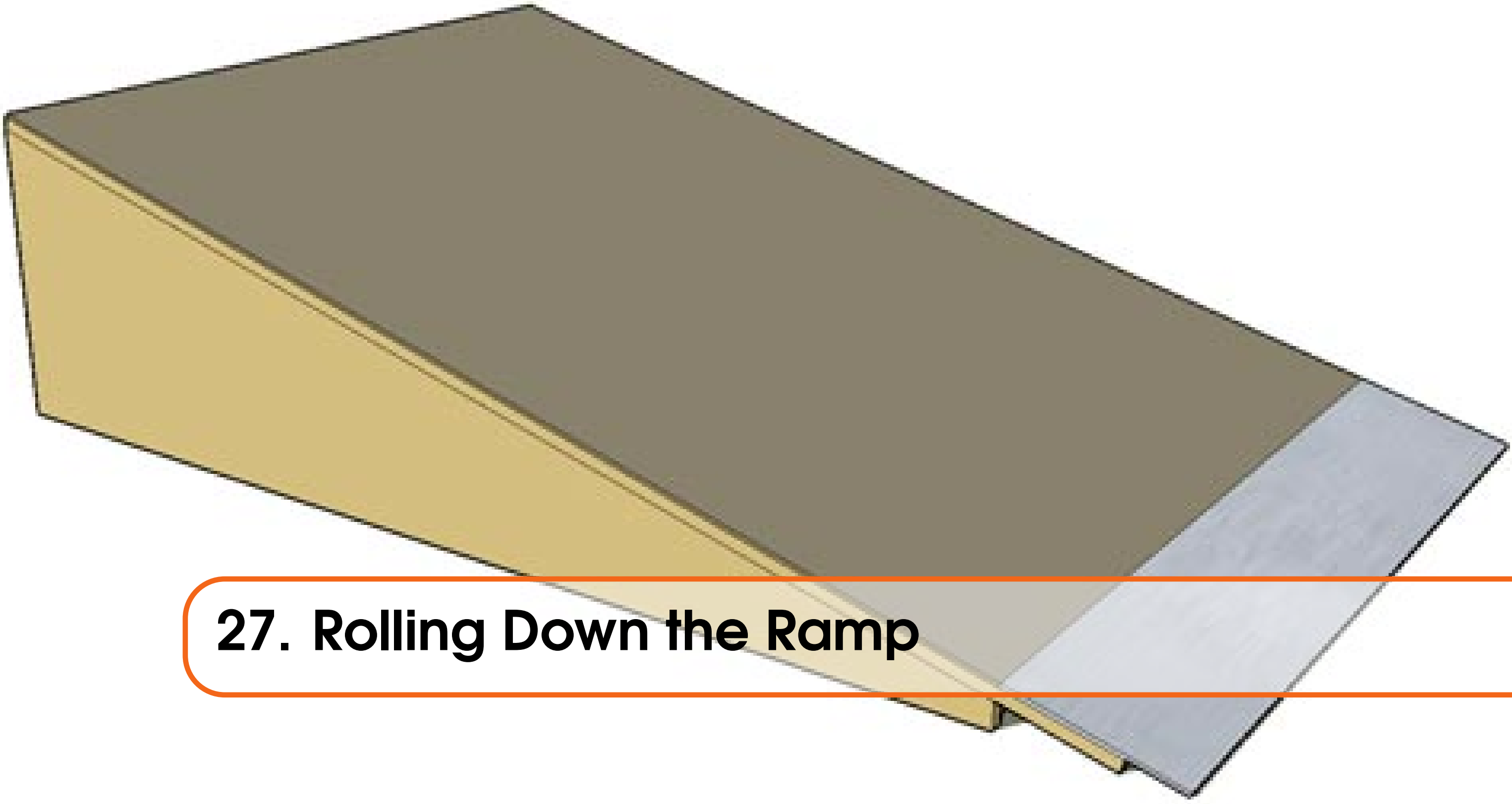
Points: 1 out of 1

Figure 26.3: Screenshot of test results page.

These tasks would ensure that every team member is focused on a few things and do those things well. We will be creating a document which addresses all the individual tasks of every member during the League Competition.

Submitted By Nandhana





27. Rolling Down the Ramp

Meeting Date: Sun, 11/15/2015
Personnel Present: Maria, Sahana, Harini

Tasks This Meeting:

- Discuss the different ideas brought up for the ramp
- Whether we should use walls or bend the walls from the ramp
- Talking about if the surgical tubing should be along the stretch of the front of the robot
- Decide where to place battery and accordingly place the cut-outs on the plexiglass
- Check the connection of the phone to the Power Distribution Module
- Check the screws and nuts as main back channels were having alignment issues

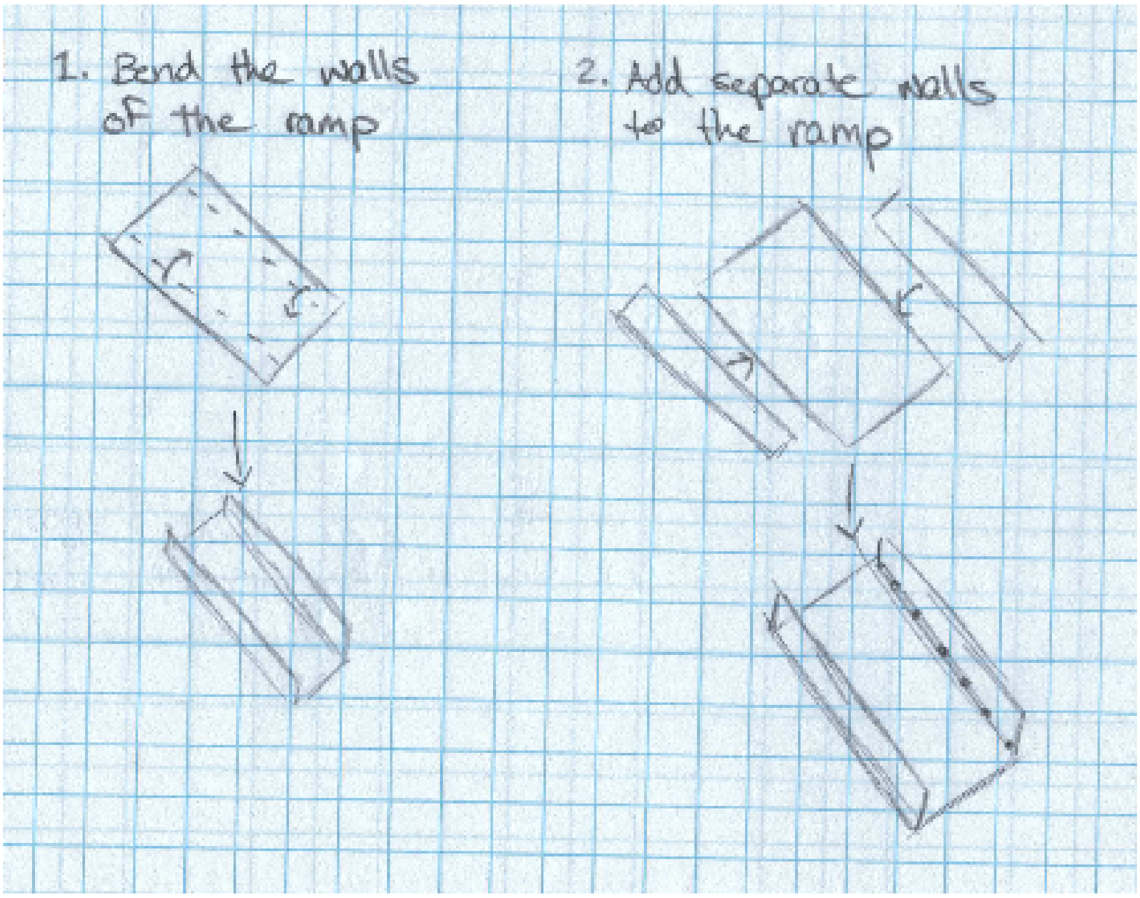
Reflections:

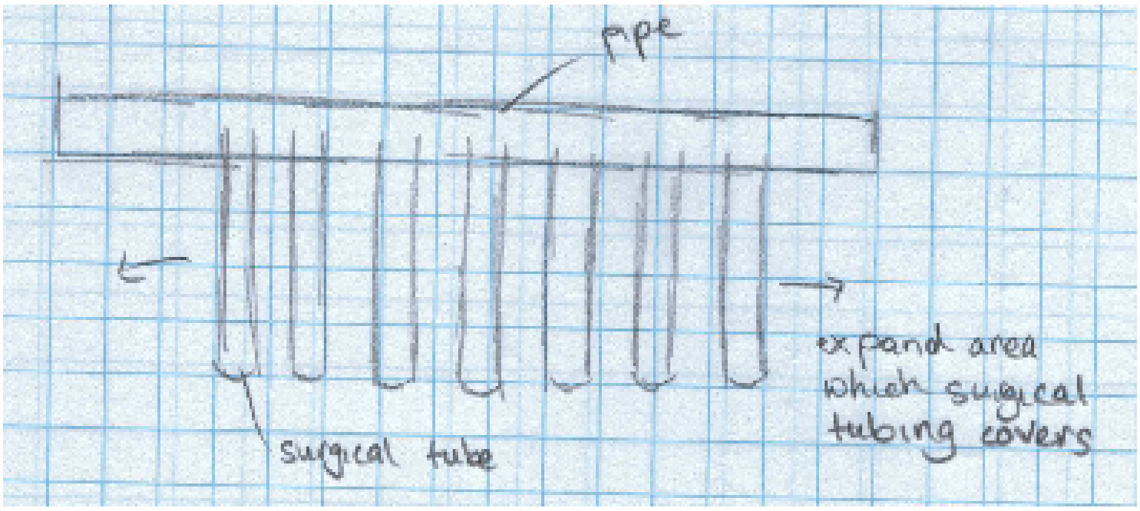
While trying to drive our robot we have come across similar challenges that we faced during the meeting. The Core Power Distribution Module is not recognizing a device so we cannot run the robot– even after several attempts. We also found that one for the phones was constantly restarting, still trying to figure out why. Although similar, this was not the same problem we faced during the tournament. Quite possibly it had to do with battery charge.

We also discussed whether or not we should stretch out the distance the surgical tubes span across the the pipe. We decide for it as it would increase our capturing of debris and decrease the chance of spheres and cubes getting into other areas of the robot, obstructing it from working.

After that, we did a bit of readjusting. Few pieces did not align perfectly so we had to redo those portions. We also tightened all the nuts and bolts and screws. To test if everything is intact, we always lightly shake the robot both indirectly and directly and see if anything comes out or looks like it is about to come out.

Nandhana and Namitha are near to finishing the FTC parody video.We did some last minute filming– we plan to submit it after this Saturday's league!





Submitted By Harini

28. Final Touches

Meeting Date: Tue, 11/17/2015
Personnel Present: Sahana, Adithi, Rushali, Maria, Namitha, Nandhana

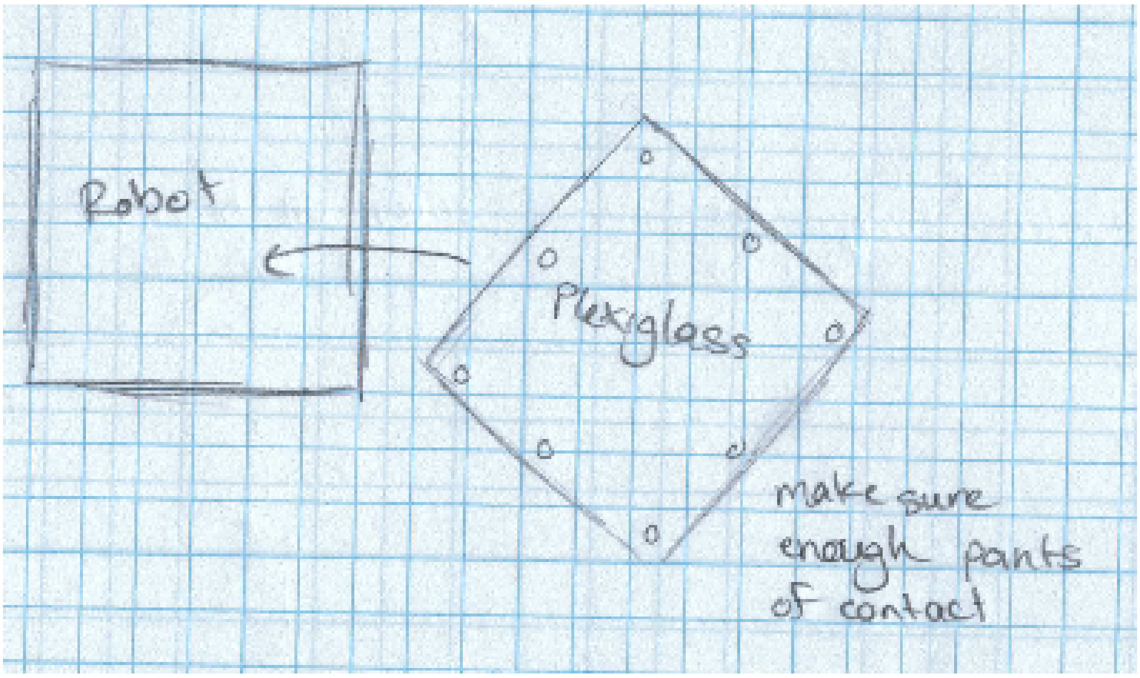
Tasks This Meeting:

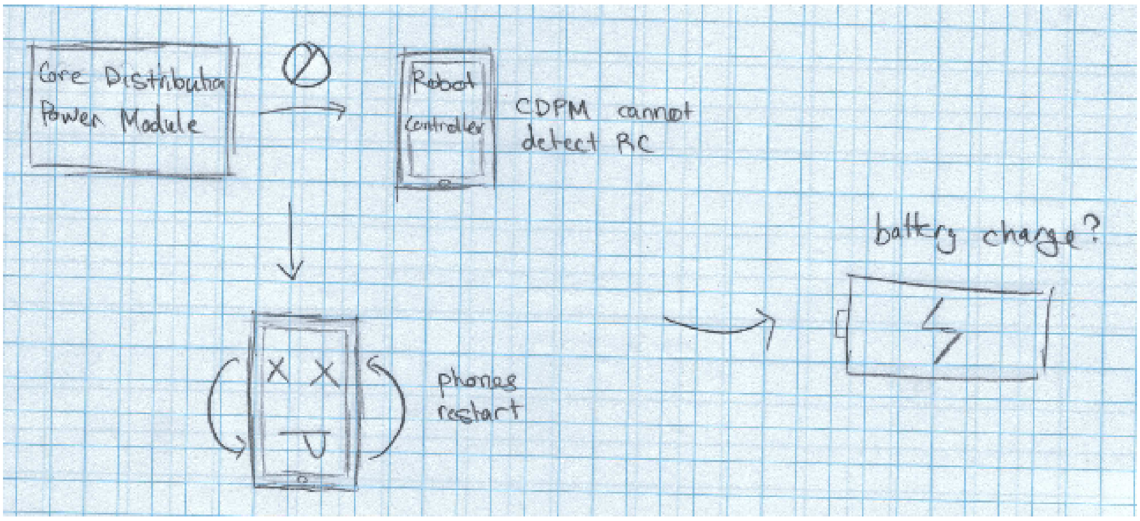
- Screw on the cut plexiglass sheets
- Practice running the robot
- Finish assembling game board

Reflections:

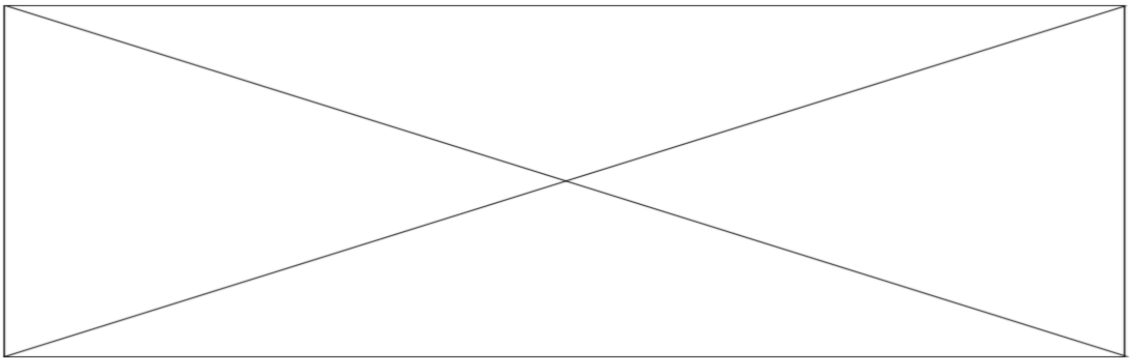
Today we screwed on the cut plexiglass sheets onto the sides and back of the robot. We had some trouble marking the exact holes and drilling them, but we finally got the hang of it and drilled the correct holes. We easily attached the glass to the robot and filed the edges. When connecting two things together, we always make sure to have at least two points of contact. This will ensure the lowest bit of strength and stability. With plexiglass, we have drill all around to keep it highly secure.

The drive team practiced running the robot on our game field, but we faced some problems. Our robot is still facing similar issues we faced at the Sunday meet! This time we were able to identify a couple possible reasons. Battery level seems to play a role in this. Our robot is not being able to configure because the battery is not being charged at the end of practices– we must make sure we keep this in mind in coming weeks so at the league our robot will have enough battery to run.





Submitted By Nandhana

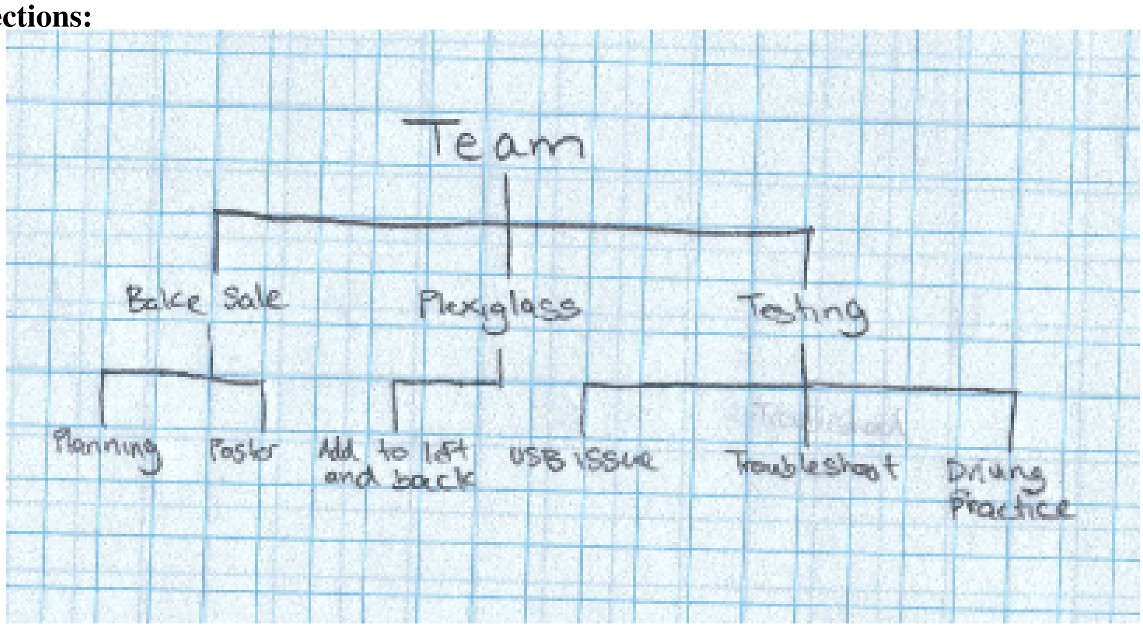


29. Starting With the Core

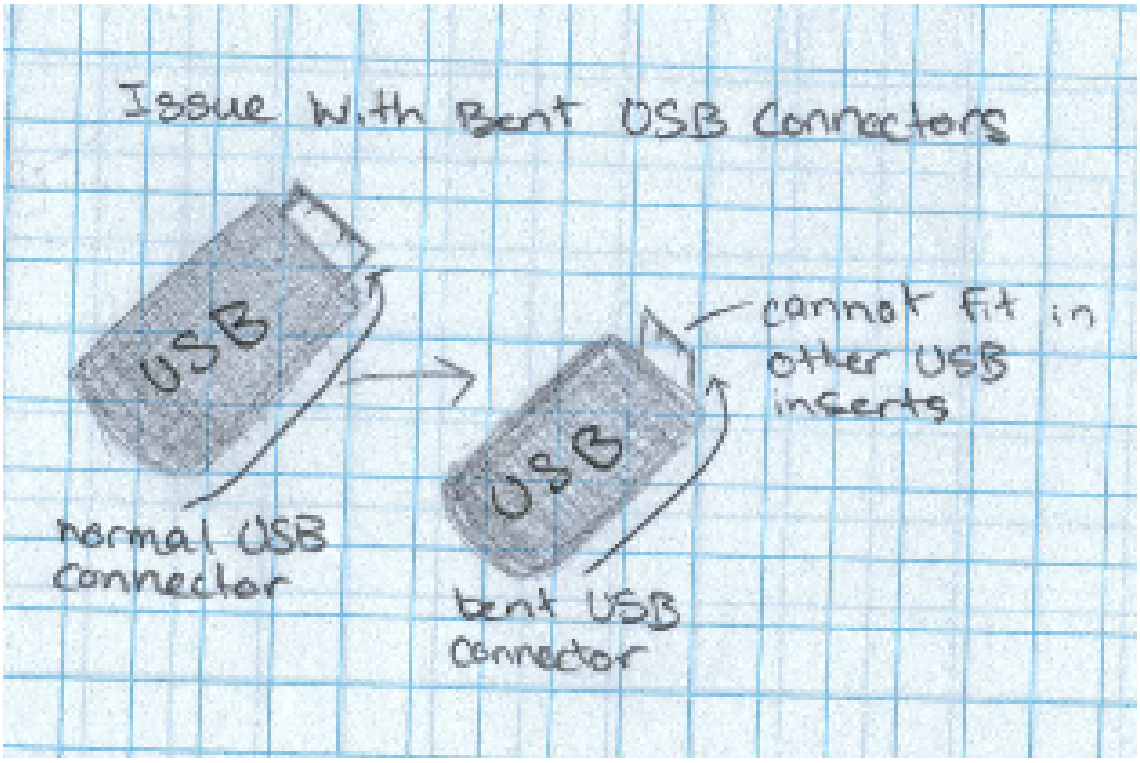
Meeting Date: Wed, 11/18/2015
Personnel Present: Harini, Irene, Maria, Namitha, Nandhana, Navyatha, Rushali, Sahana, Shamamah

Tasks This Meeting:
- Work on bake sale poster
- Refine plexiglass
- Create robot configure list
- Attempt to fix USB and Core Power Distribution Module issues
- Test and practice running robot

Reflections:



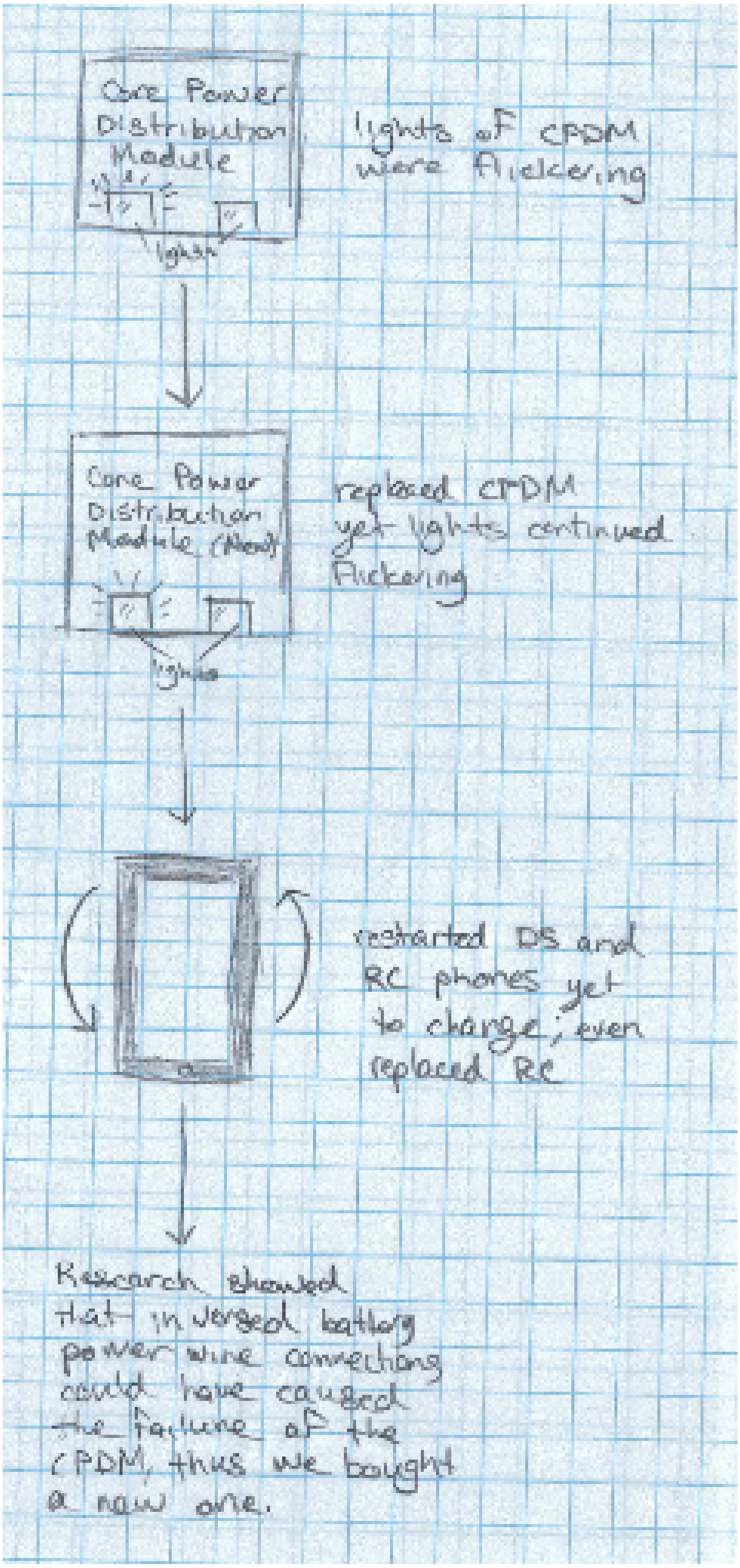
We broke into three groups: one that concentrated on creating a poster for the bake sale, another one for cutting and refining the plexiglass sheets on the left and back sides of the robot, and a third for testing the robot.



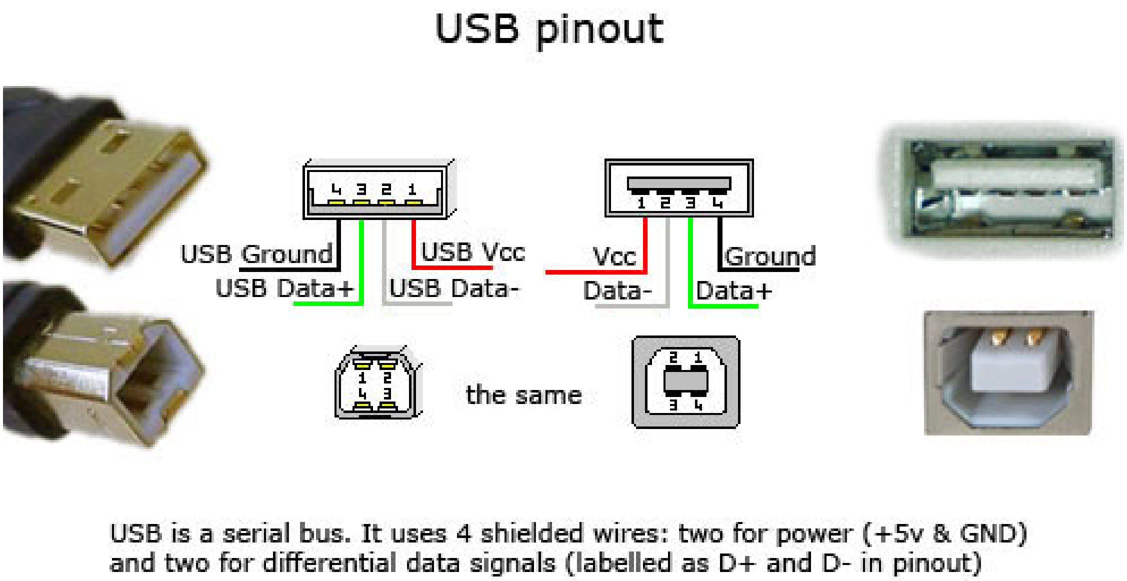
On the side of the robot testing, the recurrent USB and Core Power Distribution Module complications surfaced again. One thing was that several of our USB wires had bent USB connectors (the metal portion which is inserted into the other device), and when attempting at connecting the Robot Controller to the Power Distribution Module, the lights of the Core Legacy Module kept flickering, indicating there was something incorrect. In attempt to solve the error, we replaced the Core Power Distribution Module, though it had no effect. We restarted the robot several times and even switched the robot controller phones (we have four phones, three robot controllers and one driver stations), though it proved futile. Re-installing the FTC applications on the phone and changing the USB cable showed no improvements.

We hypothesized that the Core Power Distribution Module and/or Core Legacy Module had some sort of fuse or another issue, and thus we needed to purchase new ones. Doing a bit more research, we also found out that inverting the battery power wires could also damage the modules. That is something to consider, as careless battery connections could also have been the prime contributor to the issues we experienced.

Another thing we did was create a robot configure list so we could easily refer to it when setting up the robot controller application. It was just on paper as a simple list, so our coach instructed us that it might be a better approach to instead convert the list into a more visual chart or diagram that would be easier to remember.


Core Power Distribution Module
lights
lights of CPDM were flickering
Core Power Distribution Module (New)
lights
replaced CPDM yet lights continued flickering
restarted DS and RC phones yet to change; even replaced RC
Research showed that inversed battery power wire connections could have caused the failure of the CPDM, thus we bought a new one.

Overview of USB
The USB is also known as the Universal Serial Bus. The purpose of it is serve a method of communication, connection, and electrical supply between two electrical devices. Two main examples can be given by USBs that connect computer peripherals (keyboards, pointing devices, digital cameras, printers, portable media players, disk drives, and network adapters) and electronic devices. The USB has replaced many of the earlier interfaces, like the serial and parallel ports, along with separating power chargers for portable devices.



[1]

USB Connections
Physical USB connections are an obvious issue and contributor to loss of communication between electrical constituents of the robot. This may occur due to risky and jerky actions performed by the robot. It may also happen even when the robot is just slowly moving because a loose USB is vulnerable to be pulled out. To solve this issue, it is highly recommended to properly and securely fasten all modules and devices to the frame of the robot and make certain that all USB cables are secured tightly so they do not move during the running of the robot and risk unplugging. The two tabs of the male end of USBs make a clicking noise when they are inserted correctly, thus we have to make sure that we follow through with all USB cable connection protocols.

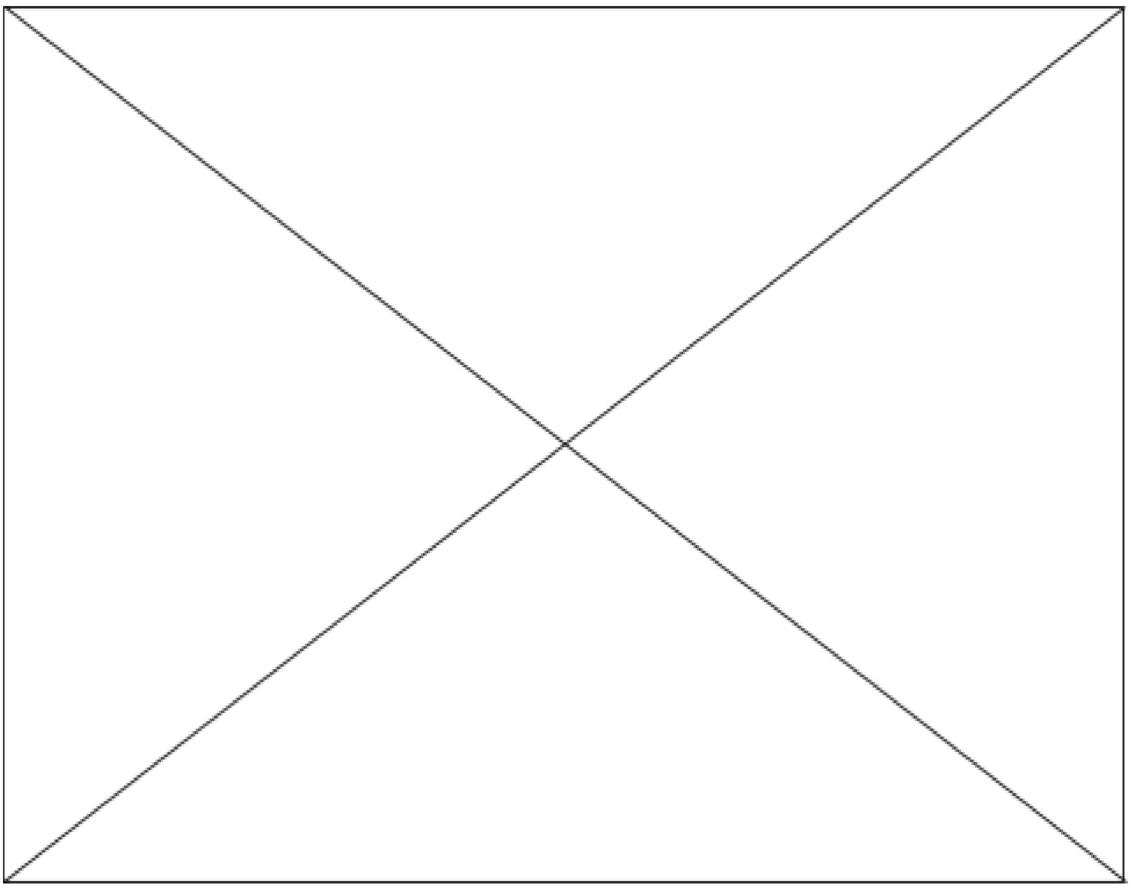
Battery Voltage Battery voltage is a crucial aspect of USB functionality. If the voltage is too high or too low in regards to the standard of twelve volts, it is expected that the USB module disconnection issues will arise. Battery power is also an issue, but it must drop a fair amount to show any changes. The Core Power Distribution Module has a built-in voltage regulatory which reduced the input voltage to 5V for the USB modules. However, if the voltage level on the main battery is low, large current draws

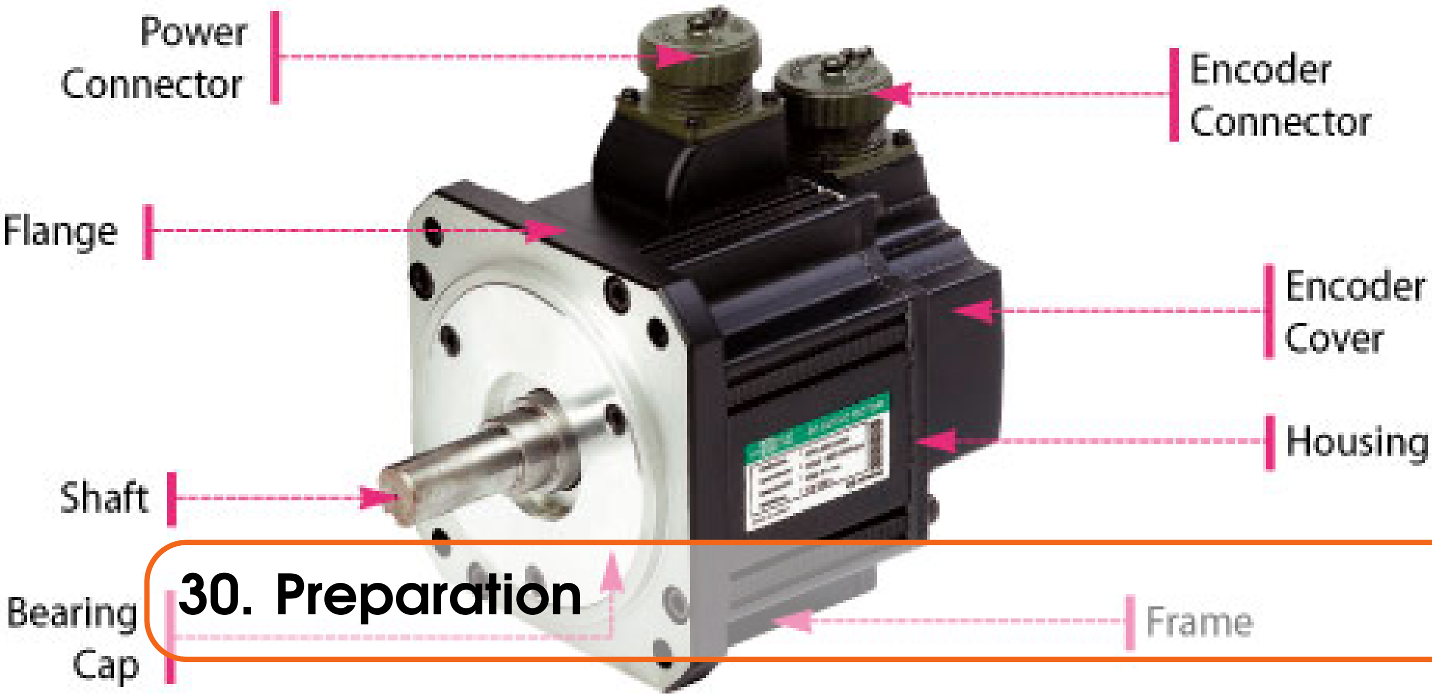
[1] Pinout.ru, "USB Pinout," 2015.

may cause the input voltage to drop enough that the Power Module fails to relay power to the other devices. When a test was done on a 12V motor on a 9.6V battery, it was observed that there was a loss in communication one the motor direction was reversed, most likely due to a drop in battery voltage. To fix such issues, paying close to the power usage is crucial. It is important to check the battery often and have a spare charged battery just in case.

Scanning Issues
Complications when scanning the robot for configuration are also possible. This can occur when the Core Power Distribution Module and the Robot Controller is unable to detect one or more of the USB modules on the Power Module's USB bus. Power cycling the robot, closing/re-installing the application, restarting the phone, and disconnecting the USB cable all seem to not work. This problem can be attributed to the error that happens when the USB microchips within the Core Power Distribution Module wait indefinitely to receive a reset signal as they are powered one, resulting n where one or more devices are not able to be detected on the USB bus. There is still more research that is to be made towards Modern Robotics and the reliability of their Power Module.

Submitted By Shamamah





30. Preparation

Meeting Date: Fri, 11/20/2015
Personnel Present: Shruthi, Namitha, Esha, Nandhana, Sahana, Rhea, Rushali, Maria, Ramya

Tasks This Meeting:

- Practice driving
- Discuss strategy
- Practice configuration
- Add sides to our ramp
- Create phone holder
- Inspect robot
- Add servo
- Solve connection problem
- Fix robot according to inspection regulations

Reflections:

Today, we started the meeting off with having a quick group meeting to specify what we need to accomplish today as a team in preparation for League 1. We double-checked the role assignment for League 1 to make sure that everyone knew their roles. We also checked the material checklist to make sure that we are taking all necessary items with us for the competition. We make sure we take items such as battery chargers, scissors, tapes, extra parts, etc.

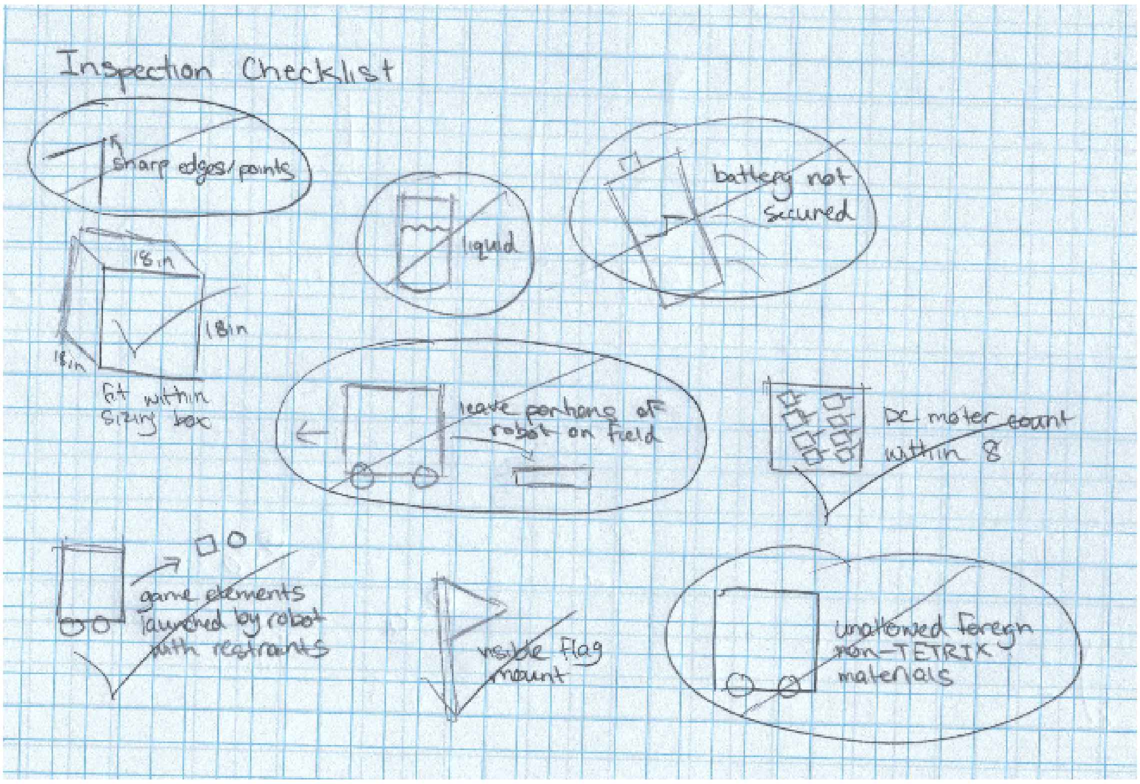
We then cascaded the meeting into some quick scrimmages. We discussed strategy and some creative ideas to have a more success in our runs such as:

- Picking up debris by aligning to the walls
- Pushing out debris using the back of our robot

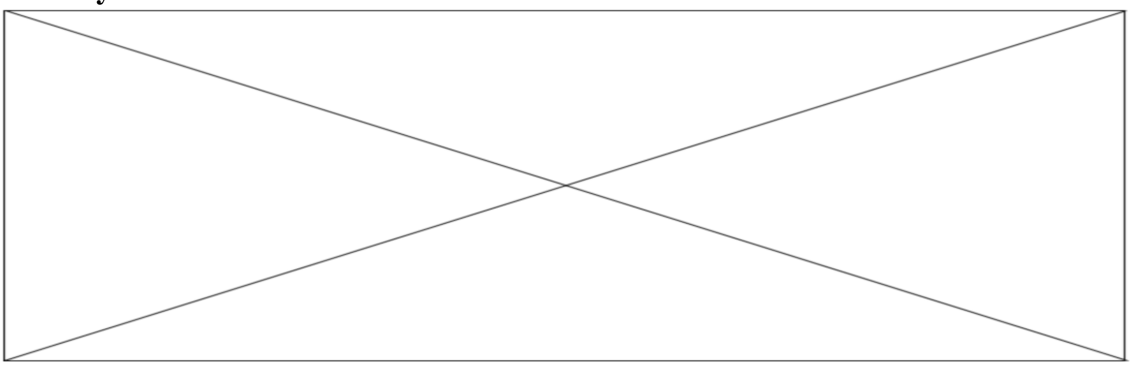
- Follow the balls
- Make sure to only carry five or less debris to the specified area
- Make sure to hit the climber releasing lever
- Lift the debris-collector up once collected at least one ball

As we finished our quick scrimmages, we realized that we need to make some changes to the robot. So according to inspection regulations, field regulations, and materialization that will help driving pass by more smoothly, we improved the robot, removing and attaching TETRIX parts.

We went over all inspection regulations, just to make sure that we have everything ready for tomorrow's league.



Submitted By Maria



31. League One and for All

Meeting Date: Sat, 11/21/2015
Personnel Present: Adithi, Aishwarya, Esha, Harini, Irene, Maria, Namitha, Nandhana, Navyatha, Ramya, Rhea, Rushali, Sahana, Shamamah, Shruthi

Tasks This Meeting:

- Get robot inspected
- Do field inspection
- Do well in all five matches
- Take note of other robots
- Learn and have fun!

Reflections:

Before participating in the first league, we did the following to prepare our robot:

Mechanical Inspection:

- Went over the inspection checklist
- Covered any sharp sides of our robot with duct tape
- Added any missing warning labels
- Made sure that there were no missing pieces, and that everything worked as intended

Electrical:

- Went through all the electrical components of the robot
- Checked battery power, all the wires were connected, no hanging potentially dangerous wires
- Took note of other teams' wire configurations

Scouting:

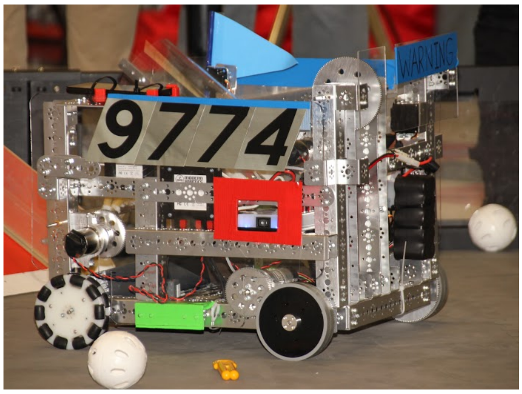
- Observed other teams' robots.
- Looked at the different mechanisms each team had.
- Thought about improvements and changes we could make to our robot, based on our findings.

Programming:
- Worked on an autonomous code for our next league.
- Autonomous program only worked for Red Alliance, for Blue Alliance, went to unexpected areas of the mat.

WiFi Problems:
Before the Competition:
We have done the following prior to the tournament, this led to more consistent results in our phones:

- Test connection between phones:
  A T
  9774-DS—> 9774-RC X X
  —> 9774-B-RC X X —> 9774-C-RC X X
- Install Wifi Channel app:
  9774-DS X
  9774-RC X
  9774-B-RC X
  9774-C-RC X

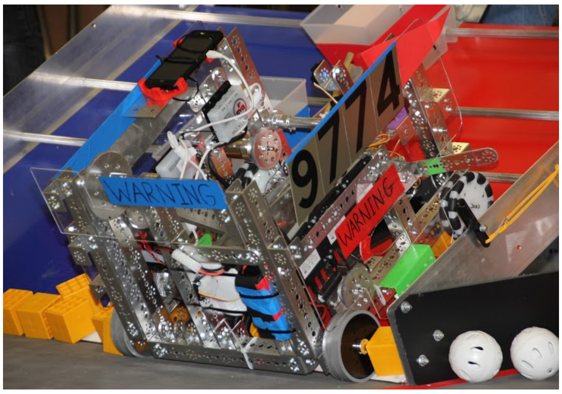
- Delete ALL previous configurations
- The State Machine Code which we have altered for our Autonomous includes an inconsistent climbing mountain state. We have decided to not include going up the mountain to be safe. To alter the code without making any permanent changes we have (at State: Locate Line) chosen the Next State as State Stop, which stops the program at the Rescue Beacon Repair Zone.

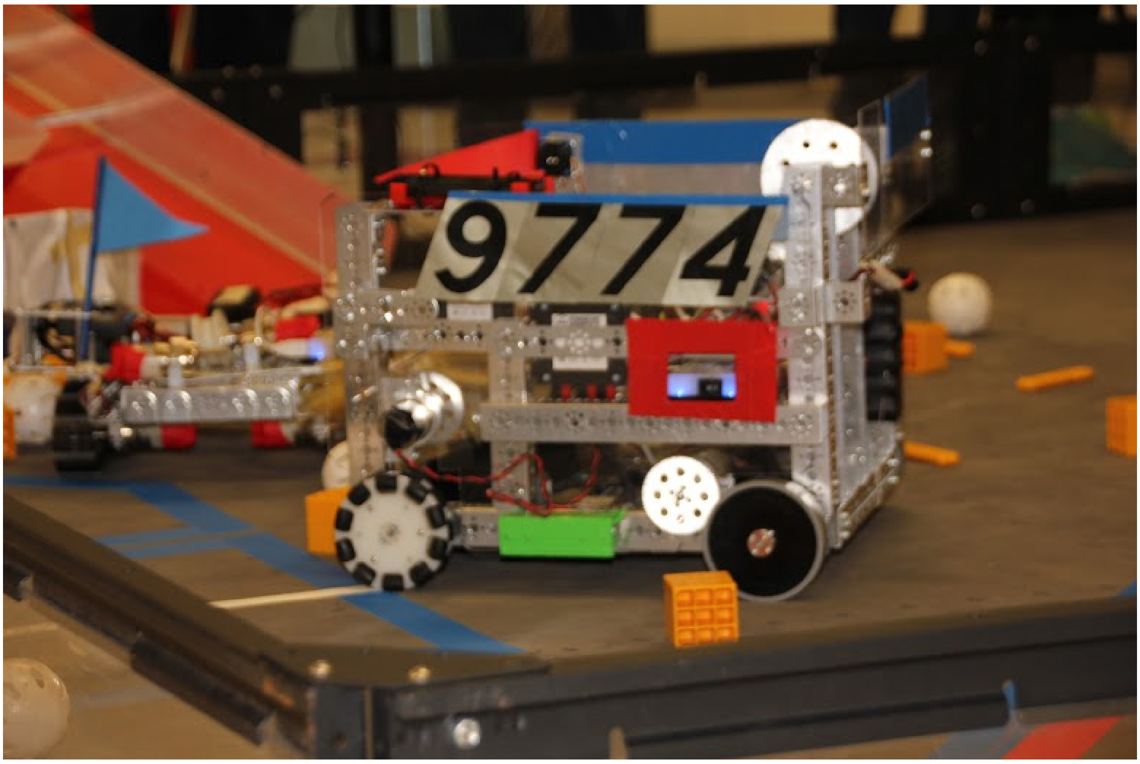


During the Competition

Wifi Issues: Because there are about 20 teams at the competition as well as the school's interfering Wifi, a bug in the software (known as the Black Screen of Death) caused many problems during the tournament. It causes the phones to completely restart.

Individual League One Experiences
As this is the very first league we have all done, we wanted all our members to reflect upon their first-league experience. Attached below are several of our personal submissions.





Shamamah:
League One was a very enriching experience for our team. We got to not only see how we as a team and our robot performed in a competitive setting, but also were able to take note of other teams and their robots.

To commence with the positive aspects of our team itself, we were able to communicate and work well with each other. However, we had a few issues with role assignments. Not everyone knew their task and even if they were told their job, not everyone actually worked and thus it caused some to do more work than they were required. To fix this, we should have a better system of assigning tasks and conveying that to everyone and make sure everyone understands what they are to do. For the most part, a majority of the team stayed on task and did something productive during buffer time, but it would not hurt to have a system which establishes that all members do something for ninety percent of the time.

In the obverse of our robot and mechanical performance, the abilities of our robot were well utilized. Within autonomous, we were able to move blocks into the repair beacon zone and park their, awarding us quite a few points. Something to note is that the referees had given us a warning for pushing more than five blocks at a time. We decided to do more research on their ruling, because we did not agree with them. To add in, our autonomous code does not do anything else but move the robot, thus we need to increase the capability of our robot during that beginning period. The depositing of climbers into the beacon repair bucket during autonomous is rather simple, so we should consider it. Also to include, the IR beacon repair strategy has been on our pending list for quite a long time, and it is time that we get it done.

During the driver-controlled period, we were capable of collecting debris and depositing them into the bins, move game elements into the beacon repair zone, and climb up to the low zone of the mountain. Though, it would be better if our robot encompassed more functionality. Duly noted, we only attempted releasing the climbers once, and that only release one of them. Thus, we should work on a better climber-releasing mechanism. One more point to make is that we need a better approach toward moving the debris in front of the mountain. Our robot does not do well when driving over blocks and balls, thus it is crucial entailment that we create an effective method that will allow us to move the items without taking too much time.

Additionally, during the end game period, our robot climbed up to the low zone of the mountain, and because we do not have a stable system which allows the robot to stay upon the mountain, our robot began to slip down. Hence this subsequently led us to accidentally driving the robot even after the game had ended. We were supposed to get a major penalty, but because it was our first match, the referees let us go that one time. This experience leads us to prioritize the task of creating a design which make certain that the robot does not slide down the mountain. We were thinking of having an arm-like mechanism where we have extensions with hooks at the ends of them grab onto the above metal horizontal parapets, and hoist the robot up. This will both keep our robot stable on the mountain and enable it to go farther up.

With the topic of the software, we experienced a few troubleshooting errors with connecting the robot controller. We, along with many other teams, also had these problems at League Zero. This was due to the fact that there was a rogue character in the venue's wifi name, and thus cause errors in wireless connection with the phones. Also, during the game, in one of our matches we came upon a complication where a pop-up came up, pausing our robot for a few seconds. Even though it did not affects our scoring, every second is still precious, and we do not know when a pop-up could postpone the working of our robot for even prolonged amounts of time. Thus, we have set the task where we disable all other applications and settings on the phones other than the FTC applications.

Also, the drive-team will need more practice. They did well on the playing field overall, but strategy was slightly lacking. We need our drivers to be well aware of the controls and abilities of the robot, and how to make last-second decisions. As mentioned before, we only attempted releasing the climbers once, and it would have been better if we had done that more. We wasted too much of our time climbing up the mountain, and that did not even give us a large amount of points.

We also took note of other teams' robots. Something that stood out were the divergence in wheels. Our robot utilizes omni-wheels in the front and stealth wheels in the back. These were competent in helping the robot climb the mountain, but it seems other teams whom had used all-terrain wheels were more successful. This may have been to the increased traction of the wheels and their ability to stably grab onto the mountain.

As noted above, the arm extension with the hooks at the ends were extremely fruitful with other teams. Nearly all the teams in the top three had used that method to get up higher the mountain and gain large sums of points. Also, nearly all the other robots were very small and light. Most of the weight the robot had was concentrated on the front and sides, just anywhere that is not the back. Our robot is rather heavy and that explains why we have trouble with climbing up the mountain. We cannot do much about it without changing the entire robot, thus as we refine and work more on the robot, we will have to be keen to the weight distribution.

Aishwarya:
My experience with league one was interesting and a good learning experience. There were many different designs at the league which only some were capable of going to the ramp. I also noticed that we were the first to put the debris into the basket. I do agree with Shamamah that we were not clear with our roles since a few of us were the field re-setters while we were supposed to do our roles. We did well at collecting the debris and putting it in the basket. This prove that our attachment worked well. Even though there were slight problems with our robot almost collecting too many debris at some point which we are thinking of a solution for it. Over all I agree that we did well with the league but may need some practice.

Rhea:
League 1 was an amazing learning experience. It was really fun and our team did well. We accomplished many things we couldn't do in League 0 such as climbing up the mountain and even released the climbers, but are hoping to put that in our autonomous. We had a couple issues too. Our wheels didn't have enough grip on the mountain so we weren't able to move up as high as hoped and were thinking of changing them(the wheels). We also had some trouble with the debris. And because we agreed to be field re setters at the last minute some of our roles were messed up and not everyone was able to attend to their technical job, mechanical and electrical, but other than that it was really fun and again, a great experience.

Harini:
League 1 was a great experience. It was my first league since I missed League 0. Our robot was pretty successful. Many robots had a problem of going over the ramp. As Aishwarya and Shamamah had said many of the members including me, were on or near the field to reset it. Because of that we couldn't do our assigned roles between the tournaments. Regarding the ramp I noticed that a few teams had wheels with sheets of material inserted so they would hold on to the bars on the ramp/mountain. And if I am right I believe that the team with the conveyor belt wheels had a hard

time getting up the ramp. Over all this was a great experience and a nice way to see how other teams are doing with friendly competition.

Navyatha:
League 1 was definitely a fun, educational and exciting opportunity. During this event, our team showcased our robot in a friendly competition all while gaining lots of information about other team's robots, and learning about different improvements that could be made to our own robot.
Throughout the competition, our robot did pretty well in terms of accomplishing tasks like climbing up the mountain and collecting/placing debris into the bins. However, we still had a few problems such as:

Releasing Climbers:
Throughout our matches, we only managed to release the climbers from the zip-line once. In the future, we should definitely think of an effective strategy for releasing the climbers during the autonomous or driver control period.

The Wheels of Our Robot Were Not Sturdy Enough:
During the end game of one of our matches, our robot ended up slipping while attempting to climb the low zone of the mountain. On the other hand, robots that were extremely successful while climbing the mountain had wheels that were made of strong rubber. So, in the future, it would be better to switch the back wheels of our robot to rubber wheels, which would allow a better grip.

Role Assignments:
For League 1, our team created a spreadsheet with different roles for each member during a certain match. However, this idea turned out to be pretty unsuccessful, mainly because some of the team members had to re-set the field, and ended up missing their assigned slots. In the future, we hope to create a more effective and efficient plan that assigns a role for every team member.

Overall, our team definitely enjoyed the first league and we gained a lot of knowledge through this experience. For example, one of the robots had a sturdy arm attachment while another robot had wheels with metal inserted, both of which helped the robots climb the mountain better. In the end, we all had a good experience in this league and look forward to many more fun and exciting competitions.

Adithi:
Going to League 1 was a great experience! It was our team's first actual league. Our robot did really well compared to the other robots. A lot of the robots had trouble going up the hill and they kept on flipping over. However, one robot did go up to the mountain zone on the hill. The team had an arm that extended and hooked onto one of the rungs on the hill and that pulled the robot up to where the arm was. We could use an idea like that on our robot to make it more successful. We could also change our back wheels to wheels with rubber on the outside, so the robot can go higher on the hill, since the teams with rubber tires are doing well.]

Since in League 0, a lot of our team members didn't have much to do, this time we made a spreadsheet with the roles of our team members for each of the five matches. That didn't work out as well as we hoped it would because some of us had to help with re-setting the field, so we missed some of our roles for the matches. So for the next league we have to find a better way to give each team member a role.

Overall our experience was great and we learned a lot from our first league!

Namitha:
Our League 1 was a really good opportunity to test our robot for the first time and we were very successful in doing so. For all five of our matches we were able to get our robot configuration up and running despite all the wifi confusion that a lot of teams were facing. When the error did occur we found the best solution to be going outside and re-pairing the phones using the Pair With RC setting NOT Wifi Direct. Also we learned to plug in EVERYTHING before actually turning on the power to the robot. It was a really good learning experience working with these technical difficulties because we were able to learn how to solve them on the spot.

For the matches we found that our Autonomous needs to be tweaked so it won't go as far into the Beacon Repair Zone but it was able to sometimes get the 5 points. We were currently using the first three "states" in the State Machine program. We did get an opportunity to test out the full program in our last match, State Drive to Beacon needs to be corrected to fit our robot's needs since it doesn't entirely end up in the Beacon Repair Zone by the end of Autonomous.

For the Tele-Op period we should focus on getting more debris into the basket because that receives 5 points each rather than Floor Goal which is only 1 point each. A major problem was debris blocking the mountain because it stopped us from climbing up to the Low Zone and hitting the climbers. We need to think of a mechanism which will move the debris but still keep in check with the rules (GS-7 in Game Manual P2 regarding the 5 debris rule). We need to make our robot work the same for both alliances because it really affected our scoring.

I think a good strategy to focus on would be to focus on moving the debris into the floor goal first (maybe by going reverse on the sweeper as we move) and then spending the rest of the Tele-Op collecting lot's of debris scoring into Low Zone Mountain Goal, and by end game having an easy path to climb up to Low Zone and then release the Low Zone Climber. Something we should think about is moving the placement of our robot's electrical components so that it will the weight is balanced and we can climb up higher on the mountain.

Overall it was a really successful league and although we have a lot to work on in the coming weeks there is still a lot we learned and accomplished through this!

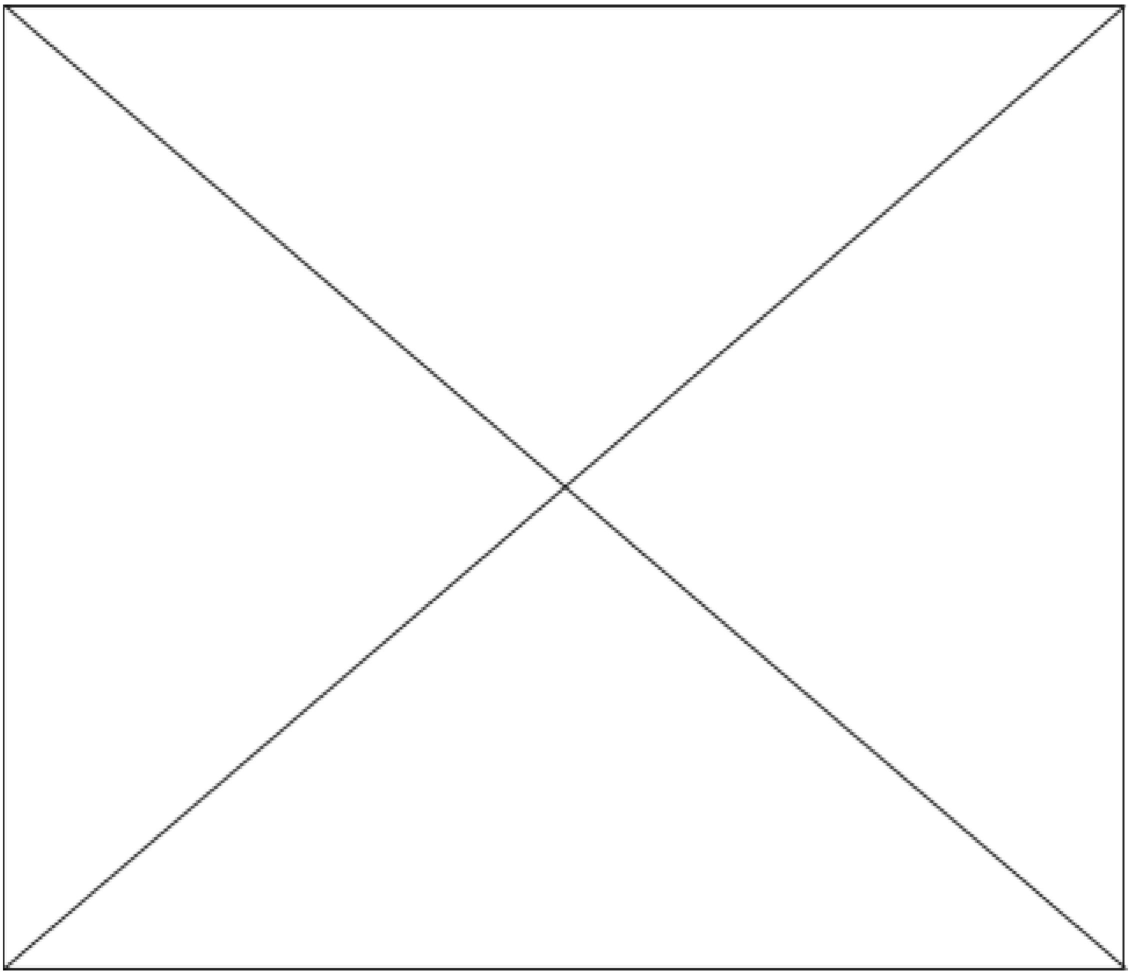
Nandhana:
League 1 was very successful. We were able to test our robot in a competitive setting for the first time, during our practice league the WiFi problems were not yet discovered so we were unable to drive our robot.

Because of the WiFi network of Hillsborough High as well as the many teams WiFi distractions our phone faced multiple problems. We were using 3 Robot Controller phones and 1 Driver Station phone, which worked well. Before hand, Namitha and I had configured and re-downloaded the programs so everything was good to go before the tournament. The best method that worked was connecting everything and then starting on the robot. During the tournament however they asked to power off our phones before the match which led to our phone doing the “Black screen of death”. To fix this bug we exited the tournament area and (in isolation) paired the two phones, then we returned to the pit where we connected the phone to the robot. At first we tried only taking out the Driver Station phone because that was the only one with the problem, but we realized that the connection would fail once we got near because it was searching for other connections, which it should not do. Though we had to go through this before every match our robot still worked for ALL the rounds!

Our Autonomous was changed the morning of the tournament: we stopped the program before climbing the mountain and we were able to score 5 points in one or two of the rounds. However in the last round we put back in the climbing mountain state and though it did not work, we were still able to understand what was needing to change. We need to come up with a stronger teleop strategy, but we were the first team in both leagues to score into the mountain goals. We ended in 7th place- which is good for a rookie!

Irene:
My league 1 experience was an educational one. We learned the debris in front of the mountain can make it very difficult for our robot to move the mountain. Robots from other teams actually got stuck on top of the cubes and were unable to move. We also learned how to communicate with other teams about our robot and its capabilities and how to work with teams who may have had the same capabilities. We also encountered a problem with our phones constantly resetting right before our matches. It was caused by a new line issue from all of the interfering WiFi. However by pairing the phones away from school and in the parking lot we were able to get the phones to function. There was some confusion with the role sheet because our team volunteered to reset the field and some of the jobs were not needed for every match. This caused some members to nothing to do before the matches. We were able to pass both the inspections easily and the inspection team did their job well. We had some problems in the driving portion of the matches because our robot would get stuck in front of the debris. One of our actions items is fixing this problem. We also got in some hot water for moving more than five debris at a time during autonomous but it is difficult to fix that when we are not directly controlling the robot at that time. We came in 7th out of 18th place for league, which is good for a rookie team. Hopefully as we continue to participate in leagues, we will do better.

Submitted By Namitha



32. Looking Back on League One

Meeting Date: Sat, 11/28/2015, 2:00 PM - 5:00 PM
Personnel Present: Adithi, Aishwarya, Rushali, Shruthi, Nandhana, Namitha, Navyatha, Shamamah, Sahana, Ramya, Irene, Maria

Tasks This Meeting:

- Reflect on League One
- Work on the autonomous code
- Work on the motor of the robot (for the debris mechanism)
- Assign homework for each team member

Reflections:

We started off today's meeting with a discussion about the results of last week's league, which is summarized in the following list:

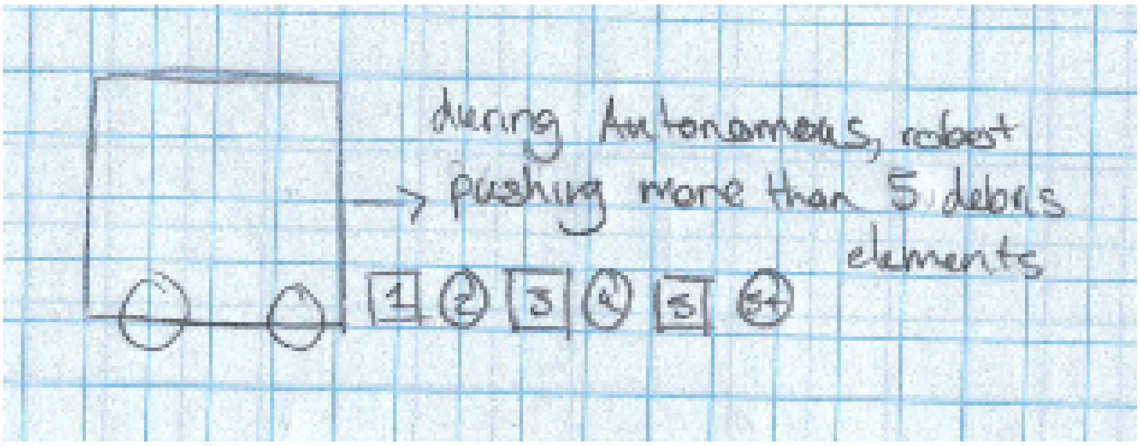
Issues

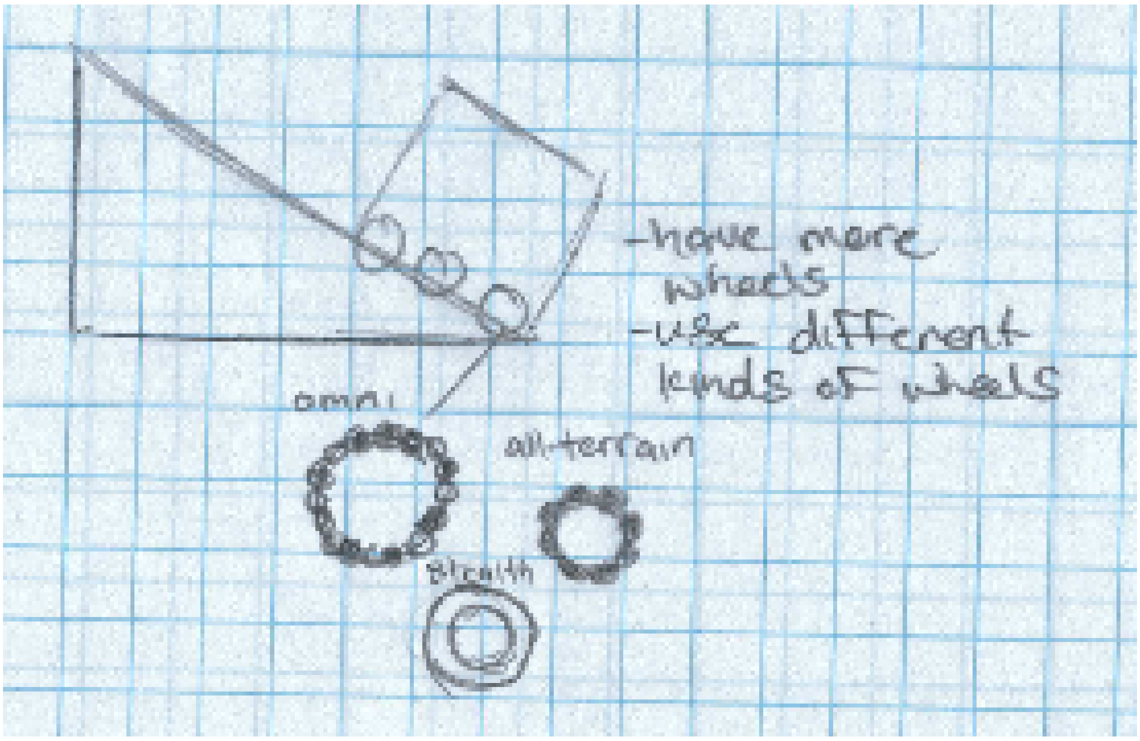
- The referees warned us about our robot holding more than five blocks/cubes during the autonomous period.
- During the teleop mode and after the end game, we experienced issues where our robot slipped down the mountain.
- We had a pop-up on the driver station phone, which hindered the movement of our robot for a few moments.
- Our plan for having assigned roles for each member did not work as intended.

Improvements

- We assigned homework where each team member would discuss their perspective and research about the topic relating to the robot holding more than 5 pieces of debris.
- We decided to come up with a better way to reinforce the different roles each

member has during a league.
- We decided to have more practice sessions, where the drivers would practice driving our robot.
- We determined that we needed to have more contributions of all the team members to the engineering notebook.





Talk with Ramesh Uncle
During today's session, we also had an informational phone conversation with Ramesh Uncle, both a close friend of our team and a volunteer at the FTC leagues. He went over the following obverses of what he noted about our performance and robot. One of the main things he covered was the need to work on the range of functionality of our robot. We also needed to...

1. Work on a system of depositing the climbers into the beacon basket during the autonomous period.

2. Work on releasing climbers during the driver-controlled period.
3. Come up with an efficient and effective beacon repair strategy.
4. Design a mechanism for our robot which will allow it to hang on the cliff bar during the end game.
5. Think of a better approach towards climbing up the mountain.
6. Work on a better design option that will not cause our robot to slip whilst climbing the mountain.

Homework

Due to the results of League 1, we determined that we needed to work upon certain aspects. Below is the list of homework we assigned for all the team members:

1. Create a sketch of a possible debris-collecting systems which can efficiently pick up both balls AND cubes.
2. Continue revising and contributing to the engineering notebook.
3. Write a one-page summary of what you learned from the league experience.
4. Write a one-page summary on the topic of the rule relating to the robot pushing more than five debris elements during the autonomous period.

Autonomous 5+ Debris Collection:

<GS7> Debris Possession/Control Constraint - Robots may not Possess or Control more than five Debris (cubes or balls) in any combination. If a Robot is Possessing or Controlling more than five Debris, the Alliance will incur an immediate Minor Penalty for each Debris above the limit plus an additional Minor Penalty per extra Debris for each five second interval that this situation continues.

GS8> Debris Score Value During the Autonomous Period - At the conclusion of the Autonomous Period, Debris has zero Score value. Debris contributes to the Alliance Score only at the end of the Driver-Controlled Period. Robots are allowed to collect Debris subject to the limitations of rule <GS7> and place Debris In Scoring Areas during the Autonomous Period.

Inadvertent - An outcome that is not a planned strategy and not the predictable result of persistent or repeated actions.

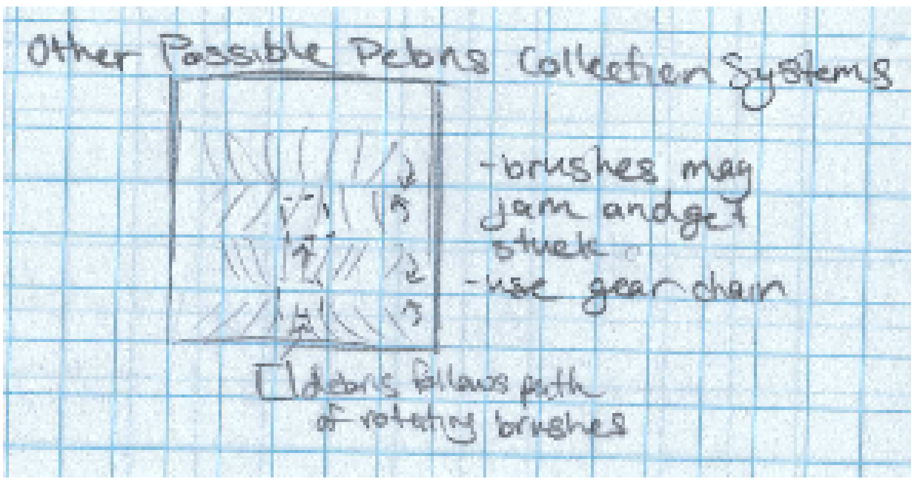
The rule book implies that even in the Autonomous period the robot is only allowed to collect at the most five debris. However since it say's “collect” not “posses”, the difference could mean that pushing the debris does not occur in a penalty. Additionally this action would be “Inadvertent” because the program is completely unintentional since drivers can not control what's going on in there. This shows that our robot pushing the blocks during the Autonomous period should not receive a penalty in accordance to the rule book.

During League One, our team had been given a warning by a referee that we were not able to push more than five debris elements during autonomous. Because we were not aware of the rule, we were excused of any penalties, yet we were still skeptical of their ruling. Hence, we sought out to do more research on the complication and validate the referees' warning to us. My personal stance on this complication is that the referees were correct to warn us.

To commence with, to be considered to be in control of a game element, the robot must be, for example, "pushing an object on the Playing Field floor, or holding or carrying an object. Objects that are Controlled by a Robot are considered to be part of the Robot." To further explain, the game manual goes on to explain that "An object is considered to be in Possession by a Robot if, as the Robot moves or changes orientation (e.g. moves forward, turns, backs up, spins in place), the object remains in approximately the same position relative to the Robot. Objects in Possession of a Robot are considered to be Controlled, and they are part of the Robot." This thus clears any doubt on whether or not our robot was indeed in control of the game elements.

With that facet of possessing of game elements proven, the other part to be justified is that our robot is allowed to control more than five debris elements during autonomous. As the game manual quotes, "Debris Possession/Control Constraint – Robots may not Possess or Control more than five Debris (cubes or balls) in any combination. If a Robot is Possessing or Controlling more than five Debris, the Alliance will incur an immediate Minor Penalty for each Debris above the limit plus an additional Minor Penalty per extra Debris for each five second interval that this situation continues," which is later supported by rule <GS8>. Though, the game manual also says that "Plowing (bumping, moving, touching, etc.) Debris located on the Playing Field floor is allowed and does not count towards the five Debris Possession/Control constraint if the movement of the Debris is not purposeful. Debris will be scattered around the Playing Field and some interaction between Robots and Debris is expected and should not be Penalized, provided that the Robot is not deliberately Controlling the Debris." This thus brings upon the obverse of purpose which is something that can only be assumed. But in our case, we actually had the intent of moving the debris for scoring, and thus deserve the penalties.

To avoid such a dilemma, we must either make sure that our drivers are trained to be careful to not accidentally control more than five debris elements or create a mechanical system that will prevent this from occurring.



Submitted By Navyatha

33. League Two Be or Not To Be

Meeting Date: Sat, 12/5/2015
Personnel Present: Adithi, Aishwarya, Esha, Harini, Irene, Maria, Namitha, Nandhana, Navyatha, Ramya, Rhea, Rushali, Sahana, Shamamah, Shruthi

Tasks This Meeting:

- Go over the inspection checklist.
- Made sure that there were no missing pieces, and that everything worked as intended.
- Observe other teams' robots.
- Went over the different electrical components of the robot, and made sure everything was working.
- Check the battery power and made sure the two android phones were fully charged.
- Made sure all the wires were connected, and that there were no hanging or dangerous wires.
- Observe other teams' robots, and took notes on their designs.

Reflections:

Today we all went to our second league. League 2 was a great learning experience. There were a total of 15 teams. In league 2 we all knew how the league went so we were a lot more organized. We made a better spreadsheet of all of our roles including the field re-set up people. For all the matches we showed our alliance partners where we had to put our robot for the Autonomous. This league we didn't have any problems with our WiFi, but our robot still didn't do as much as it could've done. For example in the matches our robot was capable of doing the zipline climbers, but we didn't have enough time to do it.

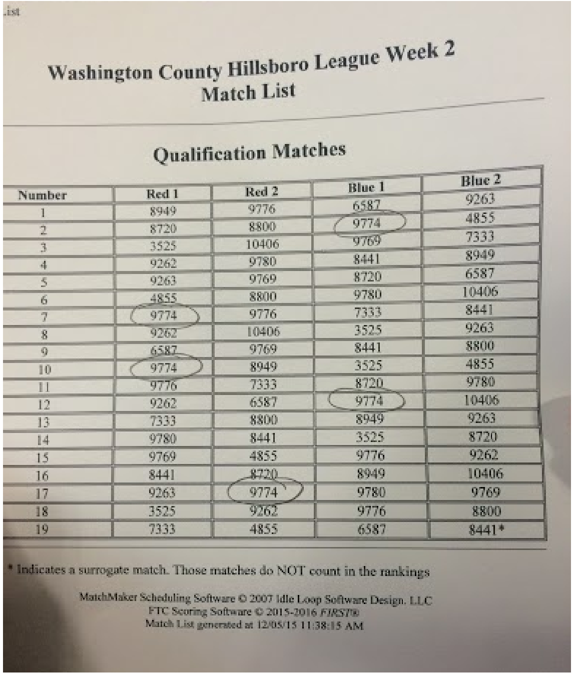
In one of the matches we tried putting the two climbers, that we had, in the shelter using our debris collecting container. That didn't go so well because we didn't know where the robot had to be in order for the climbers to fall in the shelter. For the next league we decided to find the exact spot where the robot had to be for the climbers to fall in the shelter, so we could get additional points for that.

Also in another one of our matches, a robot bumped into us and our USB cable fell out so our robot couldn't move for the match. Our team thought the other robot should get a penalty for bumping into our robot, but the referee said our USB cable was loose and we had to make our connections tighter. For League 3 we decided to change our connectors so they wouldn't fall out and make our connections tighter.

Figure 33.1: Our team discussing strategy (left) and Irene and Namitha waiting for the next match, our match, to begin (right).

In league 2 we got 14 out of 15 places. We got 14th place since we didn't win most of our matches and our robot would stop working sometimes.

Team 3525 was very kind to teach us about their IR beacon design and strategy. Their design encompassed of a climber dumper which was positioned at the top and posteriorly and was worked by a single servo with on degree of freedom, front and back. Downwards toward the middle of the back of the robot was a horizontal shaft with two cube-like protrusions which would press the corresponding beacon light. The shaft was connected to a servo in a way so that it would oscillate back and forth to move the pushers forward. Above the right button pusher was a color sensor which would read if whether or not the color detected was blue. If not, it would indicate that the color was red. Also, near the bottom was a touch sensor that would extend in and out that would control the distance the robot maintains from the beacon. A color sensor at the bottom was allotted to allow for detection of the white line, because the robot would first sense the white line and square against the wall to position itself for the IR beacon task.



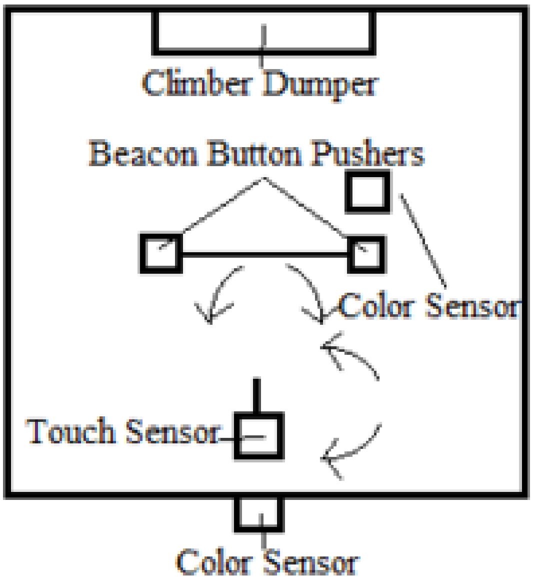
Washington County Hillsboro League Week 2
Match List

Qualification Matches

Number	Red 1	Red 2	Blue 1	Blue 2
1	8949	9776	6587	9263
2	8720	8800	9774	4855
3	3525	10406	9769	7333
4	9262	9780	8441	8949
5	9263	9769	8720	6587
6	4855	8800	9780	10406
7	9774	9776	7333	8441
8	9262	10406	3525	9263
9	6587	9769	8441	8800
10	9774	8949	3525	4855
11	9776	7333	8720	9780
12	9262	6587	9774	10406
13	7333	8800	8949	9263
14	9780	8441	3525	8720
15	9769	4855	9776	9262
16	8441	8720	8949	10406
17	9263	9774	9780	9769
18	3525	9262	9776	8800
19	7333	4855	6587	8441*

* Indicates a surrogate match. Those matches do NOT count in the rankings

MatchMaker Scheduling Software © 2007 Idle Loop Software Design, LLC
FTC Scoring Software © 2015-2016 *FIRST*®
Match List generated at 12/05/15 11:38:15 AM



Above is a brief diagram of their design. Note that the "Climber Dumper" and "Color Sensor" portions do not represent the actual positioning, but the general location for the implementation.

Programming
Overall, the inspection and pre-game process went pretty well, although it took much longer than expected. In the future, we hope to utilize our time better and make sure our robot is 100 percent ready for the league ahead of time.

Matches

- Arm extension mechanisms worked really well.
- Threads and all-terrain wheel helped the robot stay on the mountain.

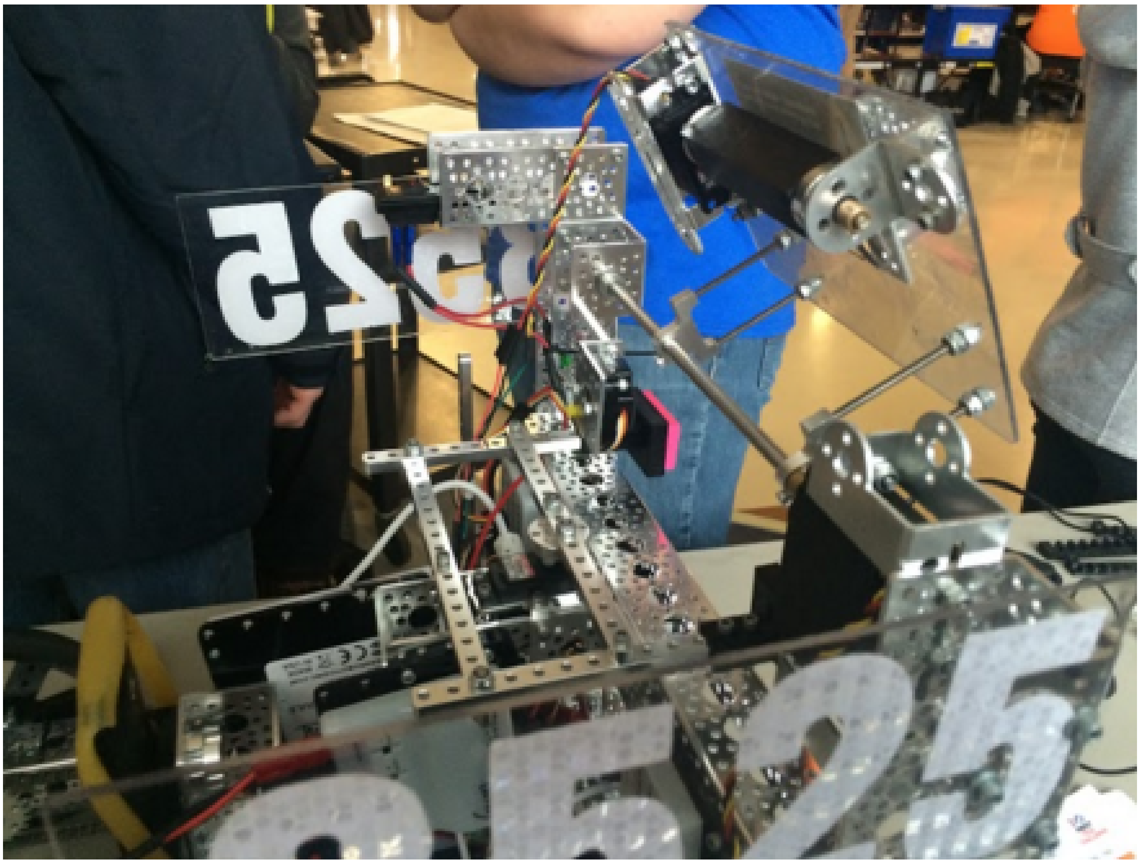


Figure 33.2: An actual photograph of team #3525's Beacon Repair system.

- Bowl mechanism was good for collecting debris.
- Flat sheet helped in pushing debris.

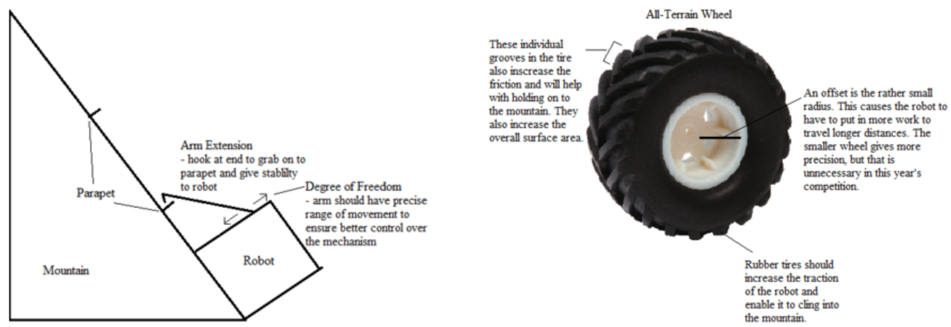


Figure 33.3: A diagram explaining the arm-like extension idea (left) and a diagram explaining the all-terrain wheel (right).

Problems/Errors

- During Round 1, we had a problem with our ZTE phones and while trying to fix the problem we overloaded the robot's capacitor and were unable to move for the round. However, by giving the robot time to reboot, we were able to make the robot function during the next round.
- During Round 2, our arm would not move up and down because there was a screw missing. This caused us to lose points but we were able to fix the arm later.
- Debris getting stuck in the robot (we need special casing)'
- Drivers were uncoordinated and the drivers changed.
- Strengthen the wires and connections.
- USB - problems connected.
- Robot rammed into our robot, causing our connection to fail.

Future Improvements

- We still need to work on an effective autonomous code for different positions on the fields.
- The roles worked better overall, but some complications still occurred.
- ZTE phones: During both League 1 and League 2, we continuously had many problems with our ZTE phones, which hindered the movement of our robot during a few matches. In the future, we hope to practice more and test out our phones ahead of the league. That way, we will have more time to fix any problems that may occur.
- Some kind of mechanism for the side, for pushing in debris.

What We Learned

- We learned to not constantly turn on and off the robot since there is a capacitor inside, and we have to wait for it to drain; the suggested wait time is 30 seconds
- Working together as a team
- We shouldn't switch out

Submitted By Shamamah

34. League Three Groups of Five

Meeting Date: Sat, 12/19/2015
Personnel Present: Nandhana, Namitha, Maria, Irene, Shamamah, Rushali, Shruthi, Ramya, Adithi, Sahana, Aishwarya, Esha, Harini

Tasks This Meeting:

- Get Robot Inspected
- Do Field Inspection
- Do well in all five matches
- Drop climbers in shelter
- Do zip line climbers
- Have fun!

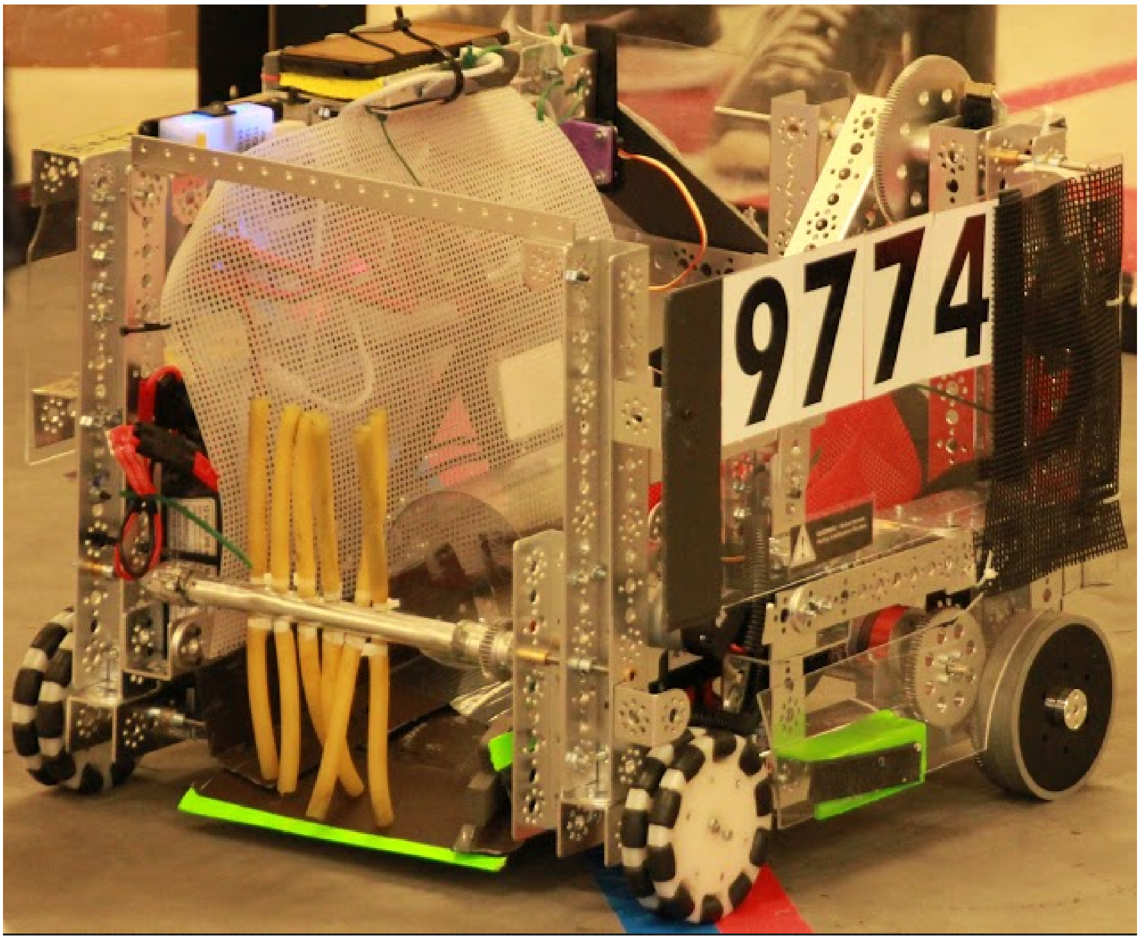
Reflections:

Today we had League 3. We learned a lot from League 2 and planned on going a lot better this time. We didn't have an Autonomous this time because we were still working on making it better. In league 3 we all observed all the matches to see what we could do better and what we did well. In the inspections we had no problems and our robot was fine.

In more detail, our robot inspection went smoothly. The only issue we had was the recurrent sharp edges. Field inspection also went well, the only concern begin that the motors moved backwards for some odd reason for just a second. We will have to go back home and look at the code to see what could have caused that, or possibly a mechanical complication had caused it.

Before all the matches we made sure everything was intact. We tried going though the roles and this time they actually went well and everyone had something to do. I guess the fourth time is the charm! Nonetheless, we also ziptied all the USB wires

so they do not have the possibility of getting caught in other things. We also added a sliver of foam to the phone mount to cushion it and redid the phone mount portion (mostly because the USB wire was bending in the previous arrangement).
Along with seeing how our robot preformed, we only took note of out other robots did. Listed below are notes we observed whilst watching the matches.



- Treads help with moving other robots
- Multiple wheels are helpful in climbing the mountain
- Getting stuck on debris is a common thing
- Large wheels are also well-suited for the mountain
- Should really consider less weight
- Difficult to score in Low Zone Goal when other robots are in front of mountain
- Not effective is just collect debris from beacon area
- Arm-like extension for climbing mountain
- Could not activate climbers because protrusions too short, and also cannot climb up mountain high enough

In League 3 there was a practice field so we looked at the exact position of our robot to drop the climbers in the shelter. Once we found the right position, we did a lot better with releasing the climbers in the shelter in the matches. Sometimes we got both climbers in and sometimes we got only one in the shelter. We gained points from doing that and we also earned points from doing the zip line climbers. In some of the matches we couldn’t do the zip line climbers because the bar attached to the servo wasn’t long enough, so before the Championship we decided to make the bar longer. In league 3 we won all of our matches except the fourth match and our ranking for league 3 was first place!!! Overall we got 6th place! This was our best league yet since we had a lot more experience since league 0. We also were a lot more organized and prepared.

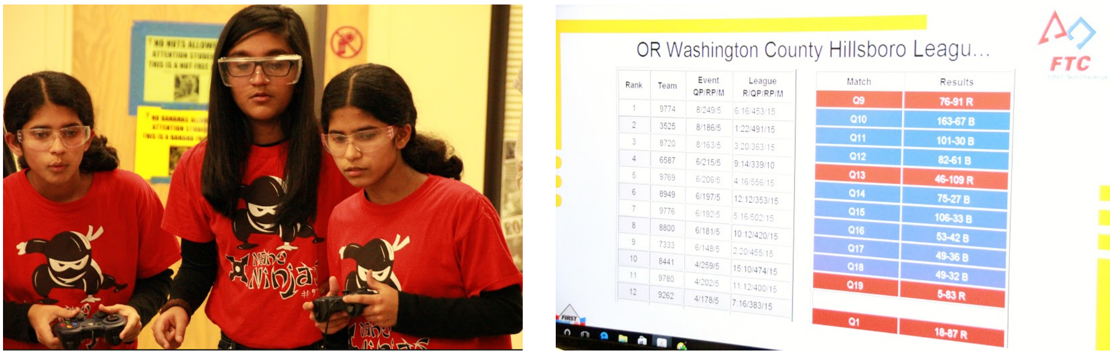


Figure 34.1: Nandhana, Maria, and Namitha as the drive team (left) and Nano Ninjas win first place (right).

Match Scores

Match 1 (Red Alliance):
- Total points - B: 80 R: 50
- Penalty points - B: 0 R: 60
- Final score - B: 80 R: 110
- WE WON!!! :)
- Rank 3

Match 2 (Red Alliance):
- Total points - B: 35 R: 87
- Penalty points - B: 0 R: 0
- Final score - B: 35 R: 87

Figure 34.2: Left to right, back to front: Adithi, Sahana, Aishwarya, Harini, Esha, Shamamah, Shruthi, Ramya, Maria, Nandhana, Irene, Namitha, Rushali.

- WE WON!!! :)
- Rank 1

Match 3 (Red Alliance):
- Total points - B: 56 R: 91
- Penalty points - B: 20 R: 0
- Final score - B: 76 R: 91
- WE WON!!! :)
- Rank 1

Match 4 (Blue Alliance):
- Total points - B: 46 R: 109
- Penalty points - B: 0 R: 0
- Final score - B: 46 R: 109
- We Lost :(
- Rank 2

Match 5 (Blue Alliance):
- Total points - B: 49 R: 32
- Penalty points - B: 0 R: 0
- Final score - B: 49 R: 32
- WE WON!!! :)
- Rank 1

What We Did Well
- We did well on dropping the climbers in the shelter, although we could do better
- We did well on collecting the debris and dropping them in the the bottom bucket
- We did well on discussing strategy with our alliance partners

What We Need to Improve
- Changing our back wheels so we can go higher up on the mountain
- Making the bar attached to the servo longer
- Improve debris collection and deposition systems
- Possibly change robot direction; make front back and back front
- Fix still occurring USB issues

Debris Strategy
We discussed on where to put the debris if the bottom bucket is filled up. We said that we would put the debris in the floor goal if the bottom bucket is full. Also we decided to go at least up to the mid zone on the mountain so we would have the flexibility to go up the mountain to put the debris in the middle bucket if the bottom bucket is full.

On the next page is a summary of our league progression.

Submitted By Adithi

League 0-League 1

One week after League 1 and we spent most of the meeting reflecting on what happened during League 1 and what we could do better. We also talked with Ramesh uncle on some strategies for League 2. We also had a discussion about ways to stop from moving more than five pieces of debris at a time and whether that rule applied to autonomous.

League 1-League 2

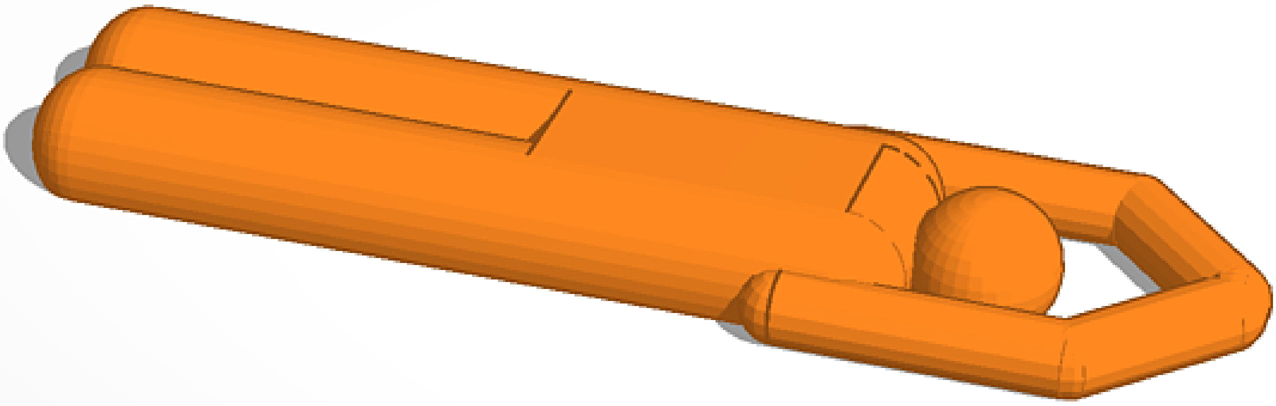
The robot has had some great input. The ramp was replaced and the climber release systems were tested. Plexiglas was added with warning signs. The robot didn't go through many major changes, except for the power distribution module. The new power distribution module that was put in affected us during league. This was how our robot evolved from league 1 to league 2.

League 2-League 3

League 2 was a HUGE learning experience for our team. During this league we were only able to run one full match with a fully functioning robot. Why? It was loosing connection from the phone and the Core Power Distribution Model. After this league, how team had one set goal: to create a system that would keep the USB tight and in place. We looked at different 3D Printing Options, but none of them were right for our tea,. We tried using different zip tie arrangements and foam cushioning. None of these individual tactics never worked. So what do we end up doing? We combined all these different strategies to create a stable and secure USB. This was, putting the phone on a sponge.

League 3- Now

Since league 3 we have changed multiple things. During this time we added a carrier for the climbers to use during autonomous and extended the climber releaser. We tried making another climber release but we removed it later on, realizing that it wouldn't work with the design of our robot. Other than that we just fixed the place glass and added labels to the robot.



35. Fixing Climbers

Meeting Date: Tue, 12/22/2015, 10:00 AM - 12:00 AM
Personnel Present: Adithi, Namitha, Nandhana, Harini, Maria, Sahana, Shruthi, Ramya

Tasks This Meeting:

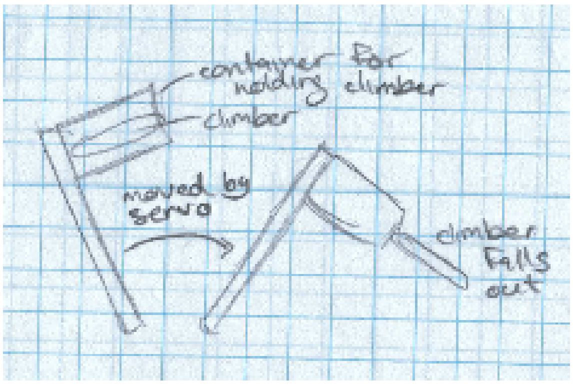
- Make bar attached to the servo longer on both sides
- Make a container to hold the climbers
- Attach a servo to the robot that will be attached to the climber container

Reflections:

Today the build team met from 10:00 AM to 12:00 AM. Our main job was to refine the robot for the next competition. We readjusted the plexiglass on the robot to make sure there were no sharp edges and that it was cut within the eighteen inch by eighteen inch by eighteen inch sizing limit.

We additionally worked on other mechanical aspects such as the task of making the servo bar longer on both sides so it would be able to consistently hit the zip line climbers. We had a little trouble because we had to take the entire servo out to attach a longer bar and the servo was already wired to we couldn't take it out fully. It was a little difficult to screw when the servo wouldn't come out all the way, but we managed.

We also made a container to put the climbers in because the arm wasn't working that well. We attached the climber cage to the servo on the robot so it would drop the climbers in the shelter easily. Our main concern however is that the servo will not be able to support the weight of the container and climbers combined.



Submitted By Adithi

36. Check Up

Meeting Date: Wed, 12/23/2015
Personnel Present: Namitha, Nandhana, Sahana, Harini, Adithi, Shruthi, Ramya, Aishwarya, Rushali, Maria

Tasks This Meeting:

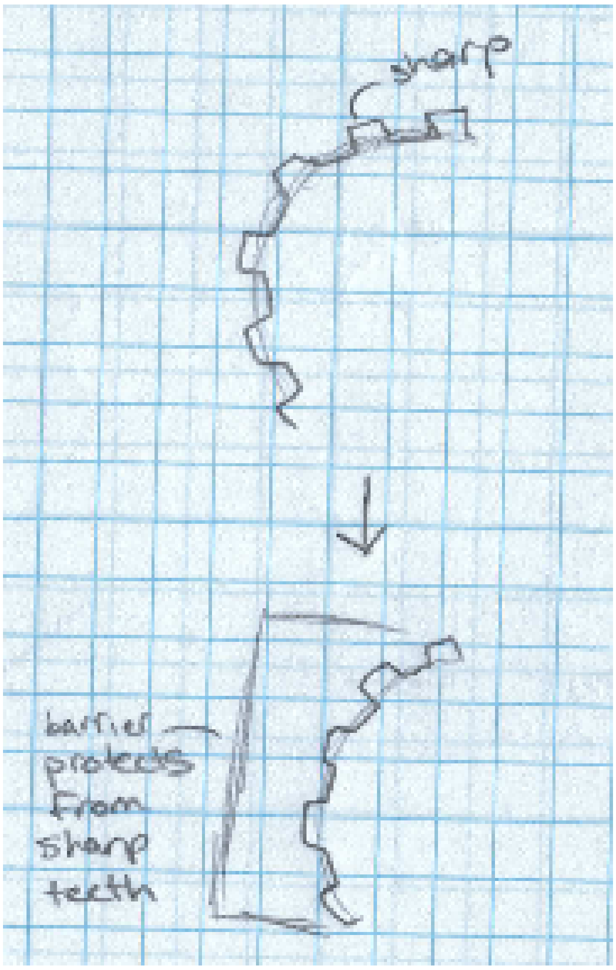
- Check where everyone is in their roles
- Talk about One Million Pixels idea
- Work on Autonomous program
- Cover the gear on the back

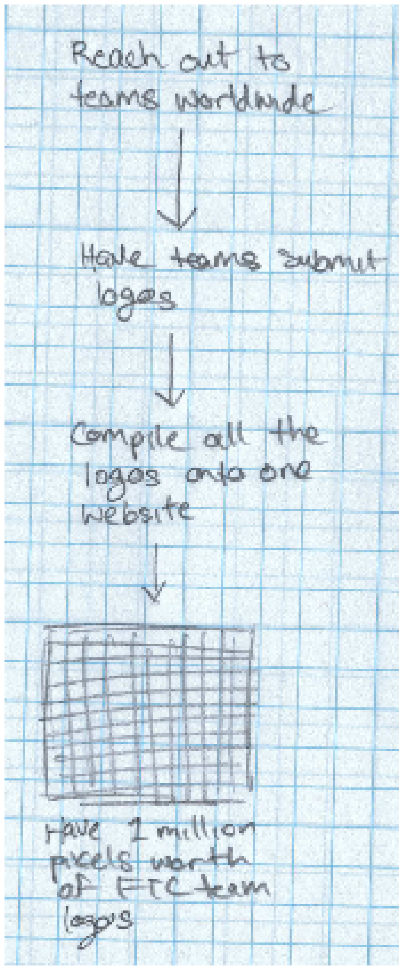
Reflections:

Today we did a quick check up on how much progress we made in our categories. We looked at how much progress we made in the Engineering Log, the promote award, the control award, the robot, and other awards. In the Engineering Log we formatted all of it, filled in the missing engineering logs, and added more to the other logs. For the promote award, our idea for the 60 second video is "How First Helped Us." We will interview everyone and ask them "How did First help you?" For example when we ask someone they will answer "Since I did First, I want to become a doctor." We will videotape all of this and cut it down to 60 seconds.

On the robot we covered the gear on the back that lifts up the arm. We covered up the gear with a short C channel and attached it to the plexiglass. We also worked on the Autonomous program. We worked on making a new program for the championship. Our Autonomous program goes straight and detects the Navigation the Navigation Line is in the floor goal, we will points for being in the floor goal in Autonomous.

For outreach, we talked about a 1 Milton Pixel idea. This website has a feature where there is 10,000 squares and each square is 10 pixels. Our team thought each FTC team in the world could send us their team logo and we would put the logo in one of the 10,000 squares. If the team sends us their team picture, they get more space for their logo. If they send us their robot picture they get even more space. And if they send us their Engineering Log the team get the maximum space for their logo. We will call this One FTC.





Submitted By Adithi

"The Engineering Notebook is not meeting notes or a diary. It is the technical design thinking process for you to achieve your goal. The organization, the concept, sources of idea including nature, things you still need to evaluate, your experiments, lessons learned from others and the list goes on."
~ Nixon Xavier

37. Taking the Engineering Notebook Further

Meeting Date: Sat, 12/26/2015
Personnel Present: Namitha, Nandhana, Sahana, Harini, Adithi, Rhea

Tasks This Meeting:

- What is the progress in our roles
- Talk about Engineering Log - Overleaf
- Figure out how to get more team members involved

Reflections:

Today we did a quick check in of how much progress we made in our sections. Some of our team still has to write their personal narratives for the Engineering Log. We also started converting our Engineering Log into this new software called Overleaf. Overleaf helps our Engineering Log look more formal and it helps a lot with formatting. Also Overleaf is a lot different from Google docs so we have to sit and learn how to do the software. This meeting we learned a little bit about Overleaf and how to use it so now everyone can work on it and help the Engineering Log sub group. Right now we have 123 pages in our Engineering Log so the sub group needs a lot of help converting the content to Overleaf.

We also talked about how to get some of the team members who are not that involved, more involved. One idea we had was to give an award at the end of each week to the person that contributed to FTC that week. We thought of this idea because it will motivate the team to do more so they can win a prize. We also think that some of the team members are not participating a lot because they don't know what to do. Our solution for that is for example someone from the programming sub group can explain programming to the people who don't know much about programming. Some team members are intimidated to ask questions, but the only way to know more is to advocate for yourself.

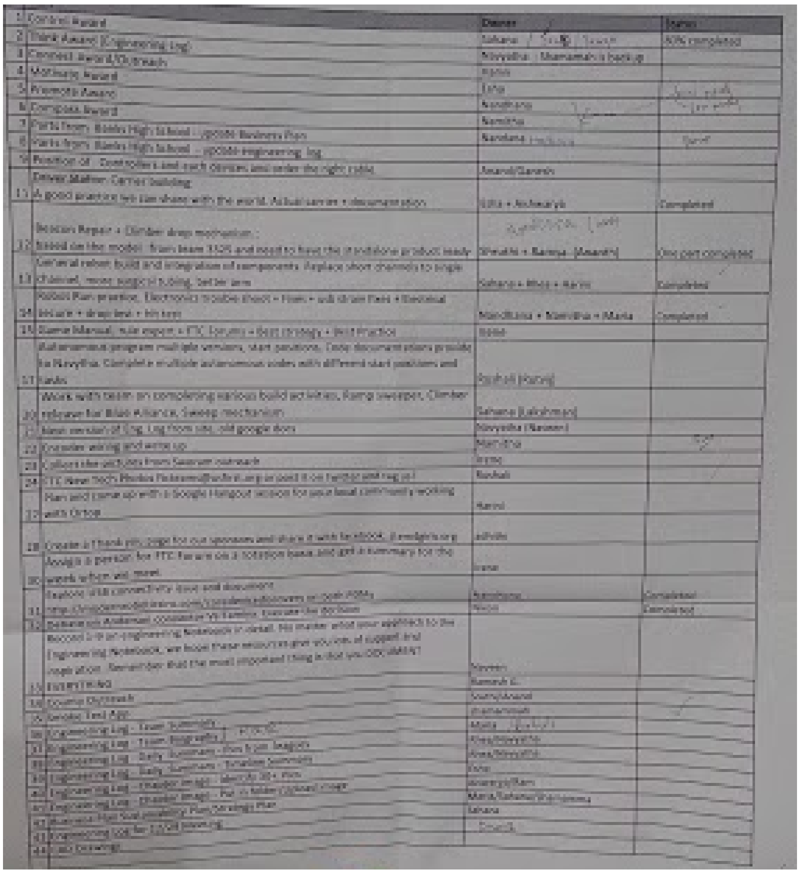


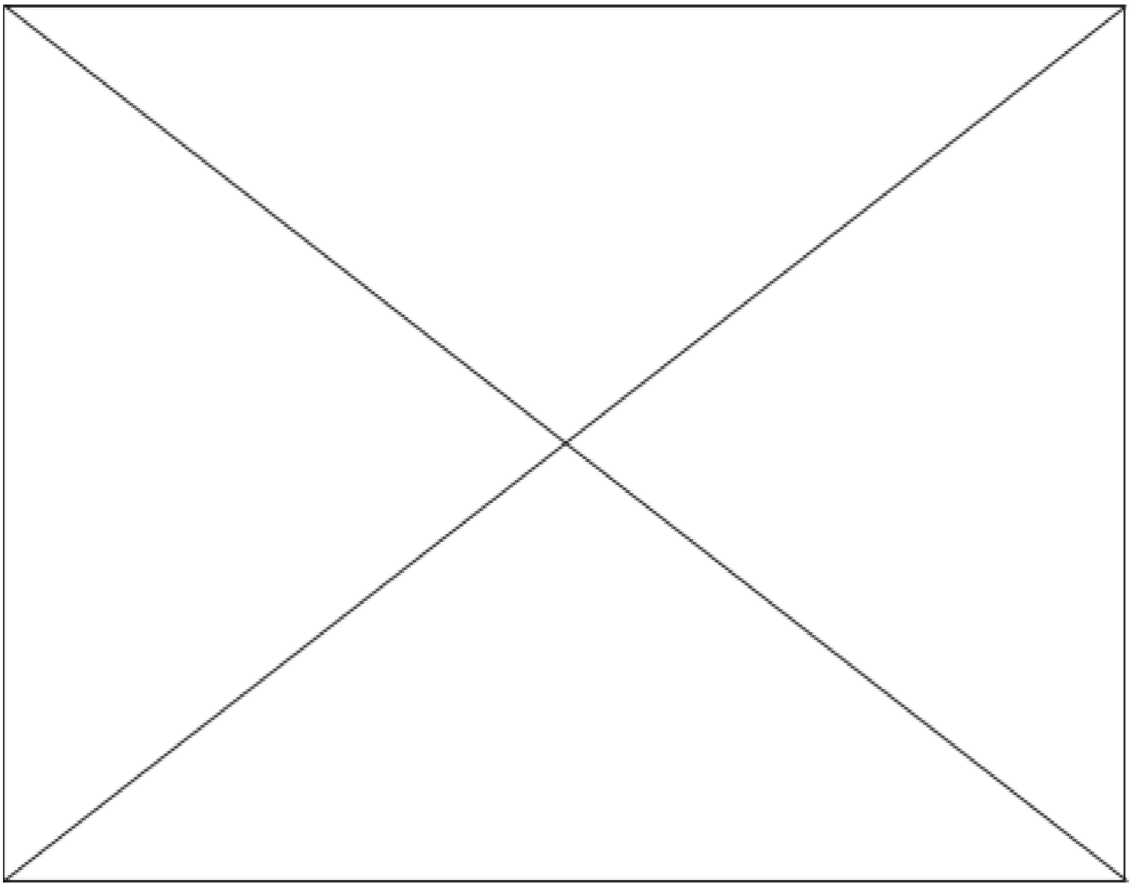
Figure 37.1: Project management checklist.

Possible Improvements

- Communication
- Speak up and ask questions
- Do it yourself, don't wait for others
- Read the links, if you know concepts you will volunteer
- Build on success, don't bring the success push it up
- Capture the moment
- There is always more to do, never sit down without being productive
- More contribution on Engineering Notebook
- Elaborate on Engineering Notebook
- Have autonomous program which allows robot to begin from any position

TEAM IS MANY INDIVIDUALS COMING TOGETHER FOR A CAUSE LARGER THAN YOURSELF

Submitted By Adithi



38. Time to Get to Business

Meeting Date: Tue, 12/29/2015, 6:00 PM - 8:00 PM
Personnel Present: Rhea, Aishwarya, Adithi, Navyatha, Maria, Sahana, Esha, Shamamah

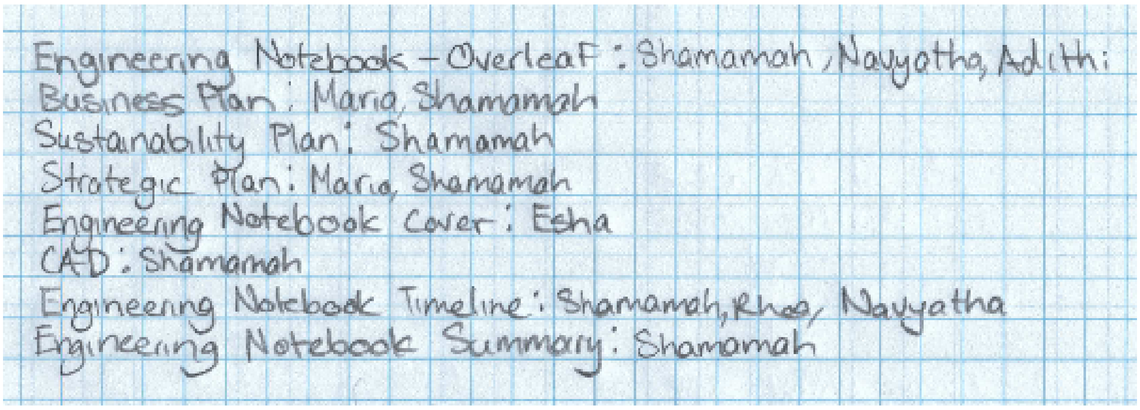
Tasks This Meeting:

- Decide certain roles
- Talk about Overleaf
- Talk about FIRST
- Talk about sponsors
- Decide certain roles
- Talk about FIRST
- Talk about business plan, strategic plan, and sustainability plan

Reflections:

In today's meeting we created certain roles that we need to accomplish by January 2nd. We also chose people for our roles and responsibilities. One topic that we discussed was our business plan which we talked about and expanded our ideas on. We also did a quick review on Overleaf and explored the website. Another task that we did this meeting is that we reviewed our progress and what we can do to keep it steady. We mildly talked about our outreach activity with Gears in Motion tomorrow.

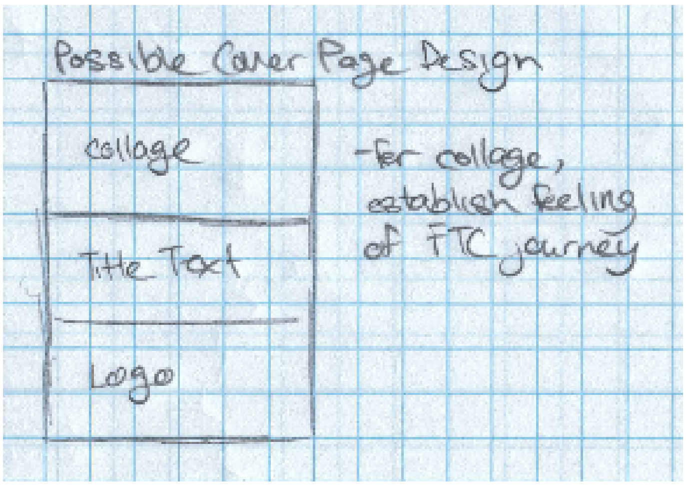
In more detail, our engineering notebook is a place of most of our concern. As of now, our robot build and program groups have shown steady progress, and we are confident in the basic abilities of our robot. Our engineering notebook however, is missing many logs and we still have to add the business plan, strategic plan, and sustainability plan. We also discussed our team story and journey summaries. To make our team and engineering notebook stand out, we must make sure our description and story pops out, thus we have one of our members, Shamamah, take that up. Another thing to add, which is not at the top of our priorities but is still important is collect chapter pictures. A must is however a stylish title page for our engineering notebook. We thought of maybe a collage or some mash-up of many pictures that could be put on the front page. Nonetheless, that task has been taken up by Esha. Also, CAD has become something we have entirely forgotten about, so we must go back on track on using the software.


Engineering Notebook – Overleaf: Shamamah, Navyatha, Adith:
Business Plan: Maria, Shamamah
Sustainability Plan: Shamamah
Strategic Plan: Maria, Shamamah
Engineering Notebook Cover: Esha
CAD: Shamamah
Engineering Notebook Timeline: Shamamah, Rhea, Navyatha
Engineering Notebook Summary: Shamamah

On the outreach side, we have not been making much progress. We have reached out to a few countries, but not enough. We need to work on making sure all the members are contributing to outreach as there has been very little updates and communication.

At the end of the meeting we all went around with our rose, thorn, and bud inputs. To summarize, we all felt content that our team communication has been gradually improving. We were also glad to see that more people have begun volunteering to take up tasks. No more did we have to assign jobs and responsibilities, but everyone volunteered. We also had much more discussion and contribution in this meeting, which is a good sign of increased team input.

Now that everyone knows what she is to do, we cannot wait until January 2nd when we all get to share all our progress and hard work!



Submitted By Shamamah

39. Bowling the Year Away

Meeting Date: Tue, 12/29/2015, 6:00 PM - 8:00 PM
Personnel Present: Shruthi, Adithi, Navyatha, Rushali, Nandhana, Namitha, Maria, Shamamah, Aishwarya, Esha, Harini, Rhea, Sahana, Irene

Tasks This Meeting:

- Clear out any confusions about everyone's roles
- Clarifications on sponsors, mentors, and partners
- Discuss progress on pending tasks
- Talk about how to improve "Our Story" and "Our FIRST Journey" sections of engineering notebook
- Talk about what make #9774 Nano Ninjas unique
- Discuss business plan and those who took up the responsibility of it, show progress
- Decide and distributed more work and tasks
- Talk about creating FTC timeline
- Watch FLL team Gears in Motion's presentation and ask questions to prepare them for state competition
- Have Anna give an overview of FRC
- Give Gears in Motion tips about FLL from our past experiences
- Celebrate the upcoming new year by going to SuperPlay to bowl, play laser tag, eat, and have fun!

Reflections:

Clarifications

- Roles

  Maria (Shamamah Can Help) - Mission Statement, Business Plan
  Shruthi - Control Award
  Harini - Global relations outreach

- Sponsorship
  Nike - Volunteer Matching, NikeGive
  Intel - Volunteer Matching
  BoardShare
  Qorvo
  Overleaf - Financial enterprise support
  C4 Labs
  Mathnasium - Volunteering/Stems4Girls
  PCC Makerspace - Publicity
  TVFR - Free facility
  Methodist Church - Free facility
  Banks Highschool - Provided parts
  ScreenSteps - Financial support, $800 license
  STEM4Girls - Financial support, Materialistic Needs
  FreeGeek - Laptops
  Aplos - Online finance managment software
  Google - Nonprofit support
  Batteries in Black - Facility, Mentoring
  HotWired - Mentoring
- Partnership
  MathWizard

Figure 39.1: Shamamah explaining "Our Story" and "Our FIRST Journey" (left) and Maria and Shamamah explaining the Business Plan (right).

Today, the personnel present went over their pending tasks and progress for the upcoming January 2nd where we are to share all our finished work, and for the League Championship on January 17th. Harini took the initiative for our global relations outreach, Maria and Shamamah took the lead for our business, strategic, and sustainability plans, and Sahana took lead for the Connect Award, with the help of Shruthi. With the Connect Award, it is planned to make an auto-check app for necessary fixes before matches using App Inventor, as we have had much experience with the software.

Next, we went over who are our sponsors and why they are our sponsors. We also went over what they have provided us with and what we are giving back to them.

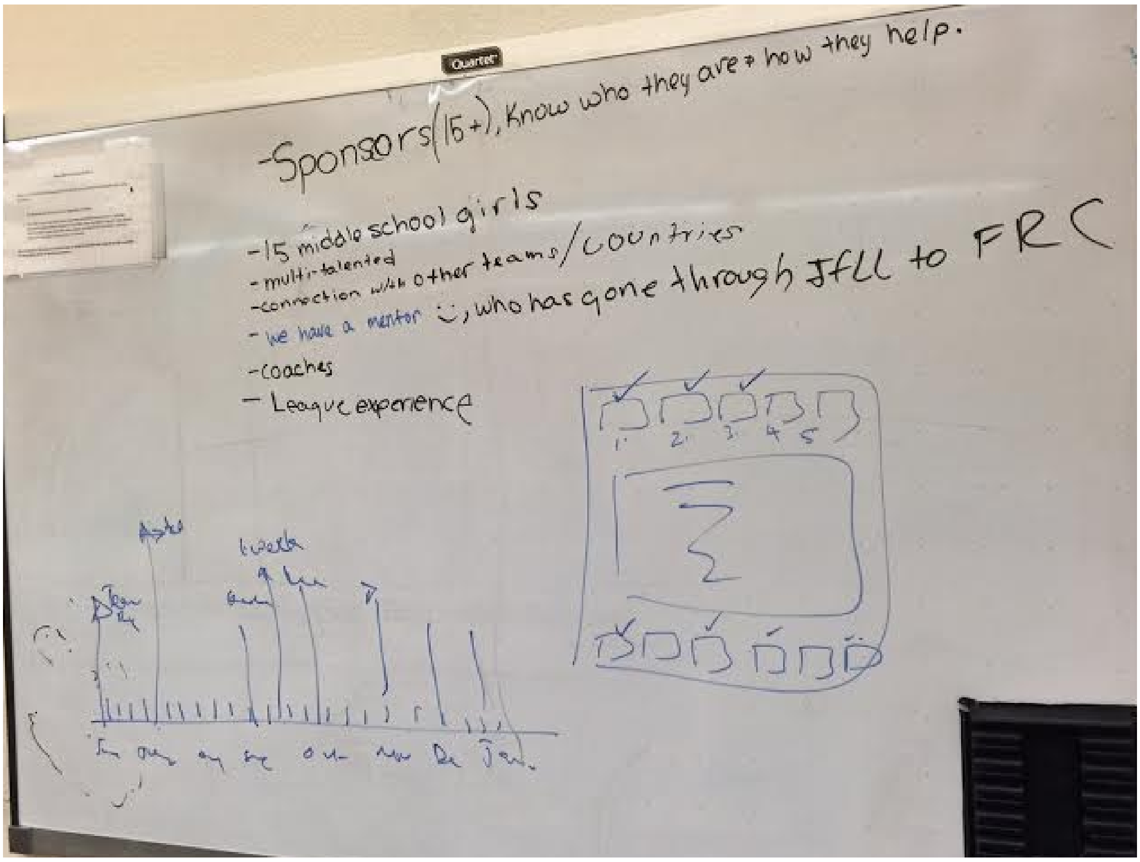


Figure 39.2: Whiteboard of ideas on how to improve "Our Story" and "Our FIRST Journey."

This will help us in the business plan and also for just a for-your-information.

The things that are unique about our team needed to be listed out. We found out why our team is different then other FTC teams, and even other FIRST teams. This was because "Our Story" and "Our FIRST Journey" needed a bit of improvement. This is the first thing the judges see when viewing the Engineering Notebook, so we must ensure that we begin with a blow and impress the judges about our team and how and why we stand out from all other teams. We have to leave a lasting impression. Additionally on the topic of the of Engineering Notebook, we decided to create a timeline about this year in FTC. We are going to label all the important events such as first meeting, outreach, fundraisers, competitions.

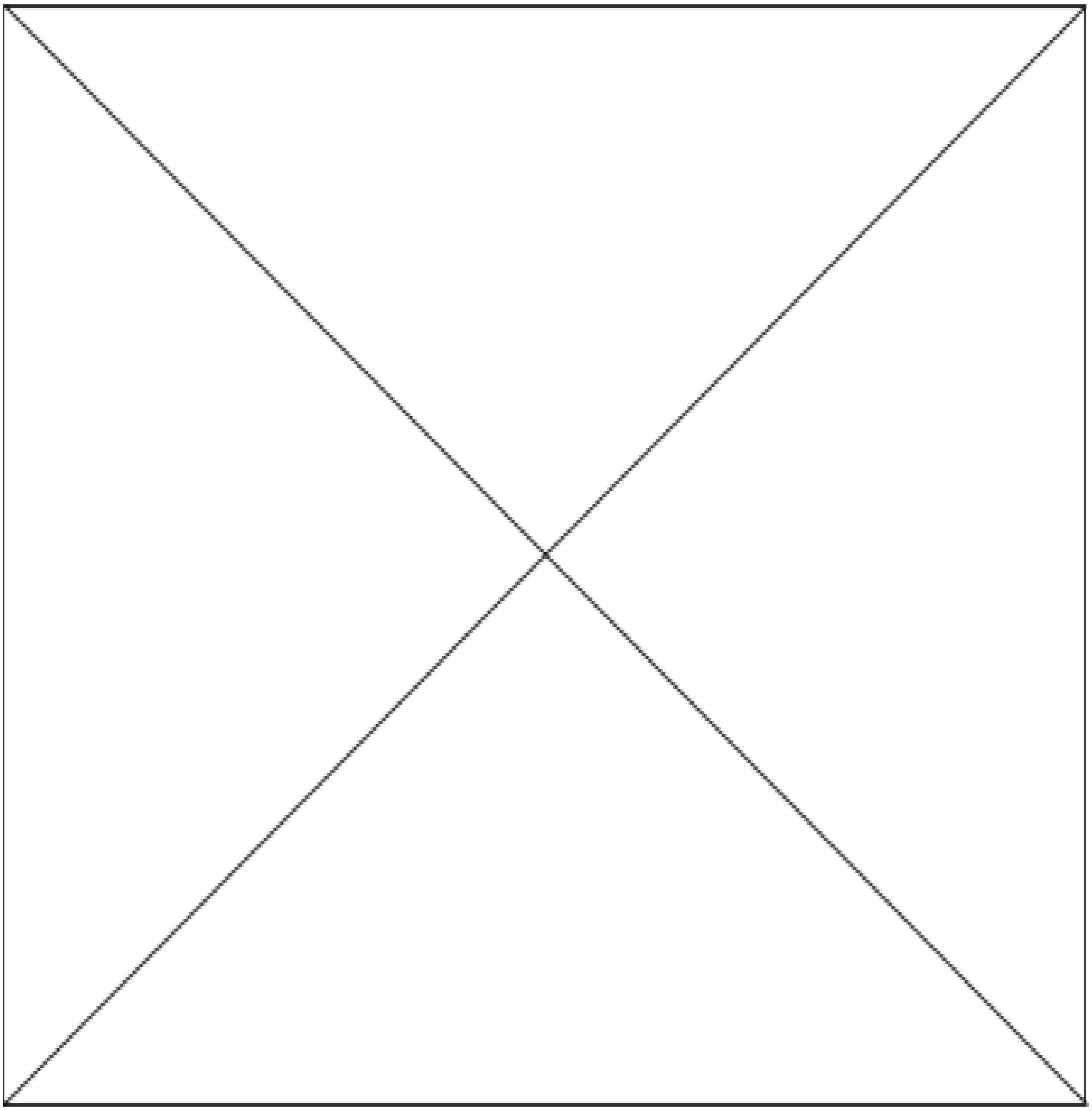
FLL team Gears in Motion then presented their project presentation to us for feedback. We enjoyed spending time with them and helping them progress, as they are going to the Oregon State Championship on January 10, 2016. We asked them project questions which made them think, and gave them tips and pointers on how to well prepare for the competition. We wish them the best! They are a team which we inspired and is also run under STEM4Girls, so we treat them as a sister team. We hope that as our Nano Ninjas team grows and members retire, members of Gears in Motion can fill in the missing spots. Let them live on our legacy!

Anna, as our mentor whom has gone through the entire FIRST journey of JFFL, FLL, FTC, and FTC, gave us a quick speech on the power and influence of FIRST and STEM. She also went over a brief overview of what to expect in FRC. We cannot wait to follow Anna's footsteps, she surely has given us so much support.

We then went over the ups and downs of our 2015 season portion of FTC. We all enjoyed getting to know each other and getting time to bond with each other. Never before had any of us been in such a large team. Our downs included the lack of communication sometimes. We would always get tasks done at our meetings, but sometimes would forget to continue working at home as well. Nonetheless, FTC has brought us the most enriching and knowledgeable fun we have ever had.

Lastly, to celebrate the upcoming new year, we went to SuperPlay to bowl, play laser tag, eat, and just have fun! We had an amazing time bonding together as a team. We cannot wait to get together again in 2016!

Submitted By Shruthi

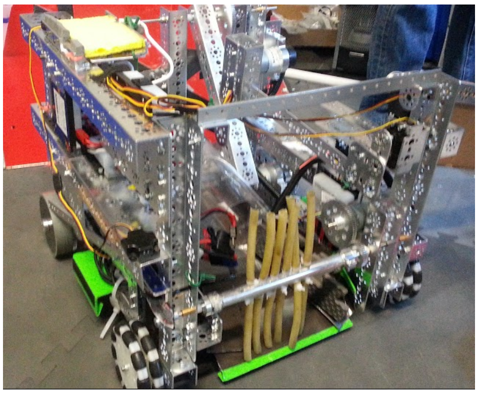
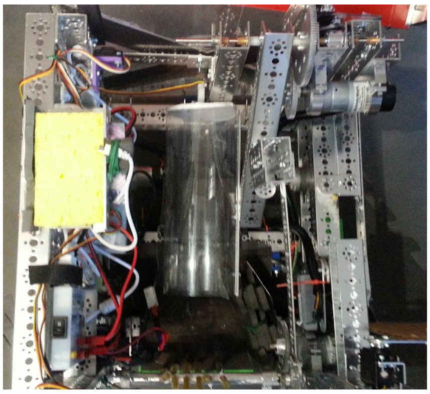


40. Beginning the New 2016 Year

Meeting Date: Sat, 1/2/2016, 2:00 PM - 5:00 PM
Personnel Present: Shamamah, Sahana, Nandhana, Namitha, Navyatha, Adithi, Shruthi, Ramya, Maria, Rushali, Aishwarya, Esha, Rhea, Irene

Tasks This Meeting:

- Fix climber activation system
- Fix climber dropper system
- Work on programming and programming documentation
- Work on Overleaf Engineering Notebook
- Have progress check and evaluation

Reflections:

We took the last few days of 2015 off and spent them more in fun rather than serious work, but now it is time to get down to business. Today was a day to get a lot done and have a progress check and see where everyone is with their tasks and responsibilities.

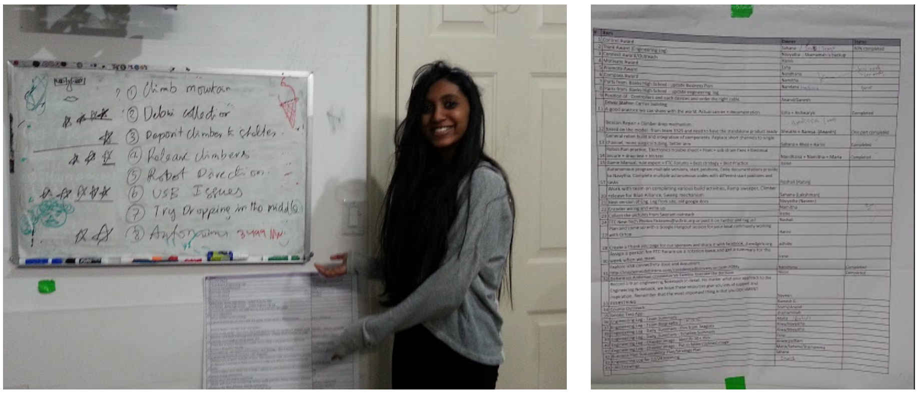


Figure 40.1: Esha presenting the project management chart (left) and the project management chart up close (right).

On the building side, our robot needed a bit more work on the attachments. The side climber activation attachments had issues regarding their length as they constantly hit the wheel and sometimes hindered the working of the drive train. Also, our climber dropper container portion, which was made entirely of metal TETRIX parts, was far too heavy for the servo motor to handle and support, thus we changed it with a lightweight plastic container which formerly held a USB wire that we found lying around the garage. We also thought of using a toilet paper roll as a climber holder, but decided that it would not look professional and was not strong enough and could easily rip (it is cardboard after all). Also, we replaced our cardboard secondary climber activator with window blind sheet. This enables more strength and the ability to withstand stronger forces. Also, if we are stuck in the rain with our robot, there will be no cardboard to get wet and rip, but the electrical components may malfunction...

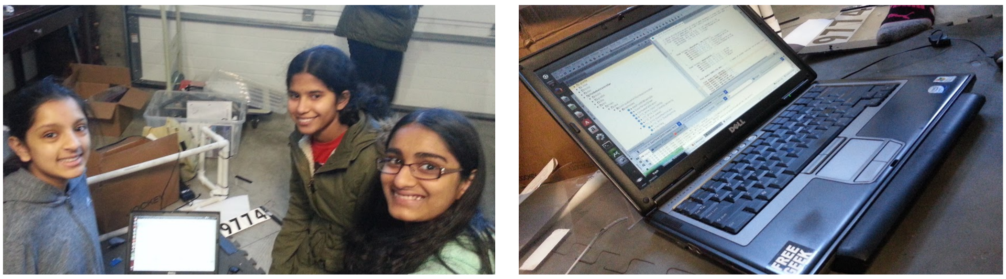


Figure 40.2: Our programming sub-group (left) and our team laptop sponsored by Free Geek (right).

On the programming aspect, our programming sub-group worked on the autonomous and teleop and worked on a document we are currently working on that documents our code thoroughly and precisely.

The Engineering Notebook group also held a meeting on the side and discussed Overleaf and their competence in it. Also, we also decided we still need a lot more pictures and CAD renderings. We need pictures for every single log. When looking through the Overleaf document, we came across a syntax error about "outer par

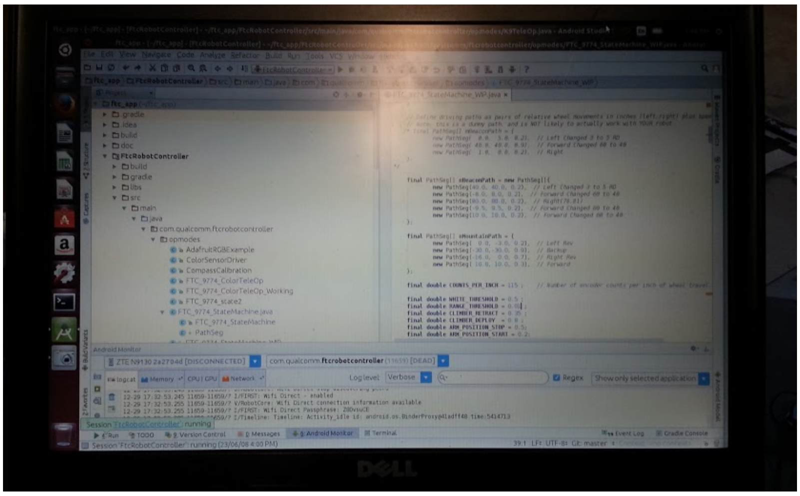


Figure 40.3: What our programming group is working on.

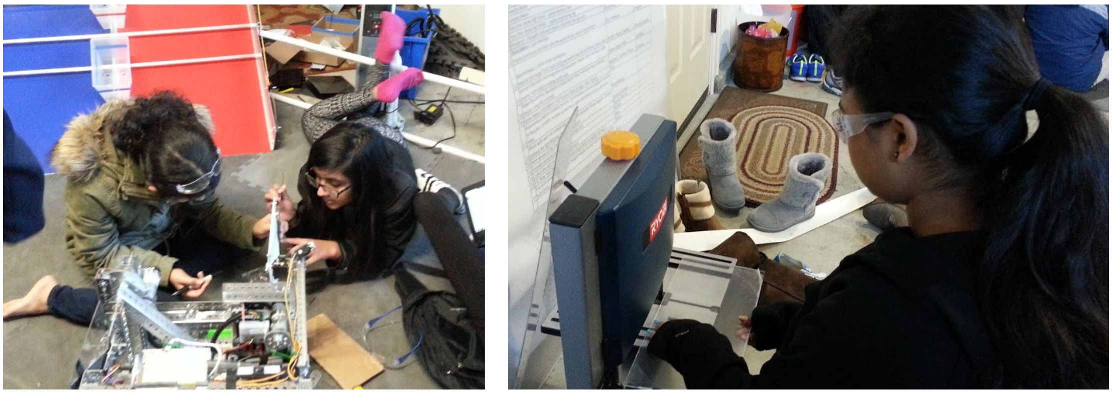


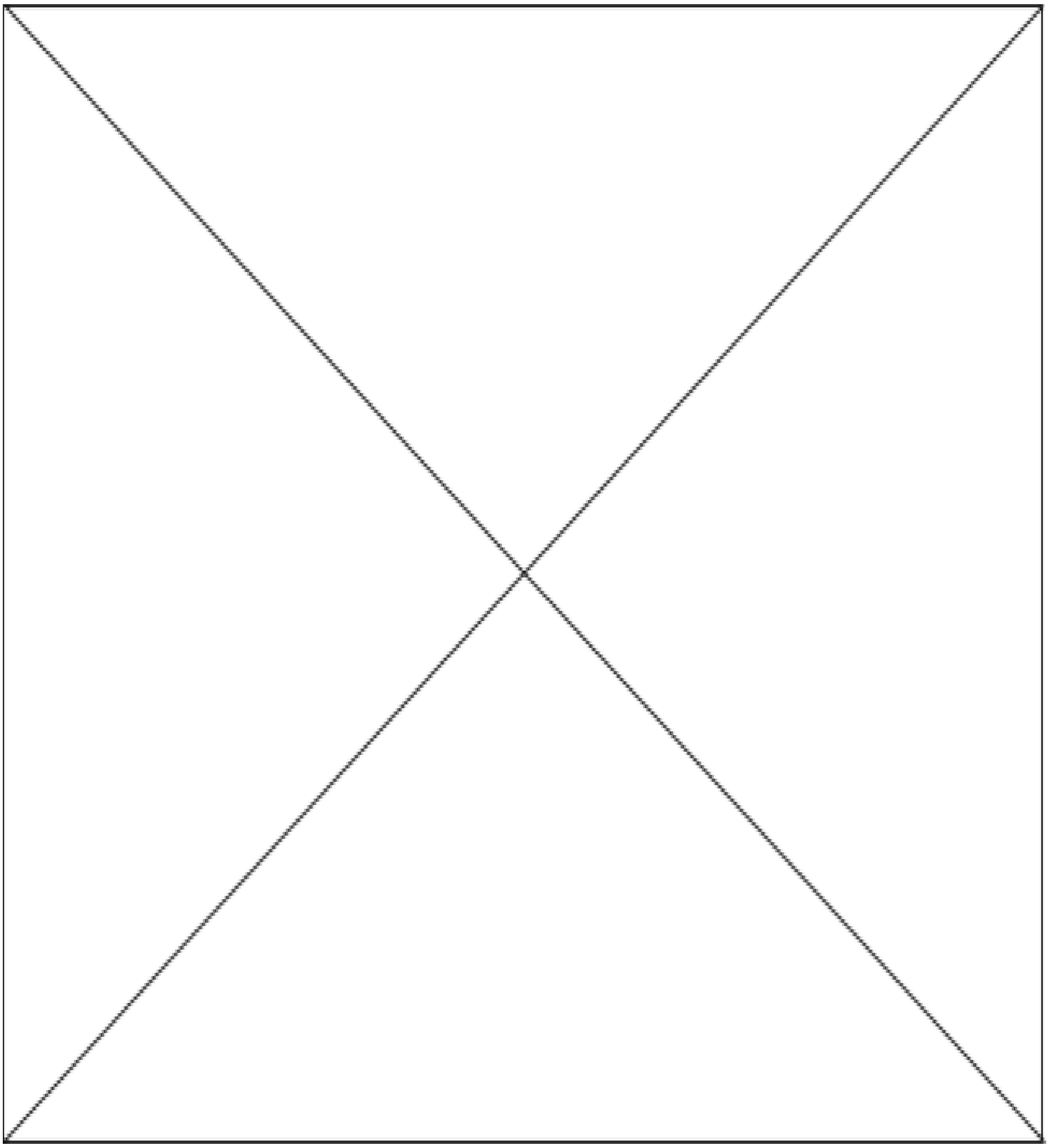
Figure 40.4: Namitha and Maria working on the robot (left) and Rhea cutting some plastic (right).

mode," which at first we did not understand. Using our debugging and problem solving skills, we finally solved that the reason why we kep having syntax errors with our photos was because we were missing an "endfigure" when we had a "beginfigure." After that, everything worked out. We also worked on elaborating on our logs and adding more pictures and photos.

Near the end of the meeting, we held a progress check-in. We went through our project management checklist and everyone took turns on informing the team on what they have completed and what they have to complete. As of now, the Engineering Notebook has shown substantial progress and just needs to add more to the engineering notebook and fix a few things, but for the main part, they are good. Our Build group has also finished all their tasks of fixing all the attachments and systems expect the creation of a IR Beacon Repair strategy. The programming side needs to work on fixing the autonomous so it can work from any position, but everything else is up to date. The outreach side is slightly behind and has not shown much progress. Shruthi, who has taken charge of the Control Award, has shown some progress and has finished the basics. All in all, our team is progressing and developing well. We are still lacking in a few facets, but we are good for the most part.

Figure 40.5: Adithi working hard on the Engineering Notebook (left) and Namitha, Rushali, and Maria working on programming (right).

Submitted By Shamamah



41. Problems and Solutions

Meeting Date: Wed, 1/6/16, 6:30 PM - 8:00 PM
Personnel Present: Nandhana, Namitha, Maria, Ramya, Harini, Sahana

Tasks This Meeting:

- Observe robot and take notes
- Think of solutions for observed issues
- Discuss pros and cons of each solution

Reflections:

After continuously watching run after run, we came up with many issues that needed work in build, programming and drive.

Here are some of the issues we encountered while driving the robot:

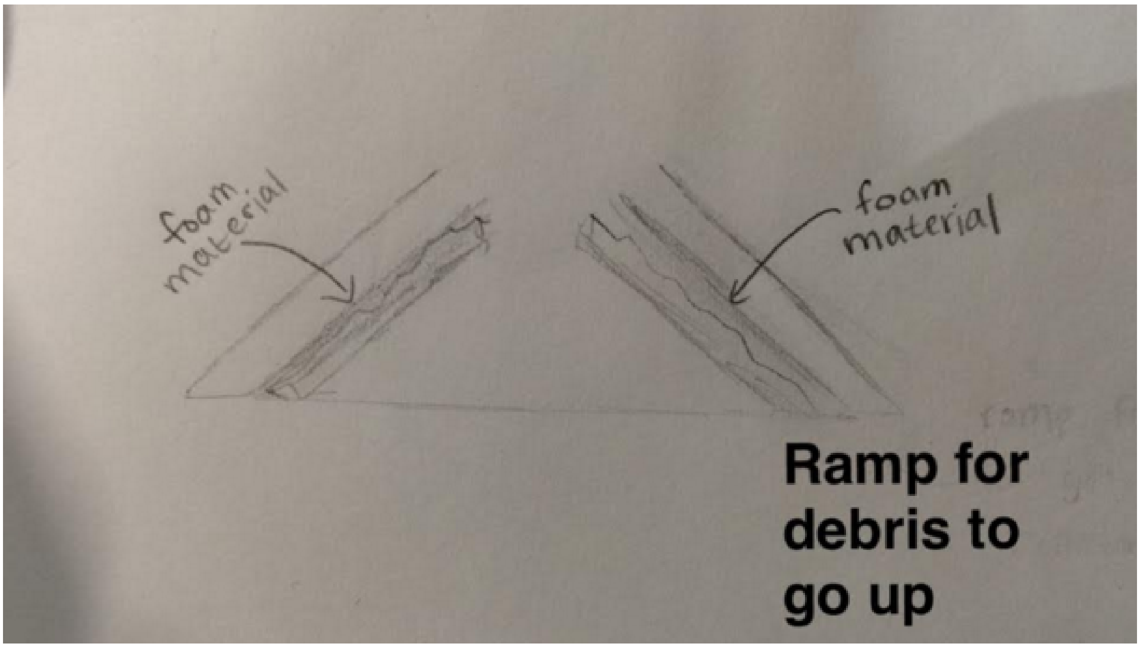
1. Debris will fly up very quickly if not collected at the right angle
2. The debris is falling out when the sweeper is not spinning
3. When debris is underneath the tube, the tube cannot go all the way down which prevents debris collection
4. Debris is getting stuck in the sides
5. If the drivers are not 100 percent sure that the robot is aligned properly before dropping the debris in the lower bucket they take up lots of valuable time
6. Debris will fall out of tube when the arm if lifting, but the sweeper is still moving

Here are the solutions we brainstormed to fix these issues:

1. Put in the plastic side panels

   The plastic side panels will efficiently block out the debris, so that it won't get stuck under the robot.

2. Change the code so the sweeper has three modes or driver continuously sweep
   This solution will include lots and lots of trial and error, plus many program updates. It is highly unlikely that we will be using this idea as we are days before the League Championships.
3. Practice and coordination so that the sweeper is only working when the arm is fully down
   As we know, practice makes perfect. This is a great and simple solution. The drivers are currently working on this task. They are doing their very best at perfecting the coordination between the controllers.
4. Attach the plastic sheets to the side of the inner robot
   This is meant to keep the debris from getting stuck within the robot.
   It will also stop the debris from causing loose connection or damage of the electrical components.
   The main point of the plastic sheets on the inside is to prevent debris from getting stuck so that we won't break the rule of possessing more than five items of debris.
5. Create a painted marking on back plexi glass of robot so that drivers can align with the ramp
   This means less time spent on searching for a position.
6. Attach small zip ties to the tube so once a debris is inside it won't fall out and when we deposit we have gravity to help it come out
   This is a fairly simple idea that is very effective, as it does not let the debris come out.
   This also seemed to be a problem when we put in more than one zip tie.
7. Add foam to side of debris collection ramp
   This will stop debris from going to the edge of the ramp and then being knocked out of the ramp by the sweeper.



On the next page is a table which explains the pros and cons of the solutions to make sure that the debris does not fall out of the collecting tube.

Solution	Pros	Cons
Continuously spinning the sweeper	-debris will not fall out of the collecting tube	-Might collect more than 5 debris -Debris might fly out
Different sweeper spinning speeds	-would make sure debris does not fly out	
Zip ties inside the collecting tube	-debris will not be able to come out until dumped -simple efficient design	-debris might get stuck inside the tube
A lid to the collecting tube that can be opened and closed	-the debris would stay inside with no chance of falling out	

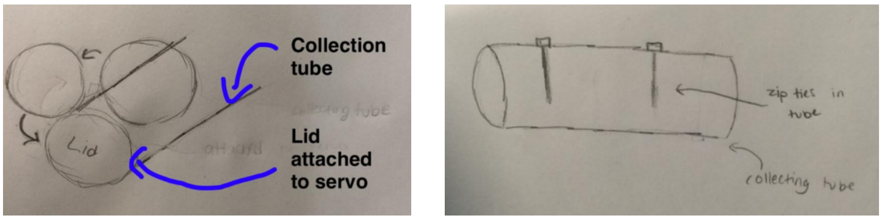
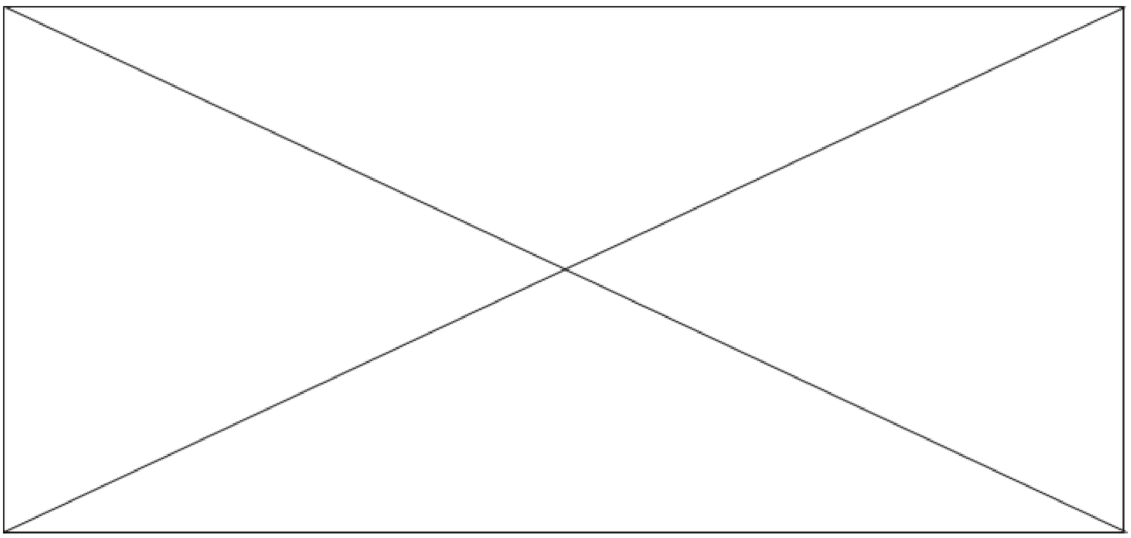


Figure 41.1: Sketched diagrams of our ideas.

While looking back we realize how most of the problems are with the efficiency of our debris collection system. We figured out multiple things we needed to do before the League Championship as well. The most important thing we noticed at today's meeting was the debris collecting system, and how we needed to improve it. This will greatly impact our robot at competitions, allowing us to collect and dump debris quicker and more efficiently.

Submitted By Ramya



42. Finishing Up

Meeting Date: Mon, 1/11/16, 6:30 PM - 8:00 PM
Personnel Present: Shamamah, Irene, Adithi, Harini, Nandhana, Namitha, Maria, Rushali, Rhea, Ramya, Shruthi, Esha

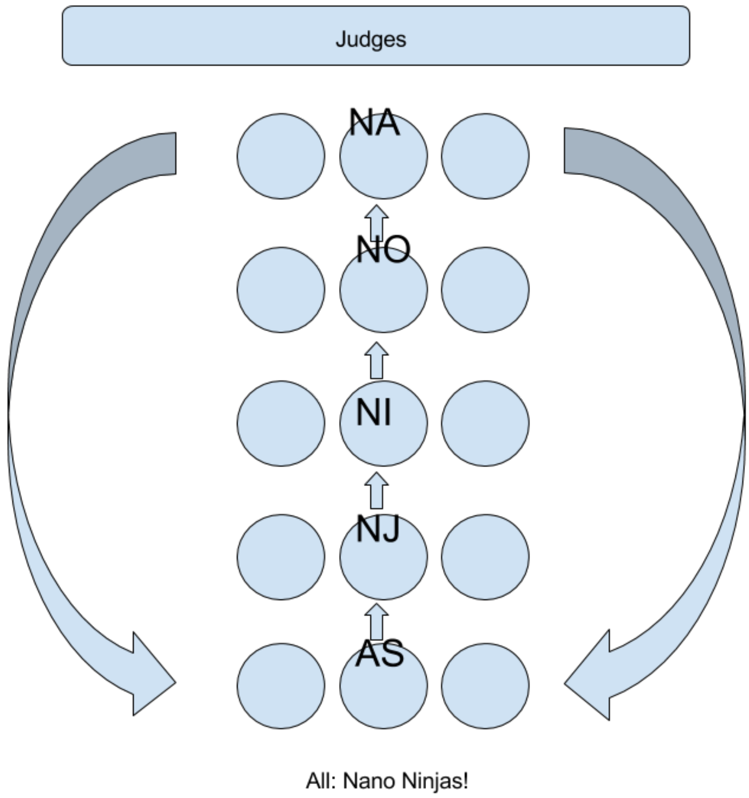
Tasks This Meeting:
- Finish adding final touches to the robot
- Fix Autonomous program
- Finish up Control Award tasks
- Edit Engineering Notebook
- Work on Judging presentation

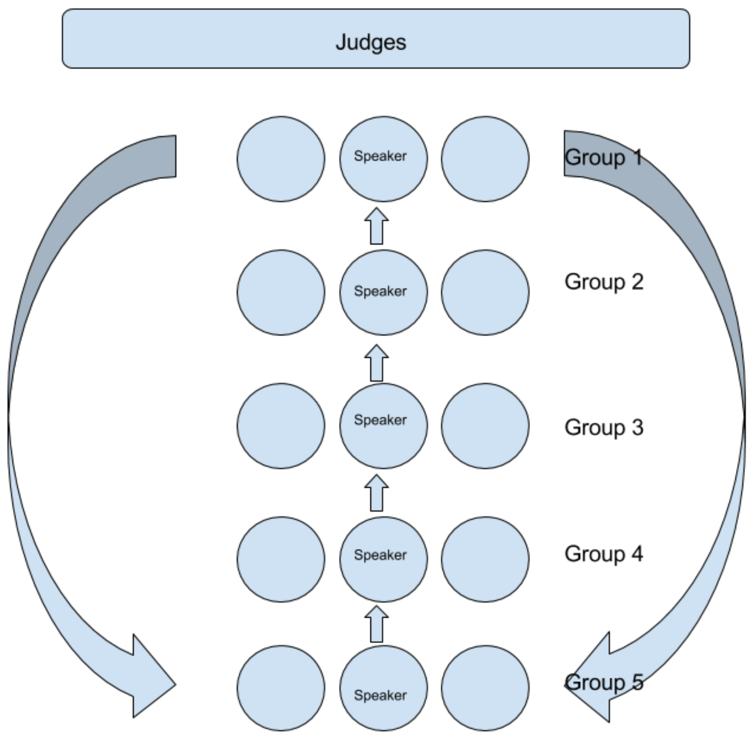
Reflections:

We were really close to the League Championship, so we worked hard and finished adding the final touches to our robot. We added the plexiglass to all the sides and made sure our Autonomous program was working.

The engineering log sub group worked on adding more pictures and the final requirements to the notebook. We looked through and edited the logs and made sure it was ready. Some team members drew sketches to add to the engineering notebook. Our engineering log looks very professional and colorful! We also revised and edited the Control Award. The Control Award has a lot of details and explains our robot and programs.

Our idea for the judging presentation was to split our 15 team members to present the 5 categories: Robot (build and programming), Team, Engineering Notebook, Gracious Professionalism, and Outreach. A few members will talk about each section of one or two minutes and then more people will talk about a different section.


Judges
NA
NO
NI
NJ
AS
All: Nano Ninjas!


Judges
Speaker
Speaker
Speaker
Speaker
Speaker
Group 1
Group 2
Group 3
Group 4
Group 5

Team
- Nandhana
- Maria

Robot (Build)
- Sahana
- Harini
- Rhea

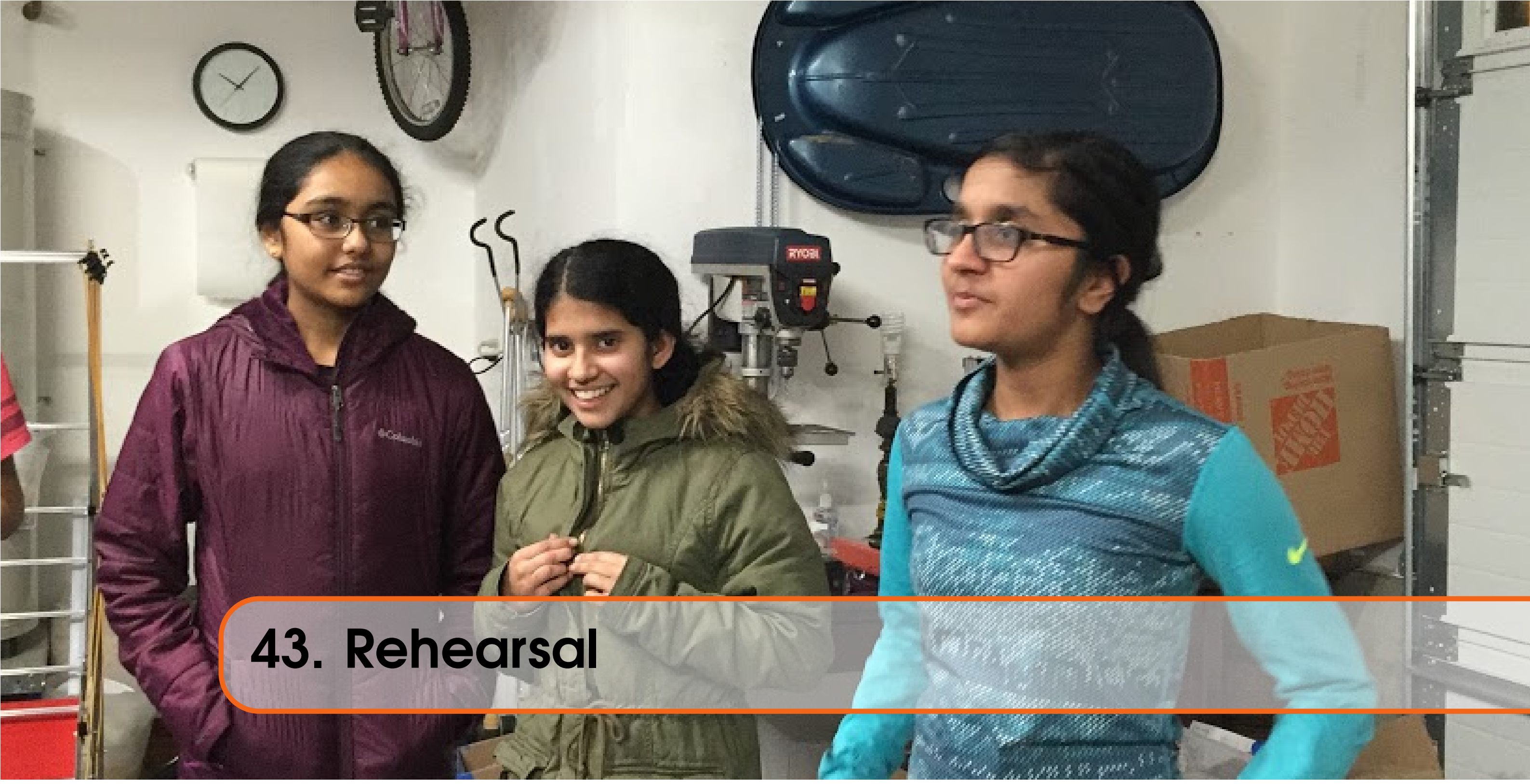
Robot (Programming)
- Rushali
- Namitha
- Nandhana

Engineering Notebook
- Shamamah
- Navyatha
- Adithi

Outreach
- Esha
- Harini
- Irene

Gracious Professionalism
- Aishwarya
- Maria

Submitted By Adithi



43. Rehearsal

Meeting Date: Tue, 1/12/16, 6:30 PM - 8:00 PM
Personnel Present: Shamamah, Rushali, Navyatha, Nandhana, Namitha, Maria, Sahana, Esha, Shruthi, Aishwarya, Harini, Ramya

Tasks This Meeting:

- Practice driving robot
- Get robot ready for League Championship
- Practice judging presentation
- Have mock judging session
- Continue revising and adding to the Engineering Notebook
- Finalize our roles for different team members, during our presentation at the League Championship.

Reflections:

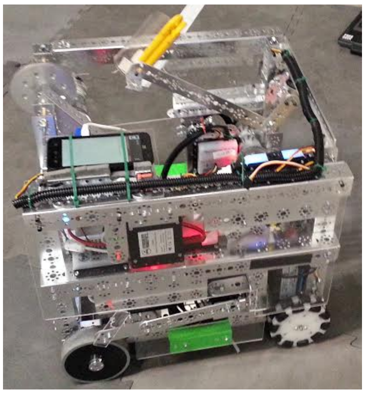
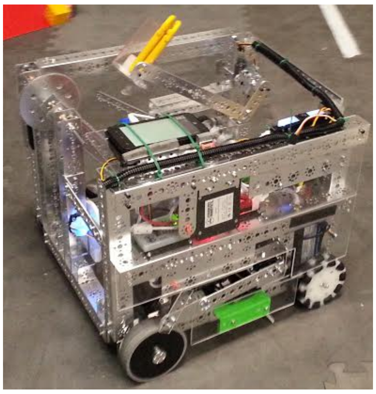
This meeting was our second meeting of the week, and we mainly focused on finalizing our robot, driving our robot, and putting our final touches on the Engineering Notebook. Towards the end of the meeting, we also focused on our presentation for the League Championship, and decided on an effective way to communicate our team's process to the judges.

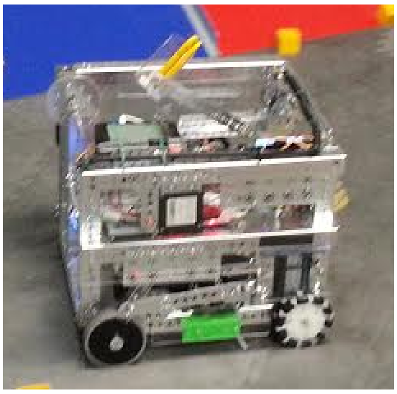
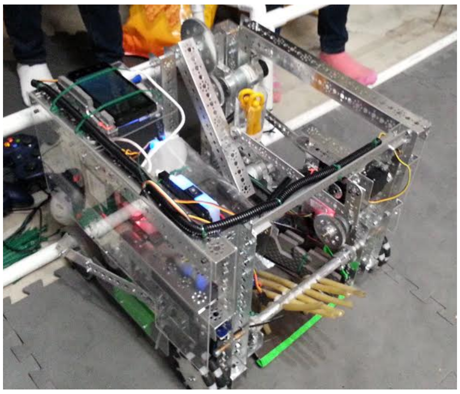
Our Robot

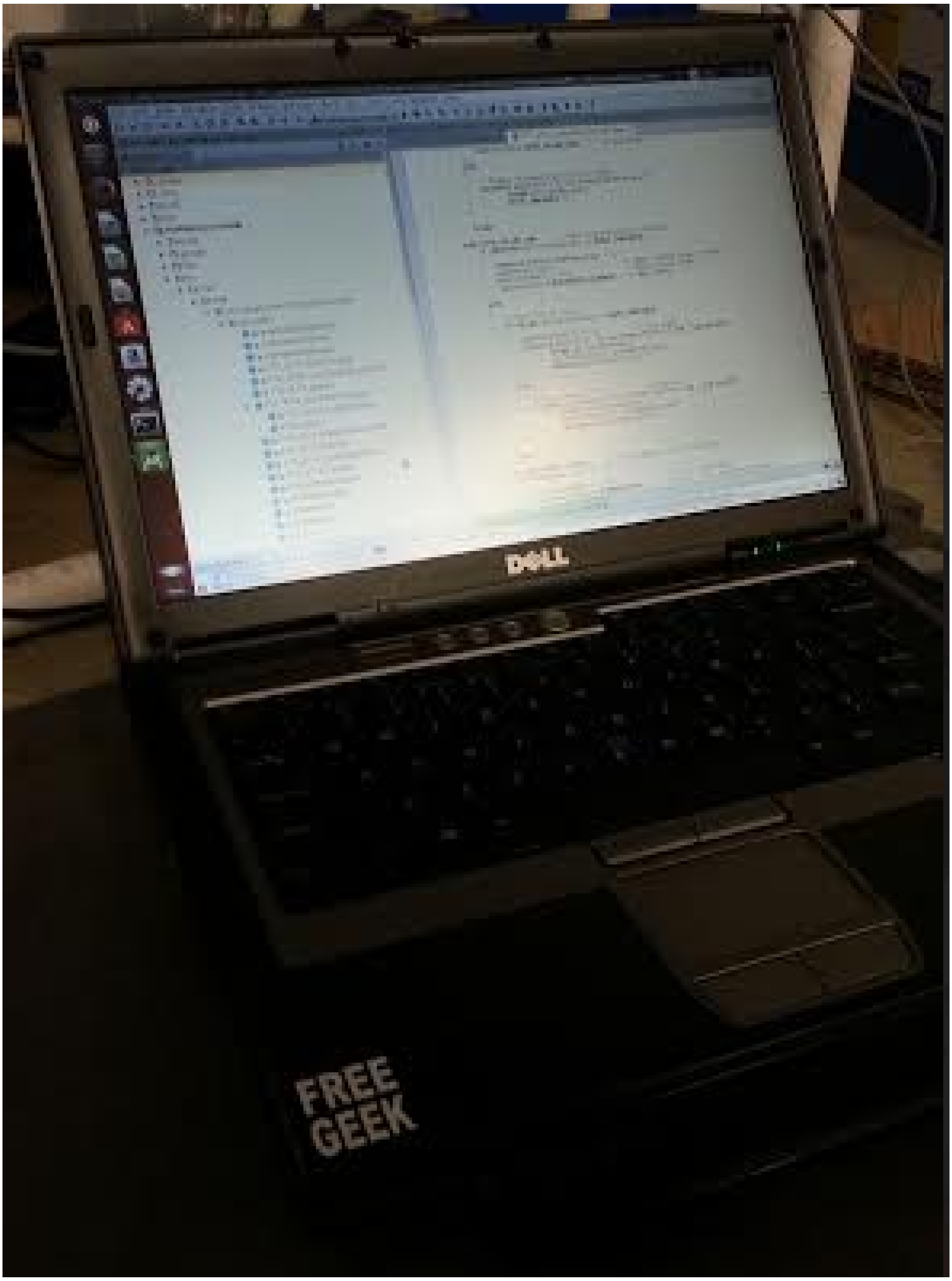
- We continued fixing any issues with the robot (such as screws/nuts that fell out, attaching the USB cable correctly, etc.)
- We practiced configuring our robot, to make sure there are no technical or electronic issues
- We practiced driving our robot: Making sure the robot collects the debris in an effective manner. making sure our robot can climb up the Mountain ramp, etc.

Engineering Notebook

- We continued adding more to our Engineering Notebook (such as missing items, pictures, etc.)
- We read through the entire document, to make sure our Engineering Notebook was accurate and error free
- We finalized our entries, and made sure every page was detailed, comprehensive and well thought out



Judging Practice

- We finalized our roles and different standing positions, for each of our team members
- We had a mock judging presentation, where our team members not only shared detailed information about our robot, outreach activities, Engineering Notebook, etc., but we also answered certain questions that may come up during the League

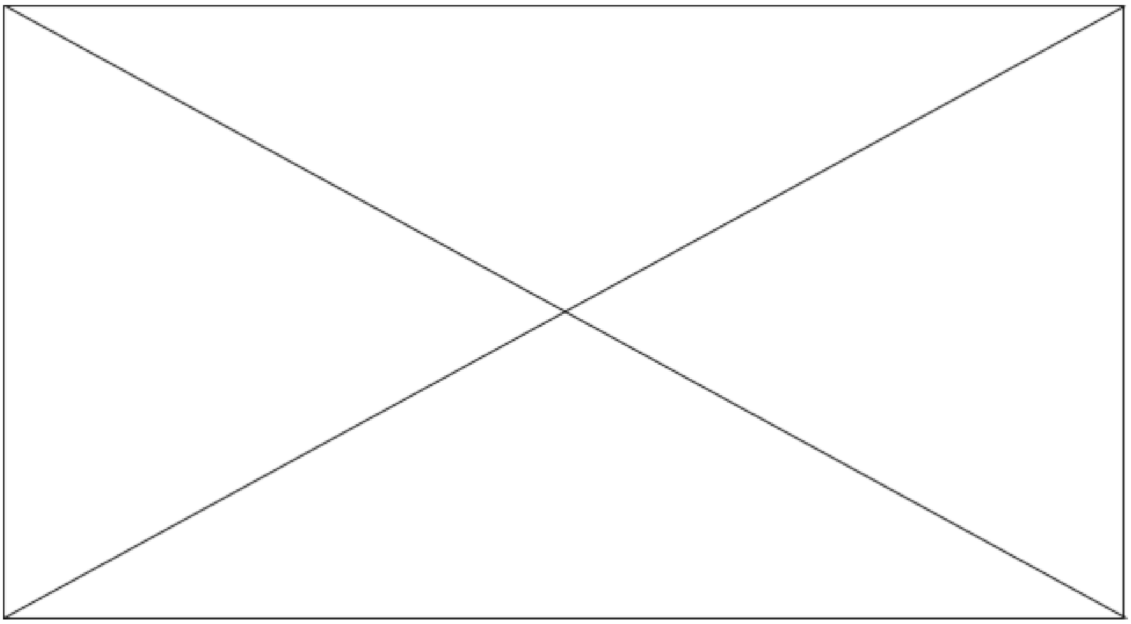
Championship

Overall, this meeting went really well, and we definitely made a lot of good progress. We hope to continue preparing and practicing for the League Championship the rest of the week!

Submitted By Navyatha



44. Extensions—No, Not for Hair

Meeting Date: Fri, 1/15/16, 6:30 PM - 8:00 PM
Personnel Present: Nandhana, Namitha, Maria, Rushali, Shamama, Harini, Irene, Shruthi, Ramya, Aishwarya, Adithi, Sahana, Esha, Rhea, Navyatha

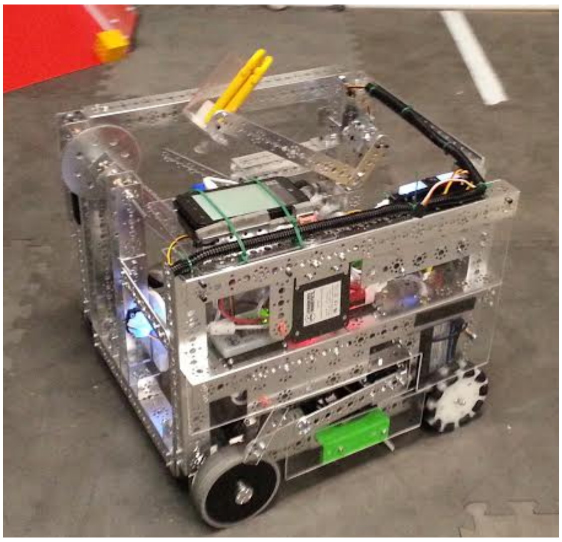
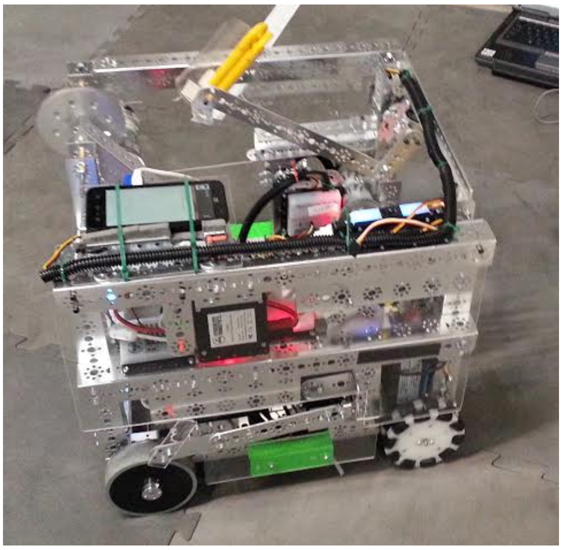
Tasks This Meeting:

- Practice for judging questions
- Final fixes to robot (Plexiglass)
- Autonomous practice
- Go through the final Engineering notebook
- Fix wire for sensor

Reflections:

Today's main goal, which was oriented on the judging aspect, was for all the team members to be on the same page. So that we all understand each other and can answer the judges, as well as have everyone involved. Half the meeting was answer questions short, precise and quickly responding. After everyone caught up and understood how to answer we had no issues with not answering the questions. We covered all obverses from robot building to programming to the Engineering Notebook to outreach and team dynamics. The main issue which came up as we practiced judging was that we only had a few members who answered all the questions. A few people did not even say a word. We need to work on having everyone involved and contributing. We even had a sub-team meet together to think of sample questions and write down example answers and educate us on the mock questions, yet we still were not prepared.

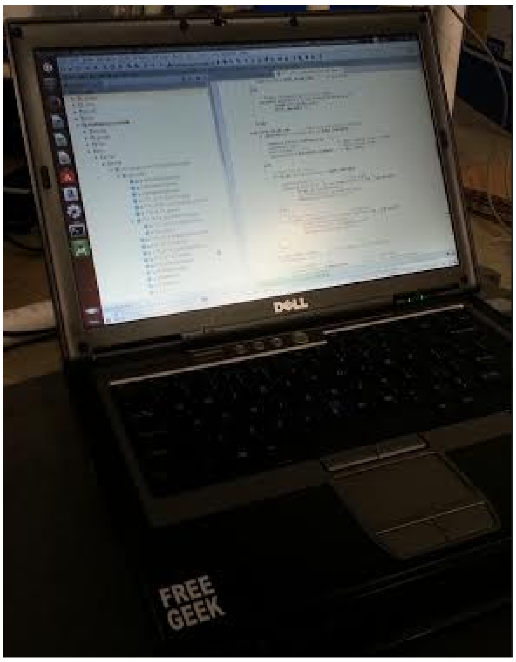
On the facet of the robot, we also had to place the Plexiglass on the back of the robot. In addition to the plexiglass we found some loose screws on our climber drop into shelter arm. After all the small fixes were made we ran our autonomous program. Our robot was not at its best. But, today we fixed all the loose parts and all the

components are looking great.

One issue we had is that when we began the day with the robot, the people whom had worked with the robot yesterday had left it without connecting the wires. We had to connect all of them and realized that on of the module's wire was too short. We spent quite some time going over what to do. We finally decided to use a wire extension and had to spend more time searching for it. In the end, we did find it, but now we know to be more organized with where we put away all our materials and tools.

For programming, Rushali continued to work on the autonomous code and worked on making it consistent from different beginning positions.



The Engineering Notebook subgroup was going over the final copy of the Engineering Notebook. All in all, the Engineering Notebook was very well documented. They just went over small edits and possible areas of last-minute improvements.

Figure 44.1: The Ninjas hard at work.

Wire Length and Resistance
One of the main issues why we had such a difficult deciding whether or not we should use a wire extension is because we did not want to risk our electrical current to face a lot of resistance and have weaker flow and output. Thus, we took the opportunity to do some mathematical computations and research to see the science and math behind wire length and resistance and exactly how much resistance would be gained if we added the wire extension.

The definition of electrical resistance of an electrical conductor is the measure of the difficulty for an electric current to through a conductor. The oppose is electrical conductance, or the easiness of the electrical current to pass through a conductive medium.

From our research, we found that the electrical resistance of a wire is greater as the wire length increases, and it less for a wire of larger cross-sectional area. Also, the material which the wire is made out of is a factor, however in this scenario, as the conductive medium stays constant, we do not have to take that variable into consideration in our calculations. Temperature is also a factor, but considering the environment as ideal and perfect, the formula of the electrical resistance of a wire can be given by

$$R = \frac{\rho * L}{A}$$

where R is the value of resistance in ohms, ρ is the resistivity in ohms time meters, L is the length of the wire in meters, and A is the cross-sectional area of the wire in meters squared.

Theoretically, wire length and resistance should linearly and directly proportionally correlate. In other words, by the laws of physics and electrical science, as the wire becomes longer, the resistance, or the difficulty for an electrical current to pass through, should also increase. Thus, we are going to test that with the two situations of our original wire and extension-added wire.

Below are our calculations. The first set finds the resistance of the wire as the original, and the second one with the added extension. Take note that the second computation is not accurate because the junction of the two wires also plays a role, but at this level, we did not try to go into depth with that.

$$R = \frac{\rho L}{A}$$

$$R = \frac{1.7 \cdot 10^{-8}\,\Omega m \cdot 0.05m}{3.308 \cdot 10^{-6}\,m^2}$$

$$R = \frac{0.000257\,\Omega \cancel{m^2}}{\cancel{m^2}}$$

$$\rightarrow R = 0.000257\,\Omega \leftarrow$$

ρ of copper $= 1.7 \cdot 10^{-8}\,\Omega m$

L of wire $= 0.05m$

A of wire $= 3.308 \cdot 10^{-6}\,m^2$

$$A = \left(\frac{D}{2}\right)^2 \cdot \pi$$

$$A = \left(\frac{0.002m}{2}\right)^2 \cdot \pi$$

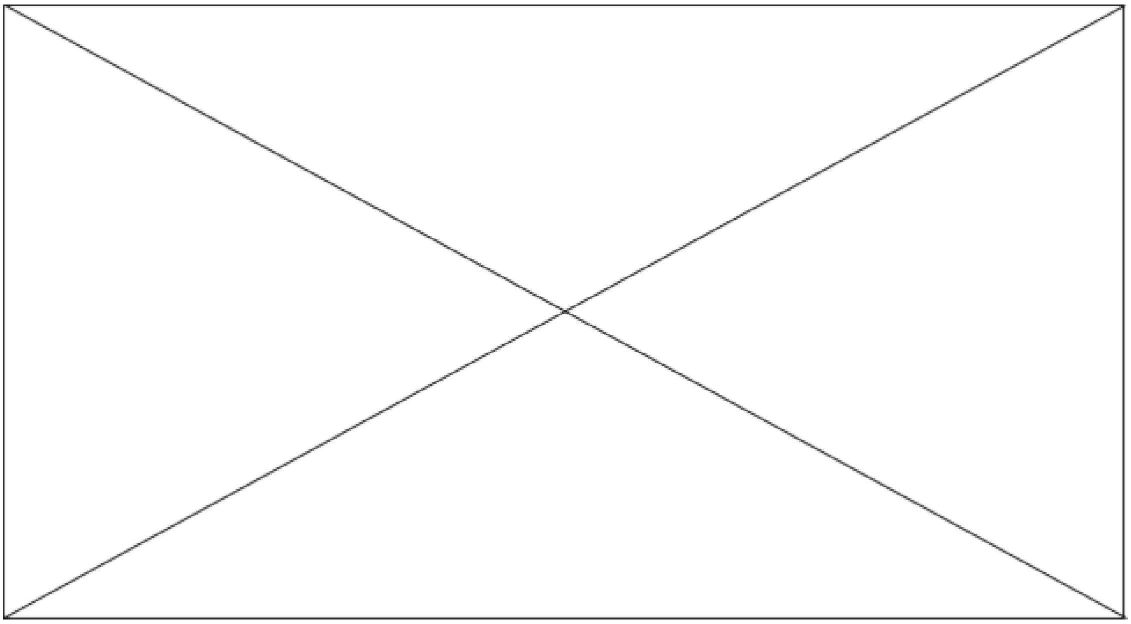
$$A = 3.308 \cdot 10^{-6}\,m^2$$

$$R = \frac{\rho L}{A}$$

$$R = \frac{1.7 \cdot 10^{-8}\,\Omega m \cdot 0.15m}{3.308 \cdot 10^{-6}\,m^2}$$

$$R = 0.007709\,\Omega$$

Submitted By Sahana



45. Gracious Champions

Meeting Date: Sun, 1/17/16, 8:00 AM - 6:00 PM
Personnel Present: Nandhana, Namitha, Maria, Rushali, Shamama, Harini, Irene, Shruthi, Ramya, Aishwarya, Adithi, Sahana, Esha, Rhea, Navyatha

Tasks This Meeting:

- Do inspections
- Go to judging
- Do scouting
- Do well in five matches
- Cheer on ALL teams and evoke the competition spirit
- HAVE FUN!!

Reflections:

Today we had our FTC League Championship!!! All of us were very excited as this was our first year doing FTC. Once we arrived we set up our pit table by putting a black and red table cloth (our team colors), displaying our Engineering Notebook and AutoCheck application, and putting our building kit and snacks on the table. We also ordered Starbucks for all of us so it would wake us up and get us energetic!

Inspection
Our inspection went well! Everything was great on our robot and the robot fit in the 18x18x18 sizing box. For our field inspection everything went well except when we were going up the mountain, our robot flipped over and a piece of our plexiglass broke off on the back. We tried our best to fix it by using duct tape to secure it back on the robot. Overall our inspections went well!

Judging
Our judging went really well! The judges seemed interested in our robot and our

Figure 45.1: Awaiting our judging session. Both nervousness and excitement wafts in the air.

engineering notebook as well. They asked a lot of questions about our robot, like how we came up with our design and what parts our robot has. We did very good in answering all the questions the judges had, although we could've had more people answering the questions. Although we were not as prepared for all robot questions, since we had been practicing many areas as well. The feedback they gave was that our robot was in need of some improvement but they were impressed with our outreach. Overall the judging went great but next time we will be more prepared!

Scouting
One of our team members made a bunch of scouting sheets, so it would help us get information about other teams and what their robot can do. On the inspection sheets we went over their autonomous, driver-controlled, and end game abilities and consistencies. Each person on the scouting team got three teams to scout and at the end we would make a list of which teams were the best to have as an alliance partner and which team we would choose if we were one of the alliance captains. We ordered the possible alliance partners based off how their robot's abilities complement ours and our drive team compatibility and cooperation. Scouting went pretty well as we were able to get all the teams down, but next time we know what we're up to so we will be more effective in our scouting.

Matches
Overall of our matches went well and we scored a lot of points. We picked up a lot of debris with our debris collecting system and we dropped most of it in the mountain low zone, so we got a lot of points from that. We also had no loose connections with our USB and no problems with the wifi direct, so that helped us with our matches too! The best thing though was our consistently! This was a good selling point during our alliance meeting.

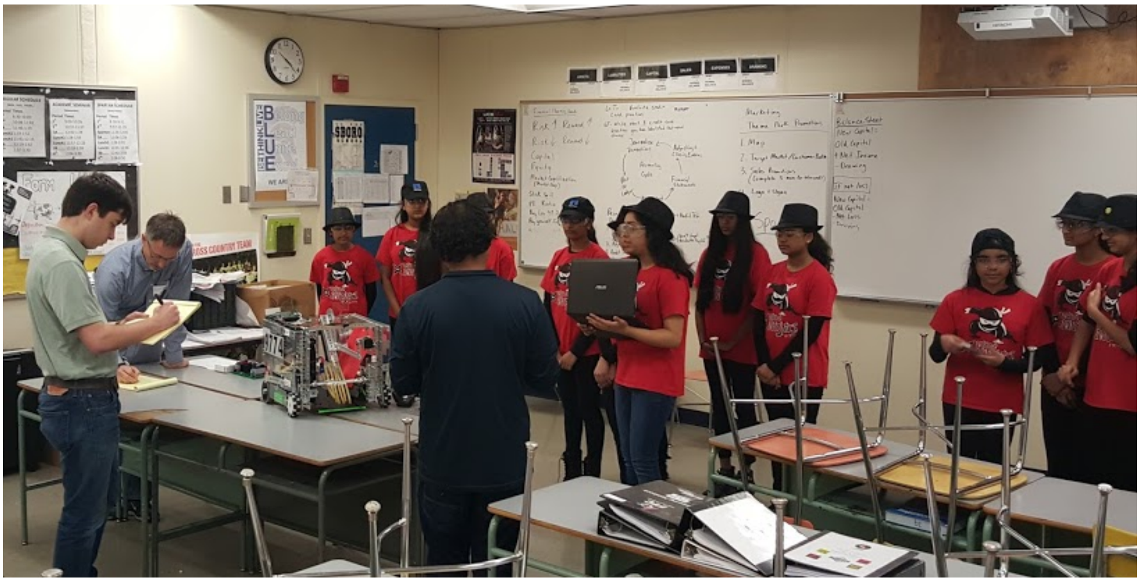


Figure 45.2: Going through our judging presentation.

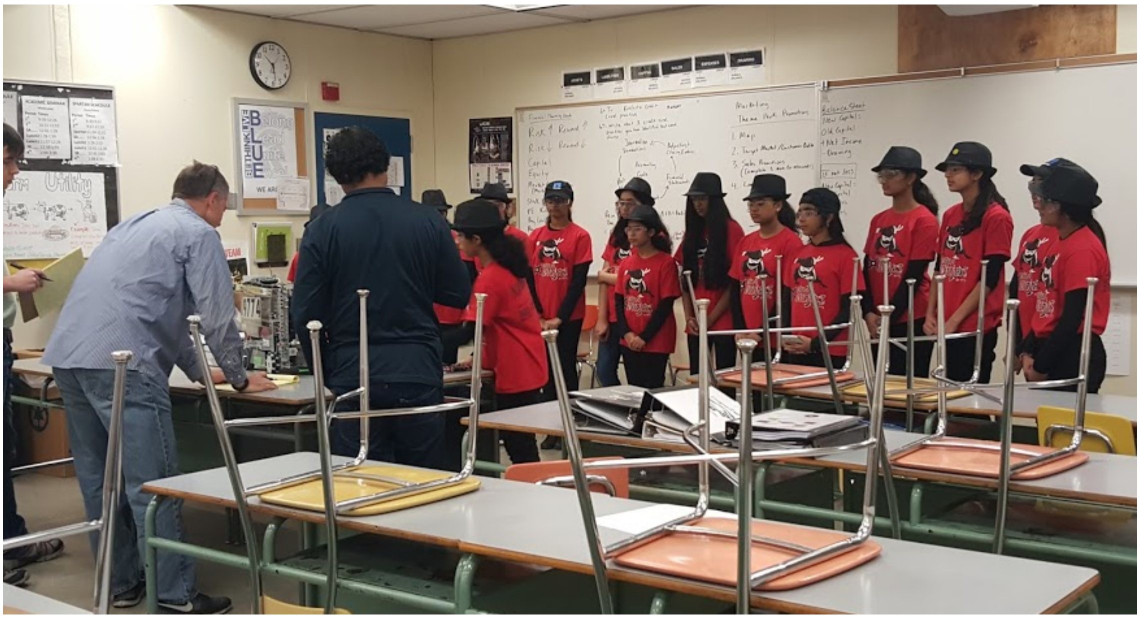


Figure 45.3: Answering the judges' questions about the robot.

Scouting Sheet: FIRST RES-Q

Team Name:
Team Number: **Match Number:**

Autonomous:
Rescue beacon reset button y n
Climbers scored in shelter 0 1 2
End of Autonomous:
Robot in floor goal/repair zone ☐
Robot in partial Low Zone ☐
Robot in Low Zone ☐
Robot in Mid Zone ☐
Robot in High Zone ☐

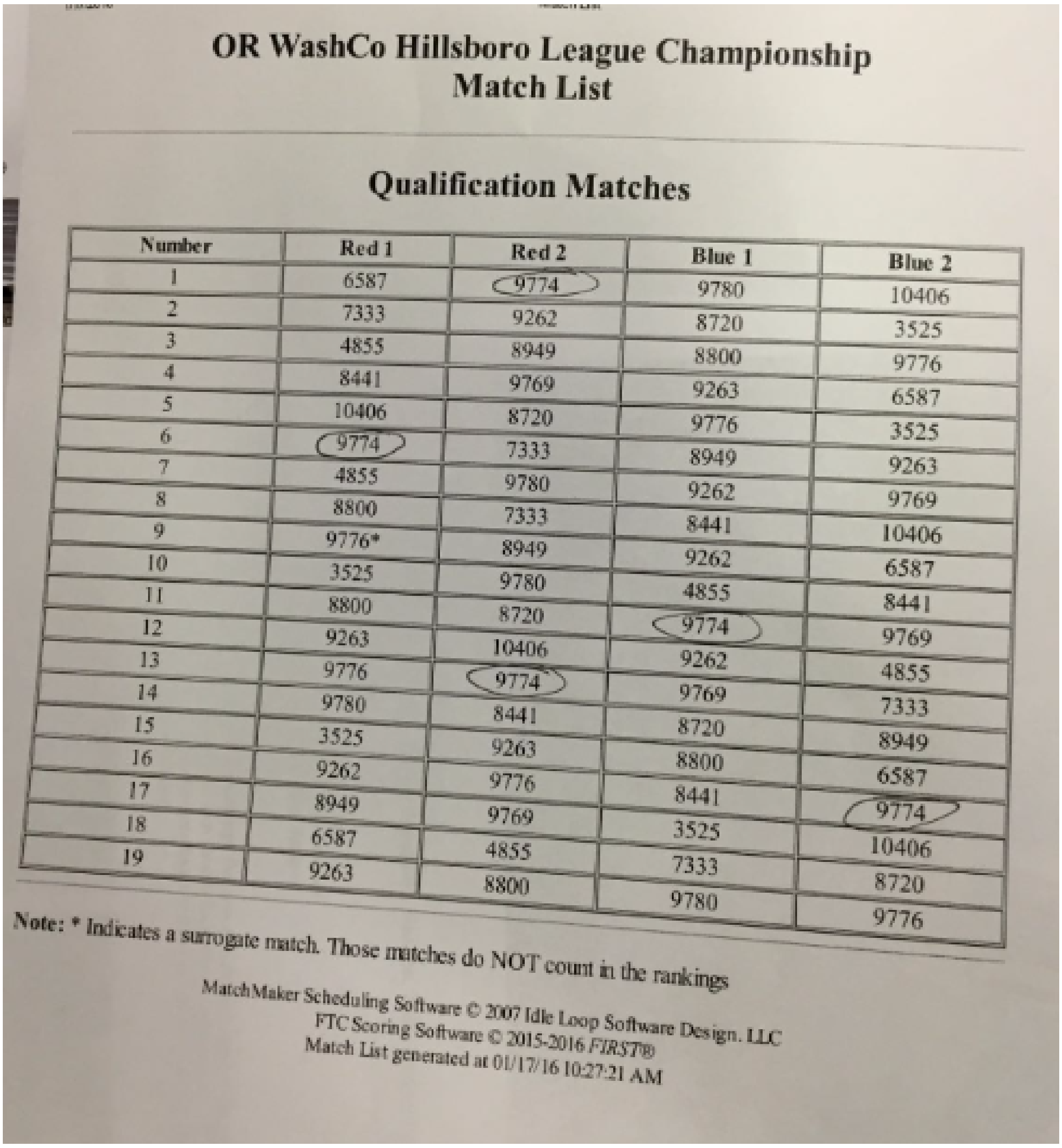
Overall
Average Points:
Highest Points:
Penalty Points:
(how much they gave to others)

Tele-Op:
Scored in Floor Goal 0 1 2 3
Scored in Low Goal 0 1 2 3
Scored in Mid Goal 0 1 2 3
Scored in High Goal 0 1 2 3
Climbers in shelter 0 1 2
(including autonomous)
Climbers released 1 2 3

End Game:
Robot in partial Low Zone ☐
Robot in Low Zone ☐
Robot in Mid Zone ☐
Robot in High Zone ☐
Robot in Cliff Zone ☐
All Clear Signal ☐
Robot Hanging y n

Figure 45.4: A screenshot of our online scouting sheet.

Figure 45.5: Determining which teams to approach as an Alliance with all our notes and observations.



OR WashCo Hillsboro League Championship
Match List

Qualification Matches

Number	Red 1	Red 2	Blue 1	Blue 2
1	6587	9774	9780	10406
2	7333	9262	8720	3525
3	4855	8949	8800	9776
4	8441	9769	9263	6587
5	10406	8720	9776	3525
6	9774	7333	8949	9263
7	4855	9780	9262	9769
8	8800	7333	8441	10406
9	9776*	8949	9262	6587
10	3525	9780	4855	8441
11	8800	8720	9774	9769
12	9263	10406	9262	4855
13	9776	9774	9769	7333
14	9780	8441	8720	8949
15	3525	9263	8800	6587
16	9262	9776	8441	9774
17	8949	9769	3525	10406
18	6587	4855	7333	8720
19	9263	8800	9780	9776

Note: * Indicates a surrogate match. Those matches do NOT count in the rankings

MatchMaker Scheduling Software © 2007 Idle Loop Software Design, LLC
FTC Scoring Software © 2015-2016 *FIRST*®
Match List generated at 01/17/16 10:27:21 AM

Match Scores

Match 1:

- Red Alliance
- B: 22 R: 71
- WON!!!
- Rank #5

We did very well in this match, which was good because it put us at a good start. Our robot was able to drop one climber into the shelter after we ran our autonomous which successfully landed in the floor goal. Throughout the match we scored into the low mountain goal and ended in the mountain. We performed very well in our first match!

Match 2:

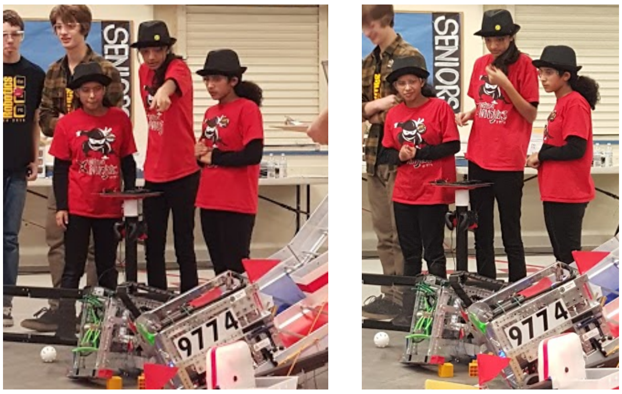


Figure 45.6: Namitha, Rushali, and Nandhana as drive team.

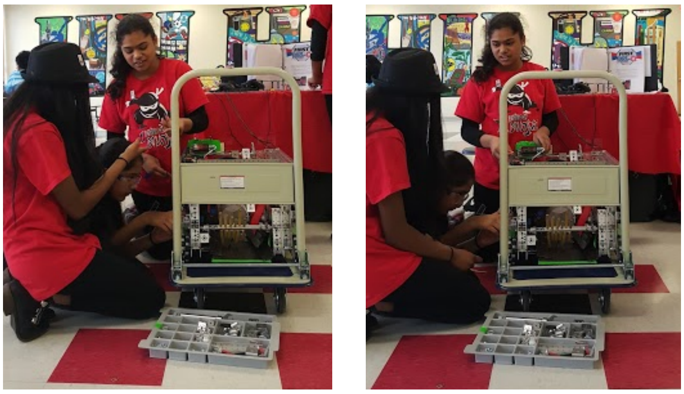


Figure 45.7: The build team hard at work.

- Red Alliance
- B: 142 R: 47
- Lost :(
- Rank #6

Match 3:
- Blue Alliance
- B: 137 R: 191
- Lost :(
- Rank #7

Match 4:
- Red Alliance
- B: 69 R: 52
- Lost :(
- Rank #6

Match 5:
- Blue Alliance
- B: 159 R: 57
- WON!!!
- Rank #5

At the end of all the matches we were at rank #6!

Elimination Matches
Our Alliance Captain convinced the 2nd seated team 7333 The Combustible Lemons, who graciously invited us to be their alliance partner and we graciously accepted! While they focused on hanging their robot we focused on filling up the low zone mountain goal and depositing climbers. Our teams worked really well together! The elimination matches went well, our robot was extremely consistent in scoring during the semi finals, but a slip in our spinner gear prevented us from picking up debris in our last two final rounds. We were very proud that we had even made it to the finals!

Elimination Match Scores

Match 1:
- Red Alliance
- B: 64 R: 75
- WON!!!

Match 2:
- Red Alliance
- B: 61 R: 91
- WON!!!

Since we won two out of the three matches, we made it to the final matches. All of us were really happy and enthusiastic!

Final Match Scores

Match 1:
- Blue Alliance
- B: 117 R: 200
- Lost

Between our matches we had a slip in our spinning gear, and since scoring was our main area we struggled to push blocks and balls into the scoring areas. Next time we need to check our main scoring areas before the match so we can score during the match. Also our alliance's robot had a connection fail that went into discussion as a possible rematch opportunity, but the judges decided against it. We were not let down by this and had lots of support from the build team to fix the gear before the final round.

Match 2:
- Blue Alliance
- B: 54 R: 155

- Lost

Our robot was the only robot to move during autonomous, and immediately after we scored two climbers in the shelter. Our spinner was working fine in the beginning and we scored multiple times to the mountain low goal. We had talked to our alliance prior and had decided they take the mountain with the low goal so we would have more room. This was pretty helpful until our spinner got stuck again. Funny enough we were the only robot running while Batteries in Black was waiting for end game to start. We decided to remove the debris from the red alliance floor goal.

We were really proud to be a part of the 2nd place allegiance and make it to the Finals. As a rookie team, we could not believe we had gone this far! We are very grateful toward the Combustible Lemons for choosing us as their Alliance partner and for allowing us the chance to compete with them in the finals!

Cheering

To show good sportsmanship and gracious professionalism we brought red pom poms and cheered for every team when they got points in their matches. We cheered the most and loudest when they announced our team name and when we scored points! But we not only cheered for our own team, but the other teams in the competition! The judges seemed to noticed that and even announced it when we won the Connect Award!

Engineering Notebook

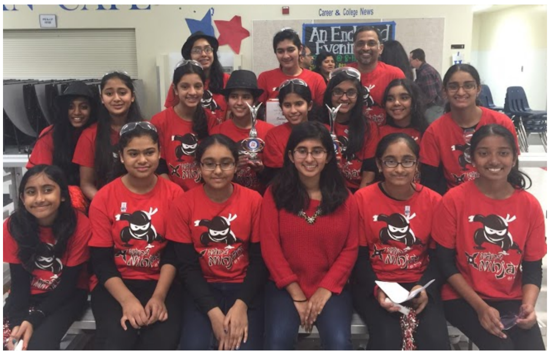
When we got our Engineering Notebook back from the judges, all of the comments were good, but we forgot to add signatures to all of our logs. Other than that they said our Engineering Log was great!

Think Award

The only reason we didn't do that well in the Think Award was because of the signatures. We had misunderstood the rules and thought that just writing whom has submitted the log would be enough, but we were incorrect. Nonetheless, that is such a small detail, we can easily fix that. Another aspect which we lacked in the Think Award category is that we had little to none scientific and mathematical backing to our documentation. We skimmed over all the physics and math that came into play with our robot. Other small things such as emphasis on documenting the wrong things and not creating an excellent Summary Page held us back, but other than that our Engineering Notebook was amazing!!! Cathy Swider even came up to us to congratulate us on creating such a professional Engineering Notebook and quoted the documentation as, "Beautiful!"

Connect Award
For the Connect Award, we got excellent on all aspects, and all the feedback that the judges could give us was to continue the great work! The loved our business and sustainability plans and said we had a very good idea about how we wanted to continue on as a FIRST team. We also had a good number of in-person contacts and our team actively engaged with the community to promote FIRST and STEM and we had good team dynamics and teamwork which the judges appreciated. In addition our cheering in the field proved our connections with all the teams and our enthusiasm for FIRST.

Rockwell Collins Innovate Award
We were not heading for the Rockwell Collins Innovate Award, so we can understand why we scored so poorly in it. Our main issues were that our Engineering Notebook does not outline our design process efficiently and that our robot was not unique or robust enough. They were also very disappointed to hear that we had never tested out or AutoCheck application.

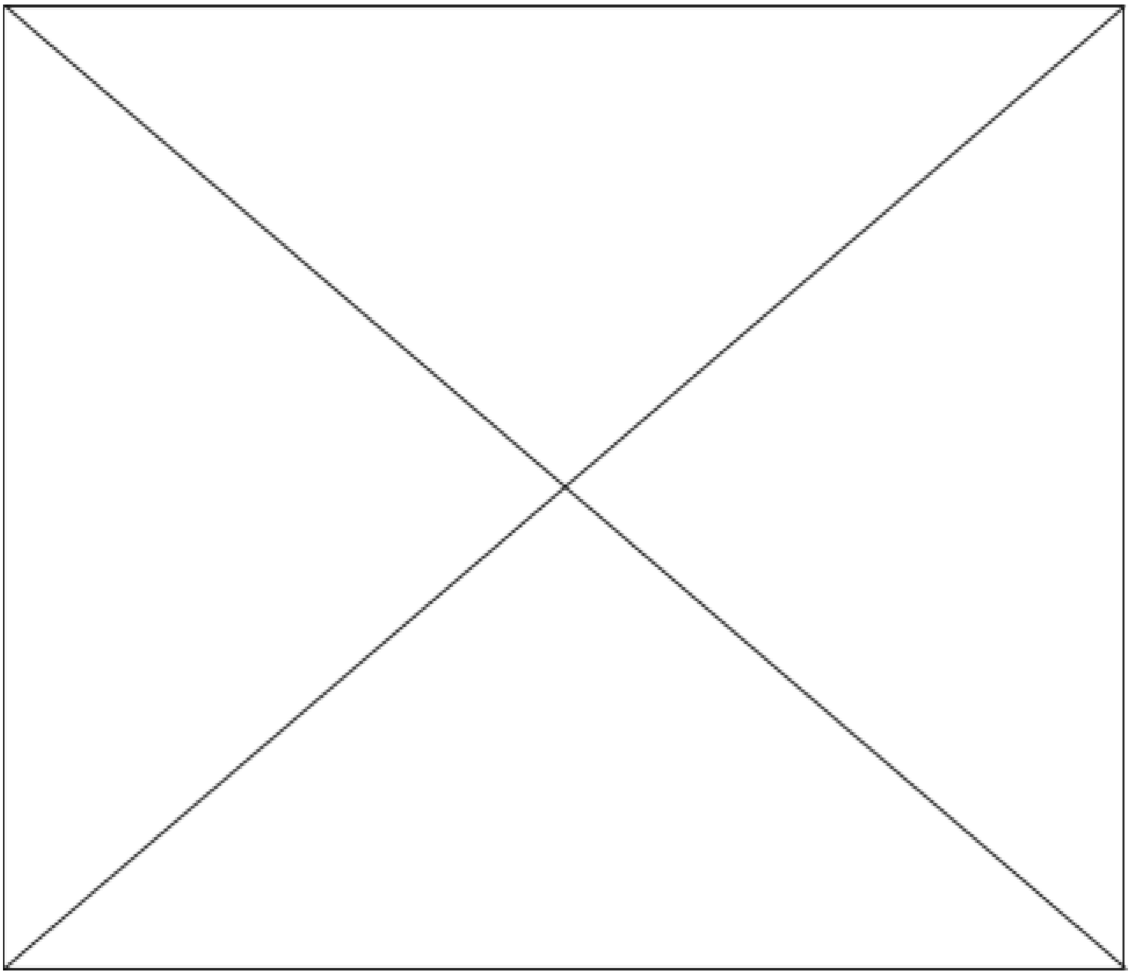


PTC Design Award
The PTC Design Award was also one of the last awards that was on our mind when going through the season, however we managed to score well in the section. Out of the four boxes, four of them were "good," and one "excellent." Not even trying to, we got those results in the award section. Our main issue was that our sensors were very vaguely explained and once again, they pointed out their disappointment in our never-tested app.

Motivate Award As in the Connect Award, we scored perfectly in the Motivate Award. The judges loved our participation in FLL and FTC and highlighted that our t-shirts gave a professional outlook to our team, and that our spirit extends to all teams. They also appreciated the fact that we helped fund other FIRST teams and how we divided the work well among the team members, and we had amazing participation in from all members.

Awards
All of us were excited and looking forward to the award ceremony! Our team was nominated for the Motivate Award and the Connect Award. We we didn't win the Motivate Award, but won the Connect Award!!! Our whole team was extremely thrilled! We also won the second place Alliance Award, along with the Combustible Lemons! We even were eligible to advance for fifth and sixth seated teams: fifth for our second place alliance and sixth for our connect award! Since we got second place, we ADVANCED TO STATE SUPER QUALIFIER!!!

Submitted By Adithi



V

Team Summaries: Pre-Season

46. Creativity at Camp (Day 1)

Meeting Date: Wed, 06/17/2015, 1:00 PM - 3:00 PM
Personnel Present: Nandhana, Namitha

Tasks This Meeting:

- Inform the kids about FIRST
- Give the kids a chance to try out the functions of a EV3 Mindstorms robot
- Do hands on activities with the robots like building and programming
- Make sure they have fun!

Reflections:

This was a really fun experience for both our team and the kids at the Math Wizard Summer Camp! We demonstrated two EV3 Mindstorms robots using built in programs and live runs with a Mindstorms Commander app. Our teammates also educated the group about programs in FIRST that they would be interested in joining as well as answering questions about the competition and robots. We organized a hands on activity where the kids were split into teams and were asked to design an attachment that could hold a ball and throw it into a soccer net. They learned how to work as a team and come up with creative strategies by combining ideas, design ideas on paper and with prototypes and also how to build functioning parts to the robot that would achieve a set mission goal. Additionally we added points and awards to make the contest more enjoyable for the class. We plan on teaching the students how to program using EV3 software when we come back tomorrow since the software was still downloading onto the computers while we were there.

We learned that kids enjoy being in a competition in teams. We had a really great experience all together, and we can't wait to come back tomorrow!

EV3 Mindstorms Software and Parts
We demonstrated two EV3 Mindstorms robots using both built in programs and live runs with a Mindstorms Commander app.

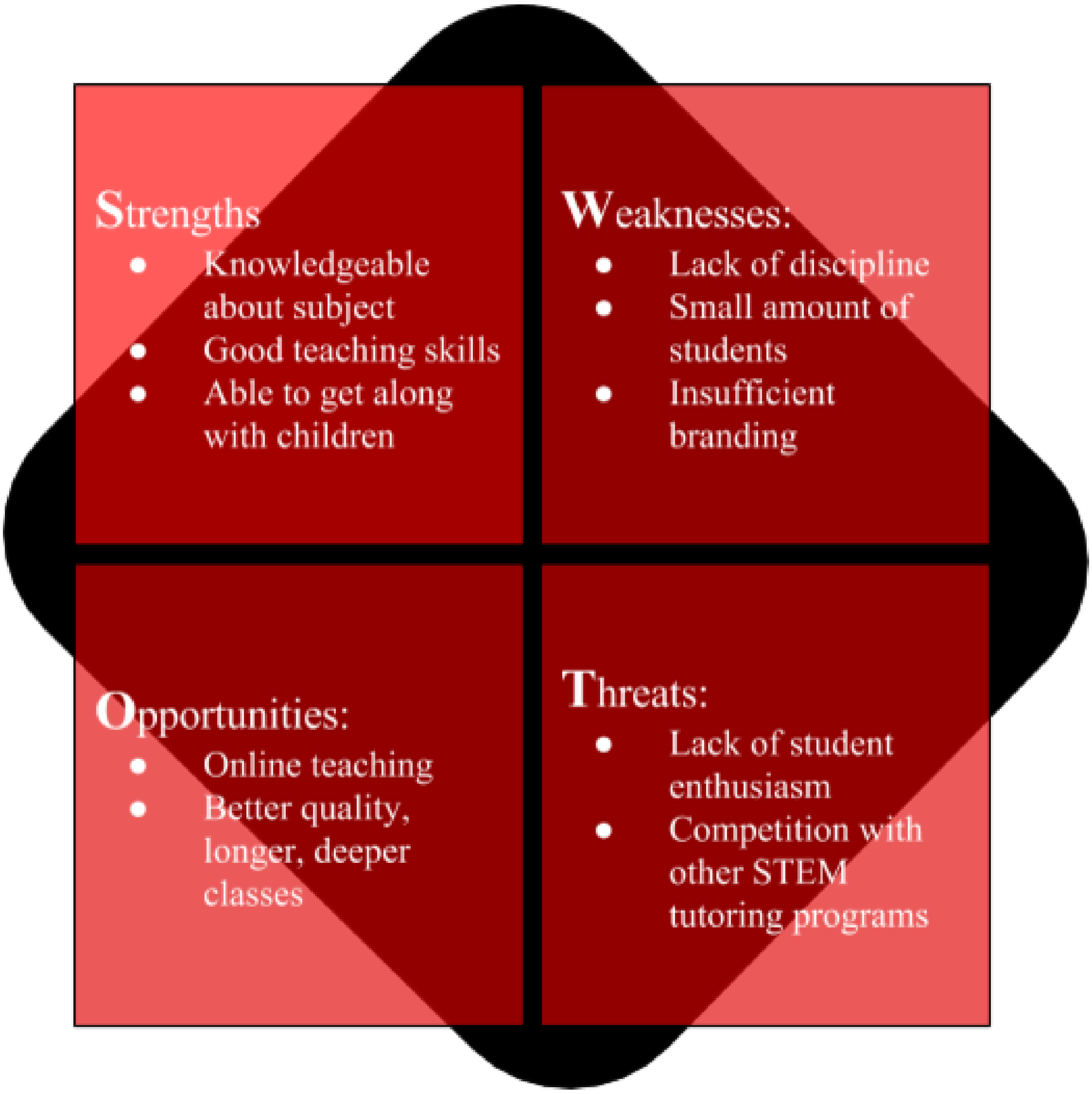
FIRST Programs
Our teammates also educated the group about programs in FIRST that they would be interested in joining as well as answering questions about the competition and robots.

Activities
We organized a hands on activity where the kids were split into teams and were asked to design an attachment that could hold a ball and throw it into a soccer net. They learned how to work as a team and come up with creative strategies by combining ideas, design ideas on paper and with prototypes and also how to build functioning parts to the robot that would achieve a set mission goal. Additionally we added points and awards to make the contest more enjoyable for the class.

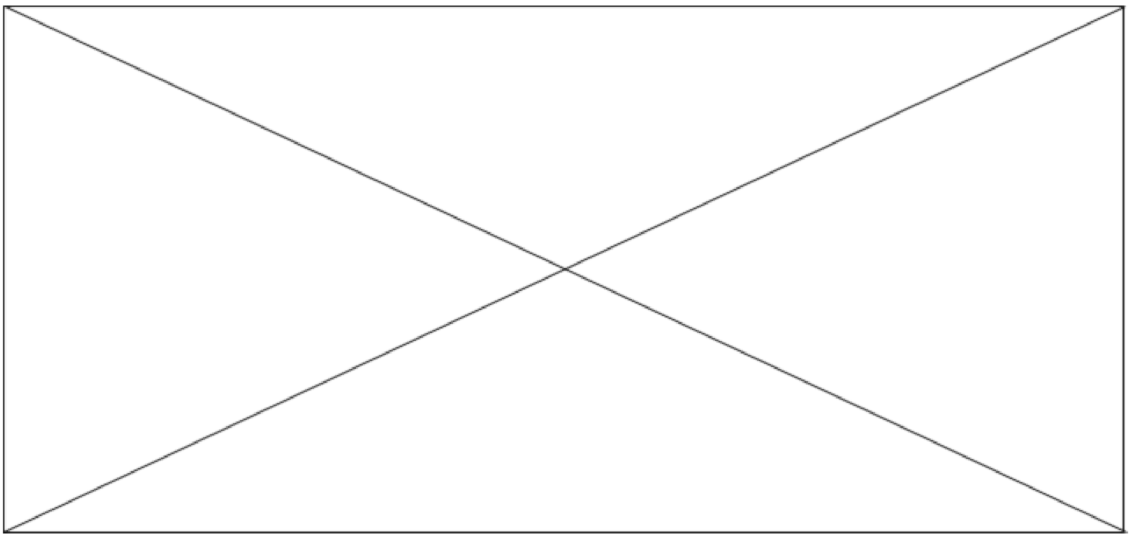
The purpose of the Creativity in Camp two-day workshop was to spread the message of FIRST and science, technology, engineering, and mathematics to young children. The facility used was the Math Wizard educational center which is located in Bethany. During the camp we demonstrated two EV3 Mindstorms robots through pre-built programs as well as a live run Bluetooth connected app, Lego Mindstorms Commander. Later we organized a hands-on activity where the students learned how to work as a team, design ideas, and build functioning parts, all this in the form of a competition. Both teams had to build a ball thrower which would throw a ball into a soccer goal. During the competition points were added for positive behavior which influenced sportsmanship and adhered to Core Values and Gracious Professionalism. Also we made sure they worked well together and awarded points for good teamwork. In the end both teams made a winning attachment and they learned the basics of robotics in a fun way!

But not only did they get to learn our robotics, but the whole package of FIRST and STEM. We gave then an entire and thorough walkthrough of the FIRST program. For Inspiration and Recognition of Science and Technology, better known by its acronym FIRST, is truly such an enriching experience and journey, and we were glad to share our knowledge about the program with these curious children. We answered all their questions and inspired many of them to join teams. Several of the children immediately bought Mindstorms kits after the first day of camp.

SWOT Analysis
As seen by the SWOT analysis on the next page, our summer camp came with both its advantages and disadvantages. We hope to continue holding programs like this and improve upon them to make them more frequent and open to many more people. In the strength perspective, we strive with tutors who are knowledgeable about the subject. Our tutors also are credited with excellent teaching skills and the ability to work well and get along with children. These are important pillars in any camp or program; the teachers must be able to keep a calm mind at all times and be able to deal with children. This however leads to a weakness we have with our tutors. Even if they may be able to get along and be nice with children, they lack the ability to discipline and are confused when it comes to children who simply do not want to follow the rules. Another down point is the low number of students. We are lacking the sponsorship and publicity to make this camp better. We however hope to achieve all that in later years. We need better branding methods and awareness. Duly noted, this opens up opportunities with possible online classes. The only bad part of online teaching is that is takes away the hands-on element and STEM, especially robotics and technology, is not the same without kinesthetic learning. We could possibly hold online classes for older children to teach more conceptual lesson plans. Creating better quality classes is also in our best interest. We could create longer classes that span more days. Also, we could create camps of all different aspects and that go deeper into STEM. Our threats include lack of student enthusiasm and participation. All classes are one percent teacher enthusiasm and 99 percent student enthusiasm. It is the students that bring the true education into a classroom. Also, other STEM and FIRST camps and programs may compete with our classes. All in all, if we work harder, we could possibly create a larger program to promote FIRST and STEM to young children.



Submitted By Namitha



47. Creativity at Camp (Day 2)

Meeting Date: Thu, 06/18/2015, 1:00 PM - 3:00 PM
Personnel Present: Nandhana, Namitha

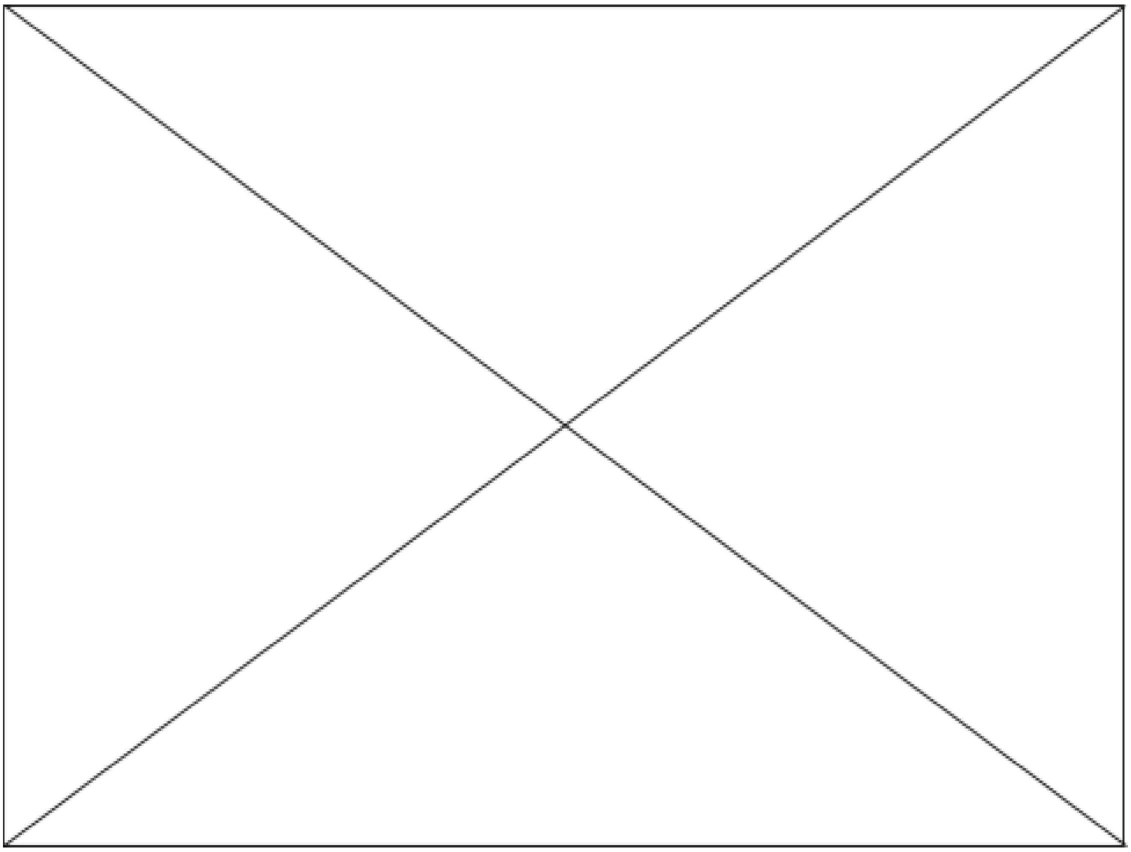
Tasks This Meeting:

- Inform the kids about FIRST
- Give the kids a chance to try out the functions of a EV3 Mindstorms robot
- Do hands on activities with the robots like building and programming
- Make sure they have fun!

Reflections:

With only one EV3 it was hard for the different groups to make their own robot, but we managed. The kids really enjoyed working with the robots and can now do some basic programming. We had a few kids with frustrating moments with programming but nonetheless, we passed all those eventually. In more detail, we taught them how to use the sound blocks and the sensor blocks, and time control blocks. They also learned how to download their program files onto the robots.

It was a great opportunity to share our experience and knowledge with the kids. It also warmed our hearts when we saw them using the virtue of teamwork. Different people did different jobs, and for example, one attached a motor while another programmed. We are very happy that we have inspired them to now enter as a FLL team and we are happy to continue to mentor them.



Submitted By Namitha

48. Learning On Wings

Meeting Date: Fri, 07/17/2015
Personnel Present: Adithi, Maria, Irene

Tasks This Meeting:

- Who the Navy Blue Angels are
- What the Navy Blue Angels do
- How the Navy Blue Angels work together

Reflections:

We went to the Navy Blue Angels showcase event where there was not only the Navy Blue Angels, but there was other stalls as well. In one stall there was a stunt robot for the Air Force. The robot actually goes on the battlefield during the war time. There was also the FTC stall where they displayed the FTC base robot which consisted of the Android smart phone, the motors and the other essential parts. All the stalls were very interesting but the Air Force stunt robot and the FTC stalls were the most fascinating ones!

The Blue Angels showcase event was very cool! The Blue Angels' mission is to showcase the pride and professionalism of the US Navy and the Marine Corps by inspiring a culture of excellence. There are a total of 16 officers who voluntarily serve with the Blue Angels. Each year the team typically selects three tactical (fighter or fighter/attack) jet pilots, two support officers and one Marine Corps C-130 pilot for the air show performance. Fat Albert (the seventh Blue Angel) carries the support and technical members wherever the Blue Angels are performing. The Blue Angels mentioned that it is typical to overlook how much effort is put in by the support and technical teams for the Blue Angels to complete a successful show. Can you believe that the Blue Angels jets are only eighteen inches apart from each other during the world famous diamond formation.

Figure 48.1: Air Force stunt robot.

Our team should be inspired to work like the Blue Angels team with concentration, focus, courage and teamwork. And if we do that we will definitely be successful in our competition and in everything we do!

Submitted By Adithi

49. Starting Small: Ant-Man Microtech Workshop

Meeting Date: Fri, 07/24/2015
Personnel Present: Nandhana, Namitha, Maria, Rushali, Irene, Harini, Shruthi, Adithi, Navyatha, Rhea, Sahana

Tasks This Meeting:

- Discover the Raspberry Pi
- Learn about the different uses of the Raspberry Pi
- Learn about the different parts of the Raspberry Pi
- Set up the Pi with all its cables and connections
- See some of the programming that goes into a finished product
- Try some basic commands
- Try out some programming on the Raspberry Pi
- Send a video to Anna about what we did on the Pi
- Have fun with the Raspberry Pi and try something new!

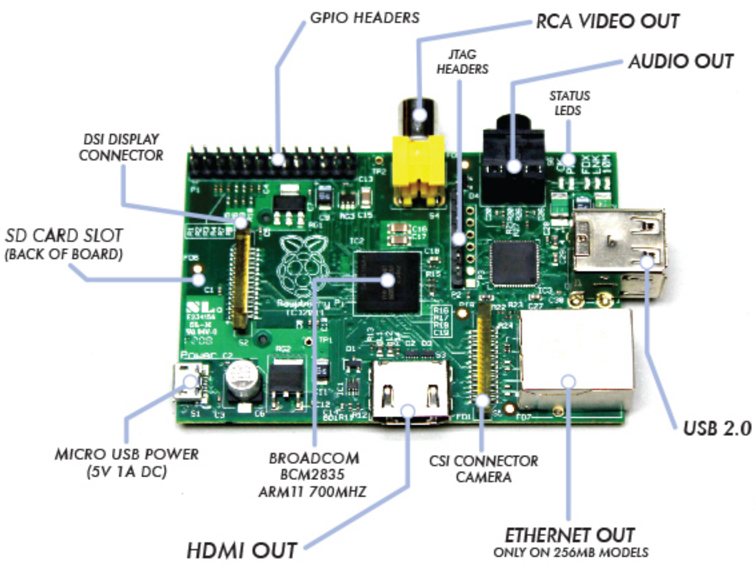
Reflections:

This was a wonderful experience. We got to work with the winner of the Ant-Man microtech challenge winner: Anna Nixon. She had one a world wide contest and we are very lucky to have her teach us today. The contest was to encourage girls to join STEM fields and as part of the STEM for Girls organization we were all very pleased to join the workshop.

Today we learned how to use the Raspberry Pi, specifically to make a interactive toy. Anna taught us how to set it up and do some basic coding. Though we did not get to programming our toy, we were given instructions on how to finish it up at home. We each got to take home a complete set of the Raspberry Pi. This means we all went back with a Raspberry Pi 2, a Pi camera, HDMI cables, WiPi dongle, speaker, microphone, a teddy bear and lastly a lot more knowledge!

A total of girls came to the camp. We are proud to say that the Nano Ninjas helped out with it. Some of the members helped pack and distribute everything while others helped out during the camp. STEM4Girls is happy at the success of the workshop and we are all very thankful to Ant-Man, Marvel, Disney, and most of all our teacher: Anna.

Raspberry Pi
The Raspberry Pi (it's not edible) is a mini computer, in the size of a normal adult fist. It can do all the normal features of a regular computer and more. For one, you can program on this device. We learned about the microtech and what it can be used for. Our teacher, Anna Nixon, has used the Raspberry Pi to program an interactive toy.



[1]

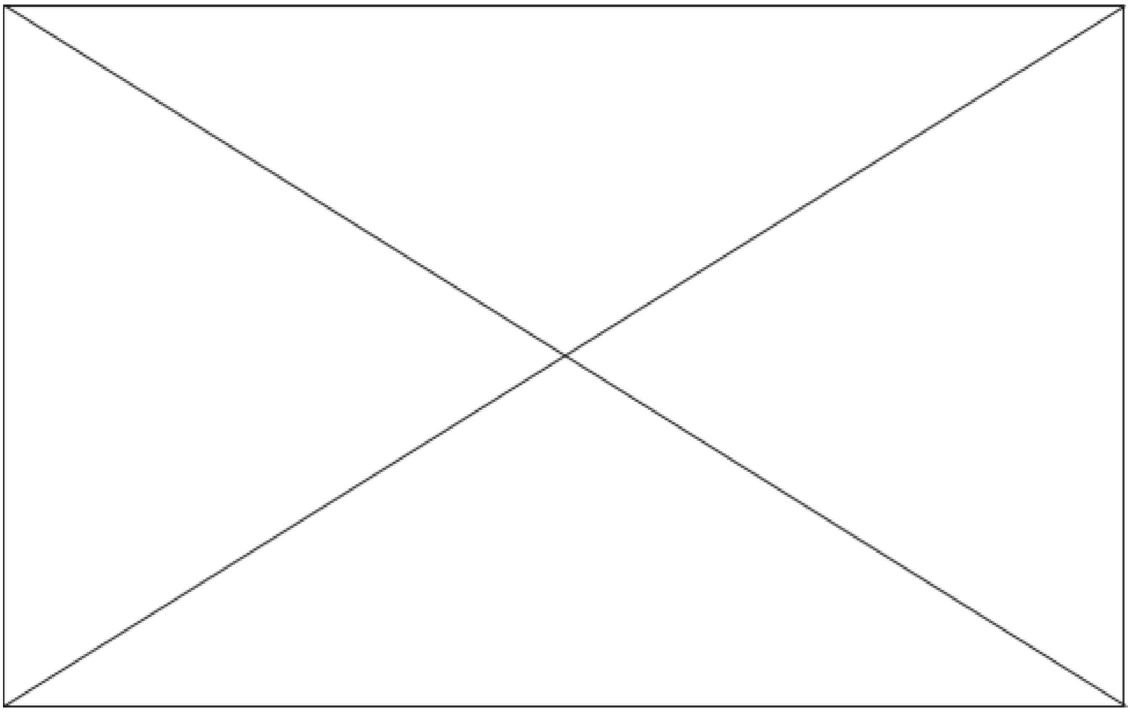
Pi Camera
The lense is as small as the plastic part of a push pin. You can use this for face detection and face recognition.

- With Face Detection, the Pi will detect where the face is. This will put a square around the person's face, if it detects it. During the workshop we learned about Face Detection
- Face recognition is different than Face Detection. In this version the Pi camera will recognize the person's face. So it will be able to tell the difference between two different people. Ex: it knows Irene apart from Adithi.

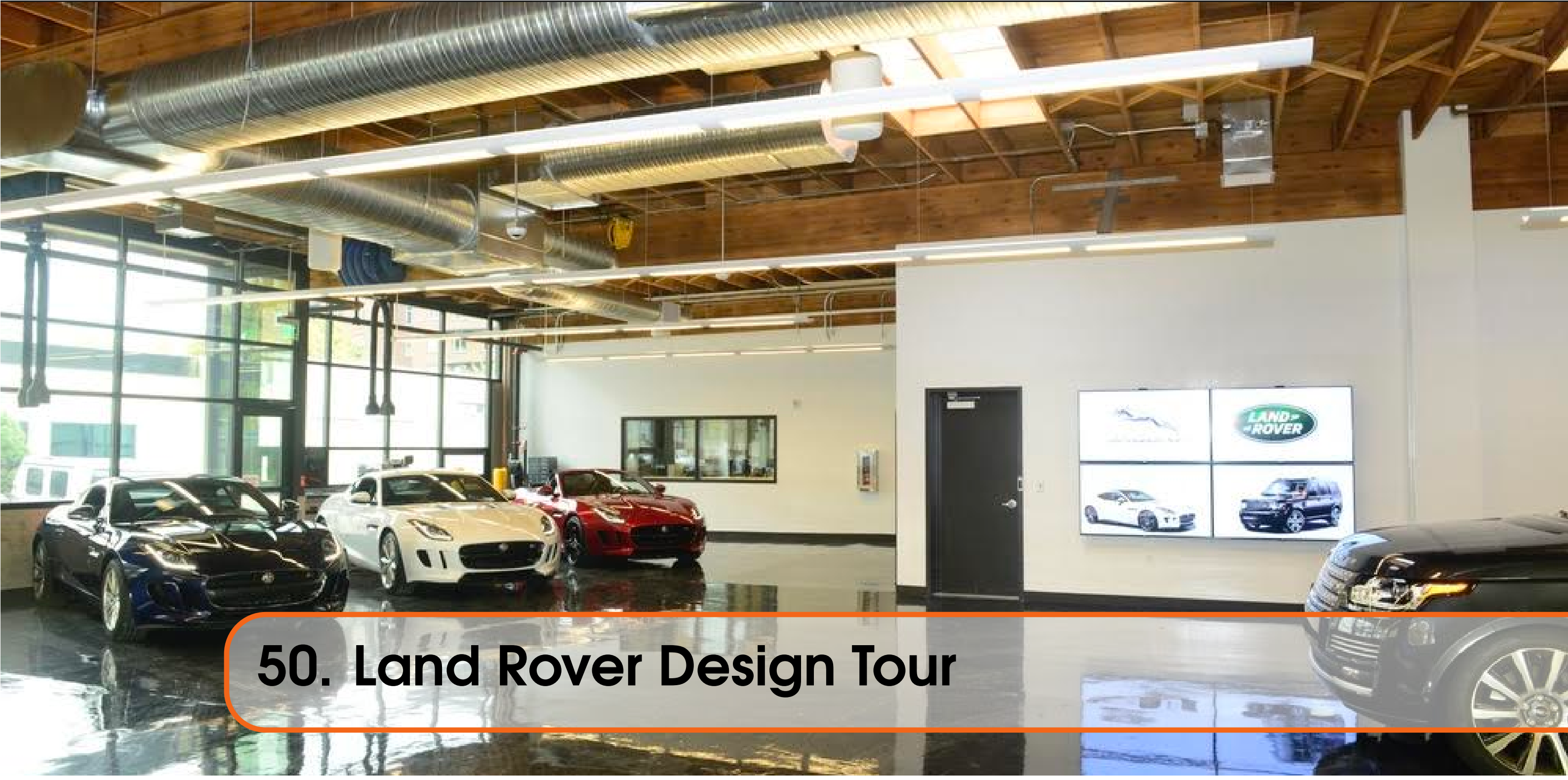
IP Address
This is a very important piece of information. With the IP address the user can use the Pi. On a desktop it is not needed to start programming, but on a laptop it is. These numbers are also linked to a website in which you can program. Anna used this website to create an interactive display for her toy.

SD Card
This was one of the other important parts to the Raspberry Pi. This tiny chip is about the size of your pinky nail, but yet it holds the entire computer in itself. The programs are all stored in the SD card. Without the chip your Raspberry Pi was nothing. Similar to the movie Big Hero 6, the chip inside Baymax that Tadashi programmed, is similar to the chip in the Raspberry Pi.

Submitted By Nandhana



[1]Matthew Murray, "Rasberry Pi," 2012



50. Land Rover Design Tour

Meeting Date: Thu, 06/25/2015
Personnel Present: Namitha, Nandhana, Adithi

Tasks This Meeting:

- Look at the landrover designs
- Find out how they work
- How they program the cars
- The roles of the employees
- Look at other FTC robots and how they work

Reflections: The Land Rover Design Tour was really cool! We got to see some of the cars they have been working on and they gave us a tour of the whole place. The employees talked about their roles and what they do during the day. One worker showed us where they practice driving the car in a simulation to see if anything in the car distracts them or if the car is working fine or not. We got to ask a lot of interesting questions that they answered. We also showed them our FLL robot and told them how it worked. One employee was a judge at FLL before and was really surprised when our robot was trying to find a line to follow because other teams usually don't follow the line since the programming was too hard. Overall we didn't really get any information that would help with building our robot, but it was still really cool to see how they programmed the car and to see some of the cars they had worked on. It was great to meet the other teams and learn together.

Here are some of the roles and what they do:

- JavaScript Developer
  Uses JavaScript to make interactions when you push a button
  Use JavaScript to program the car

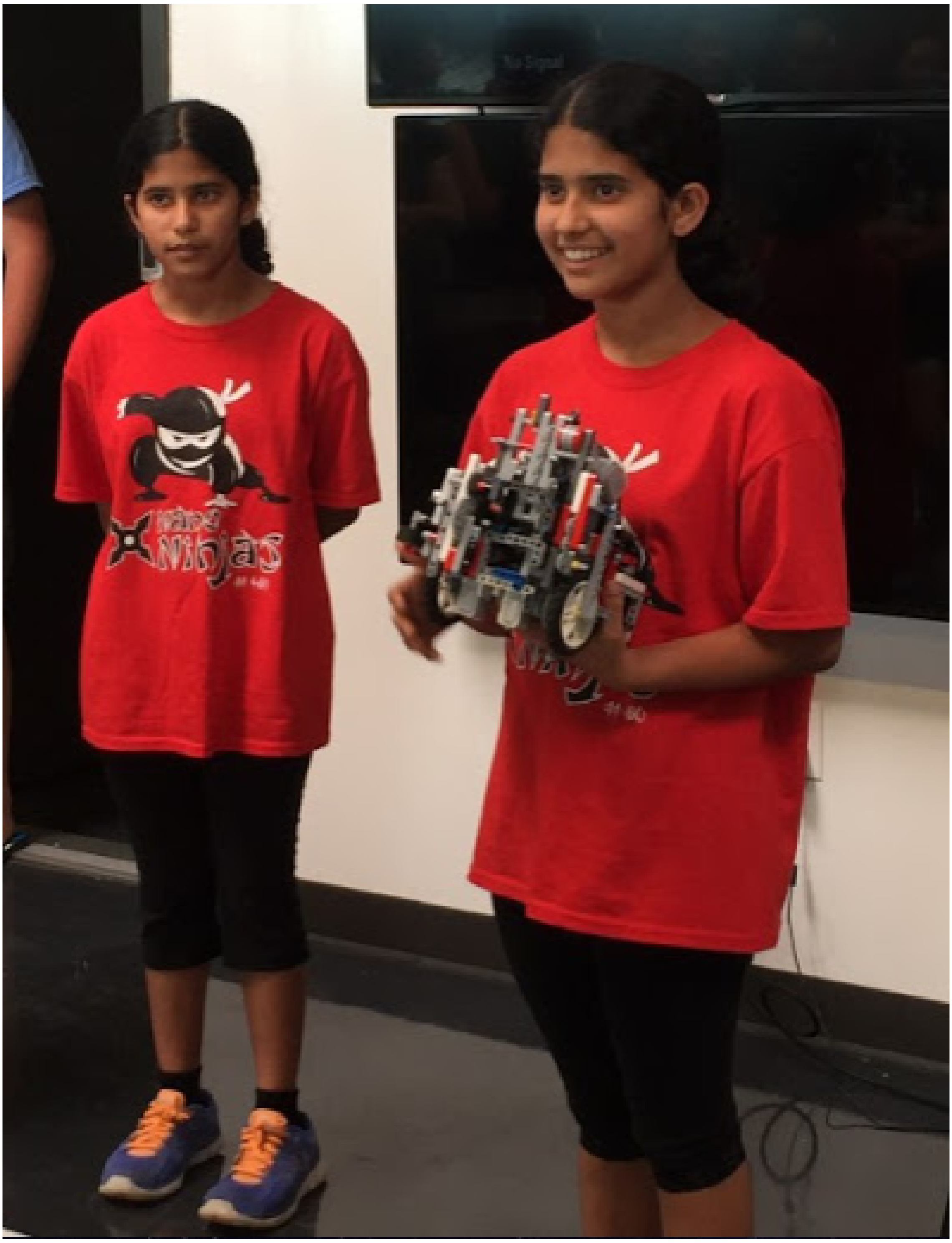


Figure 50.1: Namitha and Nandhana explaining our last year FLL robot.

- Software Developer
  They work on the software of the car that makes the car run smoothly
  They are working on a project to put tablets into the backseat of the car, so it is like your personal iPad or tablet in the car
- JavaScript Engineer
  They build apps to work in the car
  Help people when they need help with a process
- Graphics Developer
  They do graphic designing, video editing, illustrating, font-end development using scripts and some programming languages
  Write code that creates the look and feel of the what you see in apps or websites, and design what happens and how it happens

Attendants

- Hot Wired
- Syntax Error
- Gifted Gears
- Tecaholix
- Nano Ninjas

Submitted By Adithi

VI Team Summaries: Early Season

51. Mini Makers

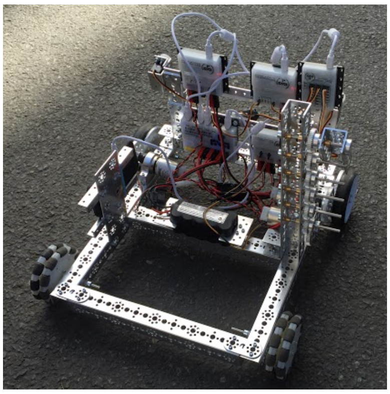
Meeting Date: Wed, 08/26/2015
Personnel Present: Shruthi, Sahana, Nandhana, Namitha, Maria, Aishwarya, Rushali, Ramya, Navyatha

Tasks This Meeting:

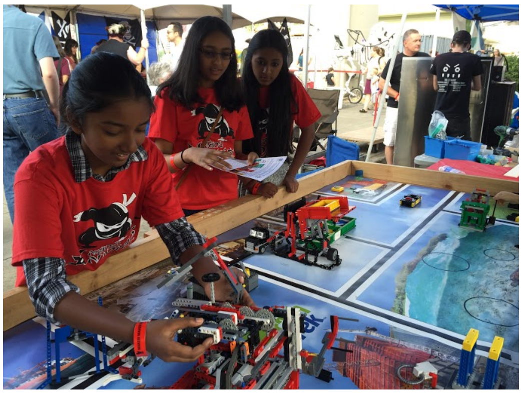
- Inform others about FIRST programs
- Run our robot for practice
- Learn from the FRC teams

Reflections:

It was a really great opportunity to get young kids involved in STEM. We were able to bring FIRST into so many lives and inspire kids and parents to get started! Today we met with so many kids that would soon become FIRST participants. Also we learned a lot from the other amazing booths, including FRC, 3D printing, Art-On-Wheels and hundreds of other hands-on educational activities.



Another benefit from volunteering was we were able to debug some errors we'd been going through for a while. It also was a great practice of driving the robot in different terrain and with steering (to avoid crowds of people). Today we were able to learn more about how our robot functioned and how we could minimize start time, remove errors, and certain parts to our robot in short time and on the spot.



We learned the procedure for restarting the system without having all errors pop up. We were to first exit the FIRST apps on both phones, power off the robot, then power on the robot again, begin Driver Station first, and then start Robot Controller.

Our robot's wheels were constantly falling off and we later found this to be because the screw wasn't lined properly with the flat side of the motor. Since we were able to identify the problem we knew to exercise caution in the competition and while in building. Also the gears needed to be re adjusted in correct alignment or else they caused black marks around the insides.

FTC Demo Table

- Talk about FTC
- Run the robot
- Audience participation!
- Practice different op-modes
- Direct people to Information Table

FLL Demo Table

- Talk about FLL
- Explain board and challenges
- Let the kids play around with the LEGOs
- Direct people to Information Table

Information Table

- Explain FIRST
    - What is it?
    - For what ages groups?
    - How do you join/start a team?
    - Where do you get more info about it?
- Hand out flyers
- Give expert advice
- Inspire people to join the FIRST program
- Get volunteers
- Direct people to FTC and FLL tables for demo

Submitted By Namitha

52. Fun Farmer's FRC Fundraiser

Meeting Date: Sat, 9/26/2015, 7:00 AM - 2:00 PM
Personnel Present: Shamamah, Navyatha, Nandhana, Namitha, Maria, Rushali, Harini, Adithi

Tasks This Meeting:

- Help the FRC team with their fundraiser
- Sell baked goods
- Make buttons for the FRC team and pass them out
- Pass out flyers about the FRC team
- Help the FRC team gain publicity
- Talk about FIRST, FTC, and STEM to others
- Demonstrate our last year FLL robot and this year FTC robot

Reflections:

Today was a very fun experience! We helped out our primary mentor, Anna Nixon's, First Tech Challenge (FTC) team from Westview, the Wildcats, hold their fundraiser at the Beaverton Farmer's Market. From brownies to doughnuts to cookies, we sold so many kinds of delicious baked goods.

Probably the best part of our experience at the Farmer's Market was learning how to make buttons. To make a button pin, first one loads in the back button into the open compartment. After that, one has to spin the base to arrive at another open compartment. On that is place the front button and the circular piece of paper which is the what shows on the button along with a clear plastic circular covering. The base is once more turned and the lever is then pushed down to compress the top button elements and then the base is turned again to compress the front button and the back button to have the final button pin. It truly was so fun to make these buttons. We made probably over one hundred in the time we stayed at the Farmer's Market. We hope to purchase or borrow a button maker so we can pass them out at competitions and such.

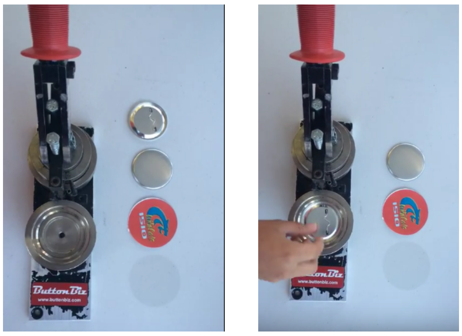


Figure 52.1: The button pin maker and the materials needed (left) and putting the back button into the open compartment (right).

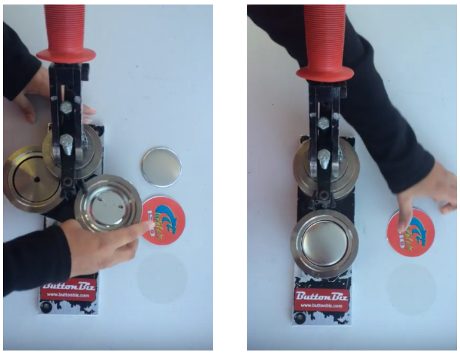


Figure 52.2: Turning the base (left) and putting in the top button in (right).

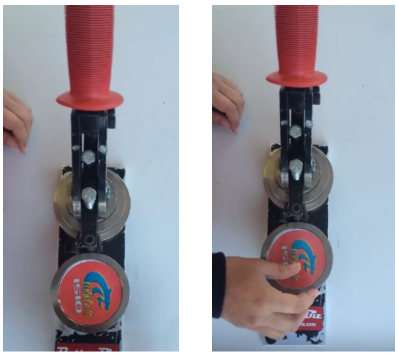


Figure 52.3: Putting on the button paper (left) and putting on the clear sheet (right).

But not only did we have fun creating buttons and selling baked goods, we talked about FIRST, FTC, and STEM to passing people. We actually inspired many young people to join and begin FIRST teams. It brings us tears of joy to our eyes to see so many young children begin so immersed in these kinds of programs for just a few words we said to them.

Figure 52.4: Pulling down the lever crank (left) and the final product, a finished button (right).

We also got to test our last year FLL robot and this year in-progress FTC robot. We had great masses of people swarming around our stall wanting to see the robots. We allowed everyone to try to drive the robots and they all had a spectacular experience. And also, we got to practice driving our robot in practice for competition. Additionally, the Wildcats had also brought their FRC robot, and I must say it was one of the largest robots I have seen. We got to talk to the FRC team and get feedback from them on our robot. They were really helpful.

All in all, the experience was great! We got to help our fellow FRC team with their fundraiser and publicity stunt, made button pins, spread the word about FIRST, FTC, and STEM, and tested out our robot.

Figure 52.5: Audience participation!

The purpose of the Beaverton Farmer's Market fundraiser was to help our mentor, Anna Nixon's, FIRST Tech Challenge (FRC) team from Westview High School, the Wildcats, fundraise and gain monetary profit. But not only that, we also helped spread the word about the FIRST program and science, technology, engineering, and mathematics (STEM). We passed out flyers and demonstrated both our last year FLL robot and this year still-a-work-in-progress FTC robot. We encourage audience participation and passed around the controllers for the robots. The FRC team also drove their robot and displayed it.

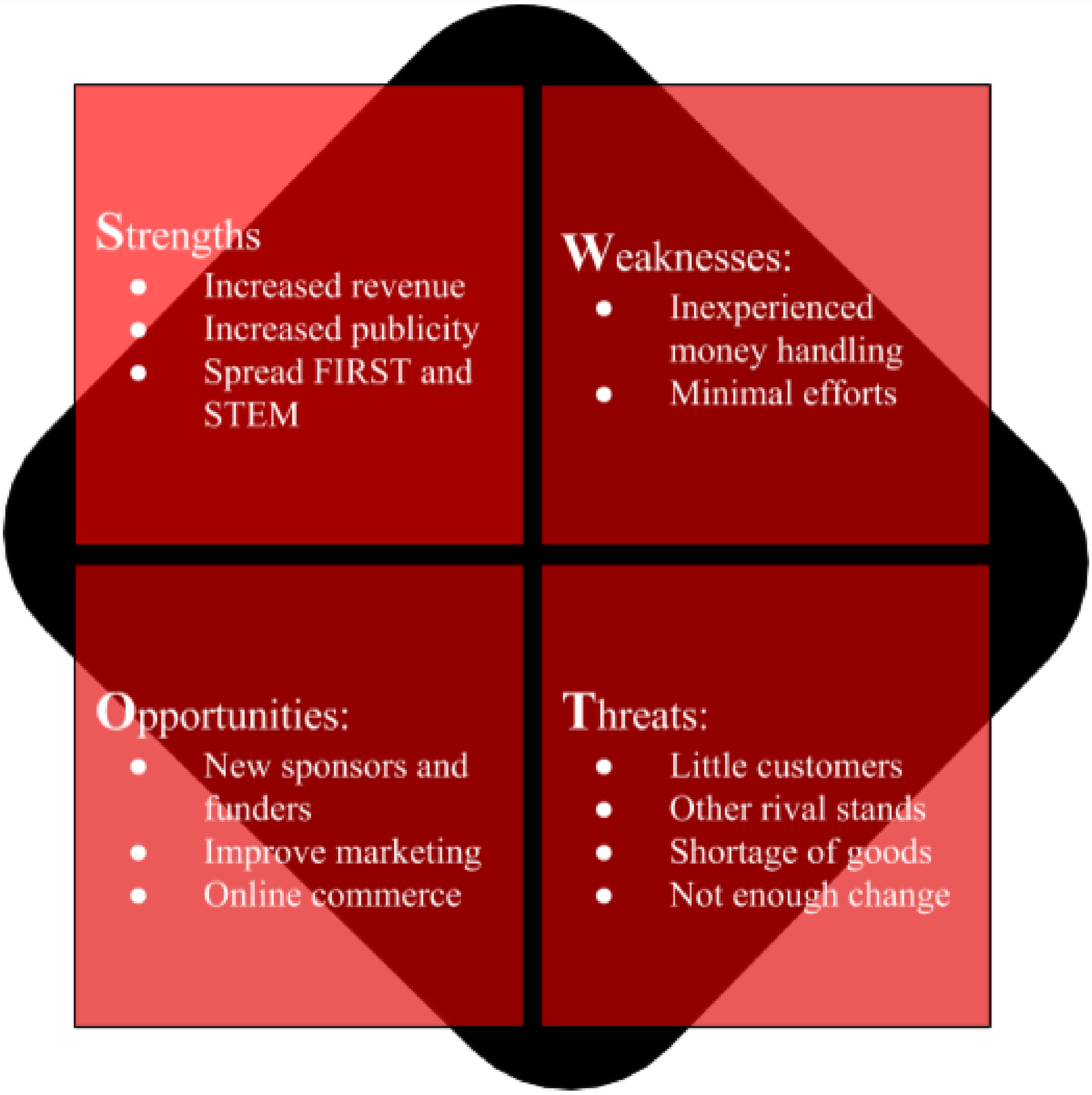
The food that was sold included doughnuts, pastries, cookies, brownies, and other baked goods. We were not informed of the exact profit that was earned but the FRC team has told us that it was over $200.

The benefits of volunteering to help our fellow FRC team includes of the fact that we got to spread the message of FIRST and STEM and also have practice in good selling skills and handling money. We took up some tricks and tips from the experienced team and hope what we learned about fundraising may help us in the future.

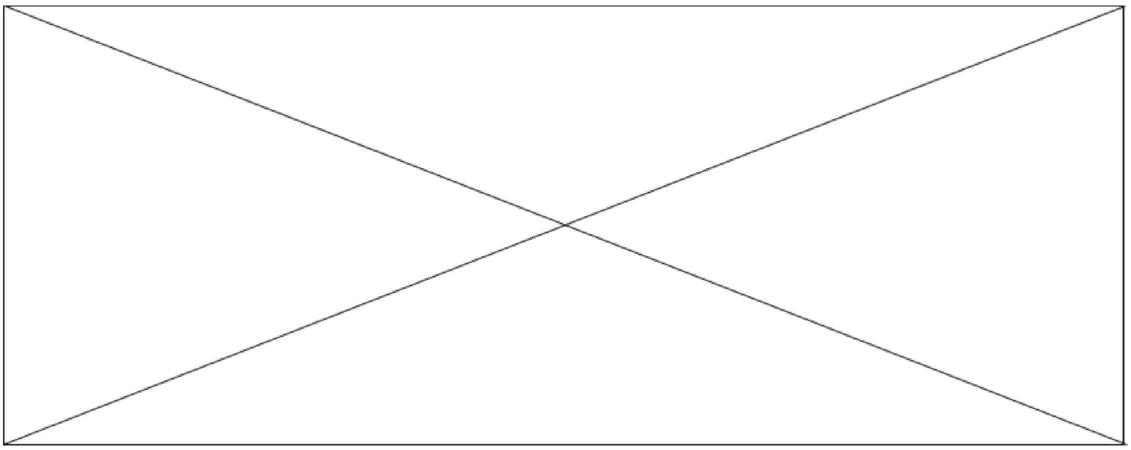
We also received feedback on our robot from the FRC team and they also gave us a brief rundown of First Tech Challenge and how it exactly laid out. We were really intrigued and several of our members hope to participate in FRC in the few upcoming years. The team consisted of mostly sophomores and juniors, so we got slightly different histories of FIRST from each member. The expertise of the individuals of the Wildcats varied, but nonetheless, they all had done FIRST for quite a long time.

SWOT Analysis
All in all, we did a good job on approaching people and giving them flyers and talking about FIRST and STEM. We were also at ease when answer questions, driving the robot, and allowing others to try controlling our last year FLL robot and this year FTC robot. We had a few issues with the FTC robot with wifi, but we troubleshooted and quickly solved them.

Our main weakness was the financial portion. We had slight issues to handling money and counting money quickly and efficiently. We could work with money, but it took us an awfully long time. We did not have much experience with money, so this was a first time experience.



Submitted By Shamamah



53. Mathnasium

Meeting Date: Fri, 11/06/2015
Personnel Present: Sahana, Nandhana, Namitha, Aishwarya, Adithi, Rushali

Tasks This Meeting:

- Show the kids our FTC robot
- Show the kids the Rubik's Cube solver
- Explain how the robots work
- Inform the students at Mathnasium about First programs
- Let the kids run the FTC robot

Reflections:

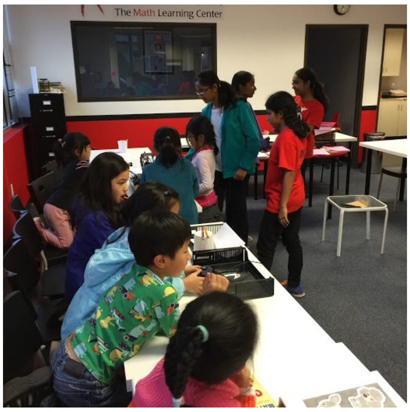
Today we went to Mathnasium to teach the kids there about FIRST and robots. We brought our FTC robot made out of TETRIX parts and our Rubik's Cube solver made our of LEGO pieces and an NXT. After we explained what a robot is and what FIRST is about, we showed them the Rubik's solver. The kids found it VERY entertaining. They thought it was very cool how a robot without eyes could solve the cube in less than a minute. We explained to them how it works and what sensors it uses.

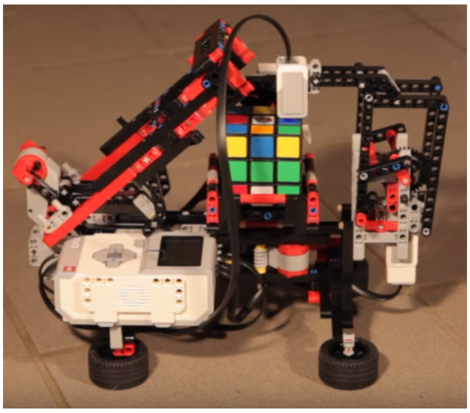
As some of the kids were trying out the cube solver, we showed the other kids our FTC robot. We explained how it works and how we built it. We showed the children the controls and how it makes the robot move. One of us set up a target for the kids to bring the robot to. All of us took turns putting the target in a different place and making the kids use controls to move the robot.

We hope the kids learned a lot about robots and the FIRST program. All of us are also very thankful to Mathnasium for sponsoring us by donating 250 dollars!

How the Rubik's Cube Solver Works

We are using a special code (thanks to David Gilday) that uses a pattern to match the colors of the Rubik's cube. We had help from our coach in building the actual Rubik's cube solver, we used EV3 pieces, motors, and brick to solve the cube.





The purpose of the Mathnasium volunteering event was to spread the message of FIRST and STEM to young children who attended the program as well give something back to our generous sponsor as they have done so much for us. We brought our this year FTC still-in-progress robot made of TETRIX parts as well as a Rubik's Cube Solving robot made of EV3 parts, the same used in First LEGO League (FLL).

We also gave a brief overview of what First Tech Challenge is, who could join, what it takes to join, and the overall layout of the program. Few of the students had done FIRST before, so they had a feeling of what FIRST was like, but for the ones who had no experience with FIRST, we gave them a deeper insight. Several of the students told us that they were most definitely join or beginning an FLL team. We are more than glad to see that our efforts have reached these young children.

We had two exhibitions, one for the FTC robot and one for the Cube Solver. Both had viewers and admirers. We explained to them how we created both robots and the imagination, thought, dedication, and teamwork it takes to make something. We also gave a brief overlook over the program; we took head not to overload them with too much coding language that they would not be able to understand. It is our primary job to ensure everyone understands and takes the most they can from the experience.

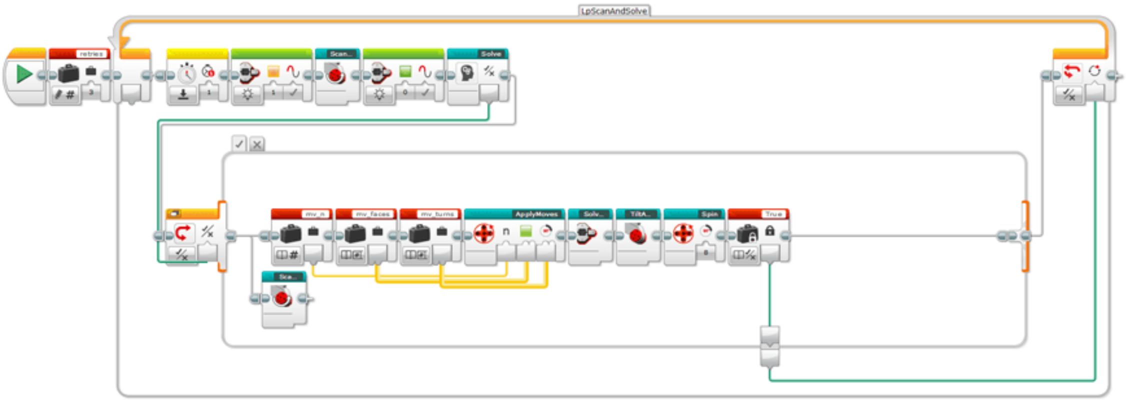
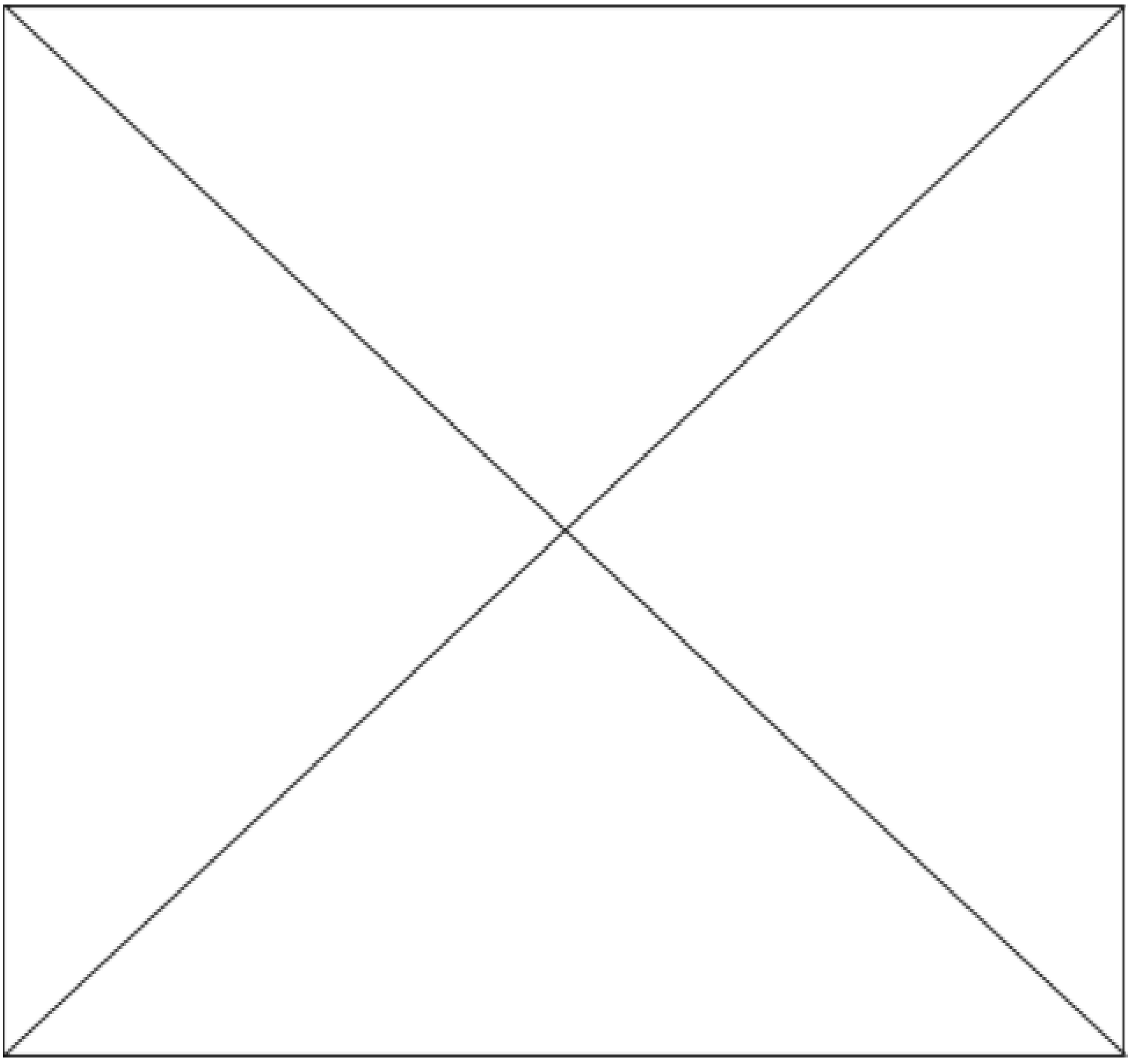


Figure 53.1: Screenshot of snippet of code.

Submitted By Adithi



VII Team Summaries: League Season

54. Bake Sale

Meeting Date: Sun, 11/22/2015
Personnel Present: Irene, Nandhana, Namitha, Maria

Tasks This Meeting:

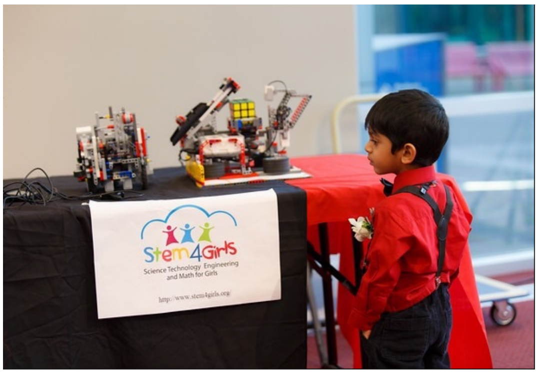
- Raise funds for our team
- Spread the word about our team, STEM4Girls, and the FIRST and FTC programs
- Gain any possible supporters or funders

Reflections:

We earned a total of 142 dollars for the Nano Ninjas. We have not yet decided what to spend the money on. The bake sale was a huge success because most of our buyers were family friends who felt like donating to the cause– not just for the goodies. Also, we brought along three robots our team has worked on. The robots garnered a lot of attention which was then diverted to the treats. On our table was also a Mindstorms LEGO Rubik's cube solver which in particular attracted a lot of customers.

Figure 54.1: Preparing and packaging for the bake sale.

We had the bake sale at the Keralotsavam dance event, hosted by the Malayali Indian community of Portland. The items sold were made by Irene, one of the team members, and her mom. Below is our business plan for the bake sale.



Goal
Generate funds for the Nano Ninjas FTC team.

Team Description
The Nano Ninjas is a non-profit FTC team with 15 girls. We are sponsored by STEM 4GIRLS.

Target Customers
People attending SWORAM's biggest event; Keralotsavam. Keralotsavam is a cultural event hosted by SWORAM. The event will exhibit performances by the children and adults of the Malayali community. The event took place at PCC Sylvannia on November 22, from 4 to 7:30 pm. Some of the participants as well as some of the audience are members of the Nano Ninjas family.

Products

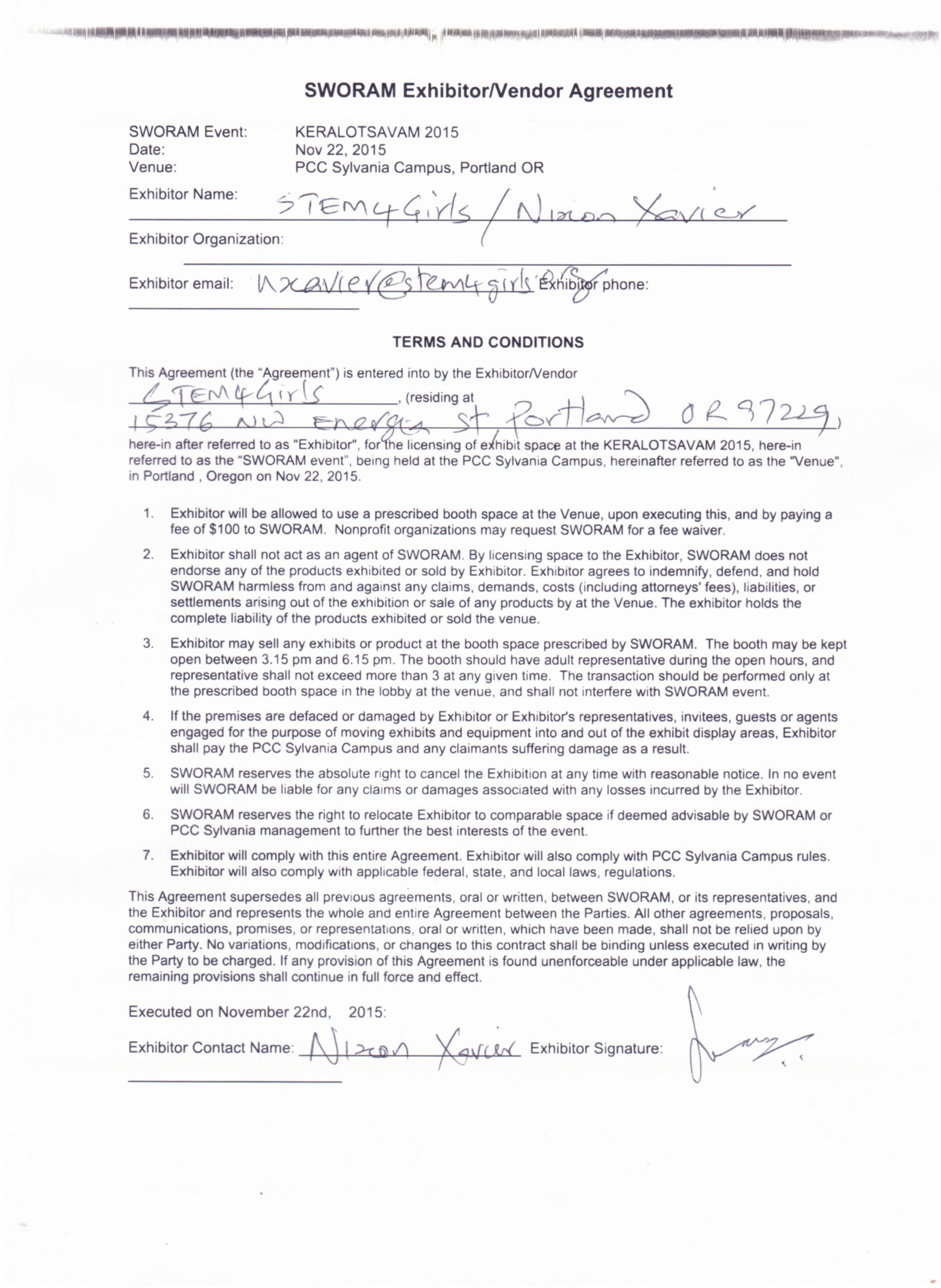
We are selling baked goodies such as: Rice Krispie treats, brownies, cookies, banana bread, chocolate milk, and water. Although dinner is served at 7:30 pm; the intent of the bake sale was to serve snacks during the four hour wait.

Financial Projections
We expect to make a total of 100 dollars.

Marketing and Sales
We used word of mouth to advertise our products to the people we know. Our sale strategy includes the decoration of our foods and table, our bake sale poster, and wearing the Nano Ninjas T-shirt during the sale.

Documents
On the next page is the Terms and Conditions of the SWORAM exhibitor/vendor agreement. We filled it out under the agreement that if anything went wrong, for

example people got sick from the food (which did not happen fortunately), we would be held responsible.



SWORAM Exhibitor/Vendor Agreement

SWORAM Event: KERALOTSAVAM 2015
Date: Nov 22, 2015
Venue: PCC Sylvania Campus, Portland OR

Exhibitor Name: STEM4Girls / Nixon Xavier

Exhibitor Organization:

Exhibitor email: nxavier@stem4girls.org Exhibitor phone:

TERMS AND CONDITIONS

This Agreement (the "Agreement") is entered into by the Exhibitor/Vendor STEM4Girls, (residing at 15376 NW Energia St Portland OR 97229), here-in after referred to as "Exhibitor", for the licensing of exhibit space at the KERALOTSAVAM 2015, here-in referred to as the "SWORAM event", being held at the PCC Sylvania Campus, hereinafter referred to as the "Venue", in Portland , Oregon on Nov 22, 2015.

1. Exhibitor will be allowed to use a prescribed booth space at the Venue, upon executing this, and by paying a fee of $100 to SWORAM. Nonprofit organizations may request SWORAM for a fee waiver.
2. Exhibitor shall not act as an agent of SWORAM. By licensing space to the Exhibitor, SWORAM does not endorse any of the products exhibited or sold by Exhibitor. Exhibitor agrees to indemnify, defend, and hold SWORAM harmless from and against any claims, demands, costs (including attorneys' fees), liabilities, or settlements arising out of the exhibition or sale of any products by at the Venue. The exhibitor holds the complete liability of the products exhibited or sold the venue.
3. Exhibitor may sell any exhibits or product at the booth space prescribed by SWORAM. The booth may be kept open between 3.15 pm and 6.15 pm. The booth should have adult representative during the open hours, and representative shall not exceed more than 3 at any given time. The transaction should be performed only at the prescribed booth space in the lobby at the venue, and shall not interfere with SWORAM event.
4. If the premises are defaced or damaged by Exhibitor or Exhibitor's representatives, invitees, guests or agents engaged for the purpose of moving exhibits and equipment into and out of the exhibit display areas, Exhibitor shall pay the PCC Sylvania Campus and any claimants suffering damage as a result.
5. SWORAM reserves the absolute right to cancel the Exhibition at any time with reasonable notice. In no event will SWORAM be liable for any claims or damages associated with any losses incurred by the Exhibitor.
6. SWORAM reserves the right to relocate Exhibitor to comparable space if deemed advisable by SWORAM or PCC Sylvania management to further the best interests of the event.
7. Exhibitor will comply with this entire Agreement. Exhibitor will also comply with PCC Sylvania Campus rules. Exhibitor will also comply with applicable federal, state, and local laws, regulations.

This Agreement supersedes all previous agreements, oral or written, between SWORAM, or its representatives, and the Exhibitor and represents the whole and entire Agreement between the Parties. All other agreements, proposals, communications, promises, or representations, oral or written, which have been made, shall not be relied upon by either Party. No variations, modifications, or changes to this contract shall be binding unless executed in writing by the Party to be charged. If any provision of this Agreement is found unenforceable under applicable law, the remaining provisions shall continue in full force and effect.

Executed on November 22nd, 2015:

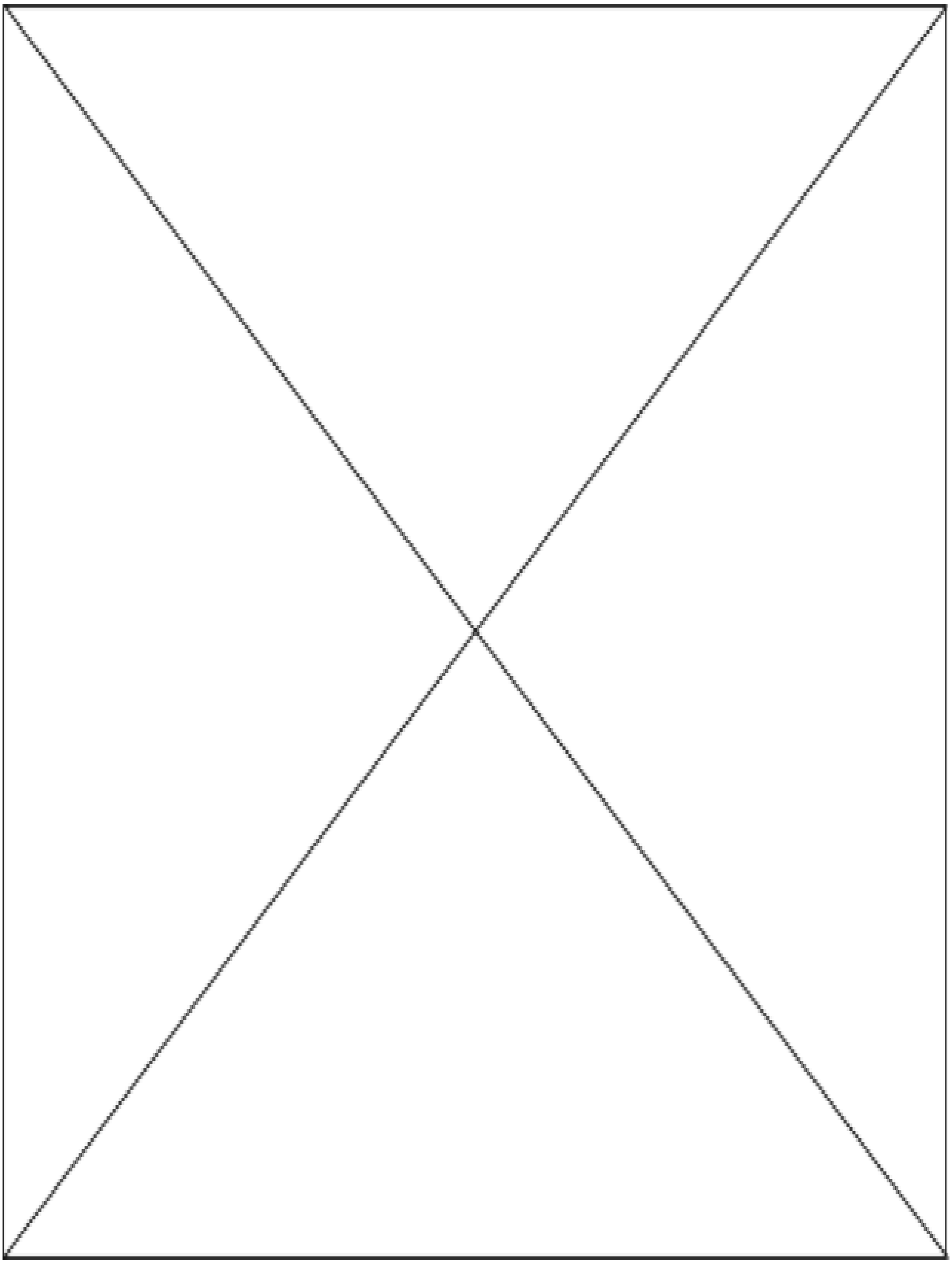
Exhibitor Contact Name: Nixon Xavier Exhibitor Signature:

This is a description of the final financial earnings of the bake sale:

- Money Spent: We spent a total of 46.85 dollars on supplies and decorations

- Money Earned (including change): We earned 213 dollars
- Profit: After taking out money that was used for change and the money used for supplies, we had a total of 142 dollars in profit

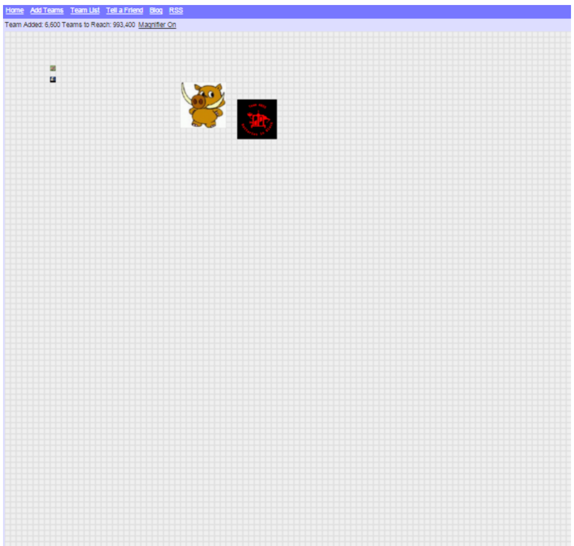
Submitted By Irene



55. One FTC

The Million Dollar Homepage
We got our idea from The Million Dollar Homepage with the URL http://www.milliondollarhomepage.com/. The Million Dollar Homepage was created to both earn money (each pixel cost one dollar), but mostly to bring a lot of people and companies together.

One FTC
We hope to recreate the 2005 Internet sensation of The Million Dollar Homepage except it is completely free and it is with FTC teams. Our URL address is http://stem4girls.org/OneFTC/. This is a great way to get all the FTC teams together on one webpage. Below is a screenshot of what we have so far on our webpage. As it is obvious, we need some major support and publicity to put forth this idea at its full potential.

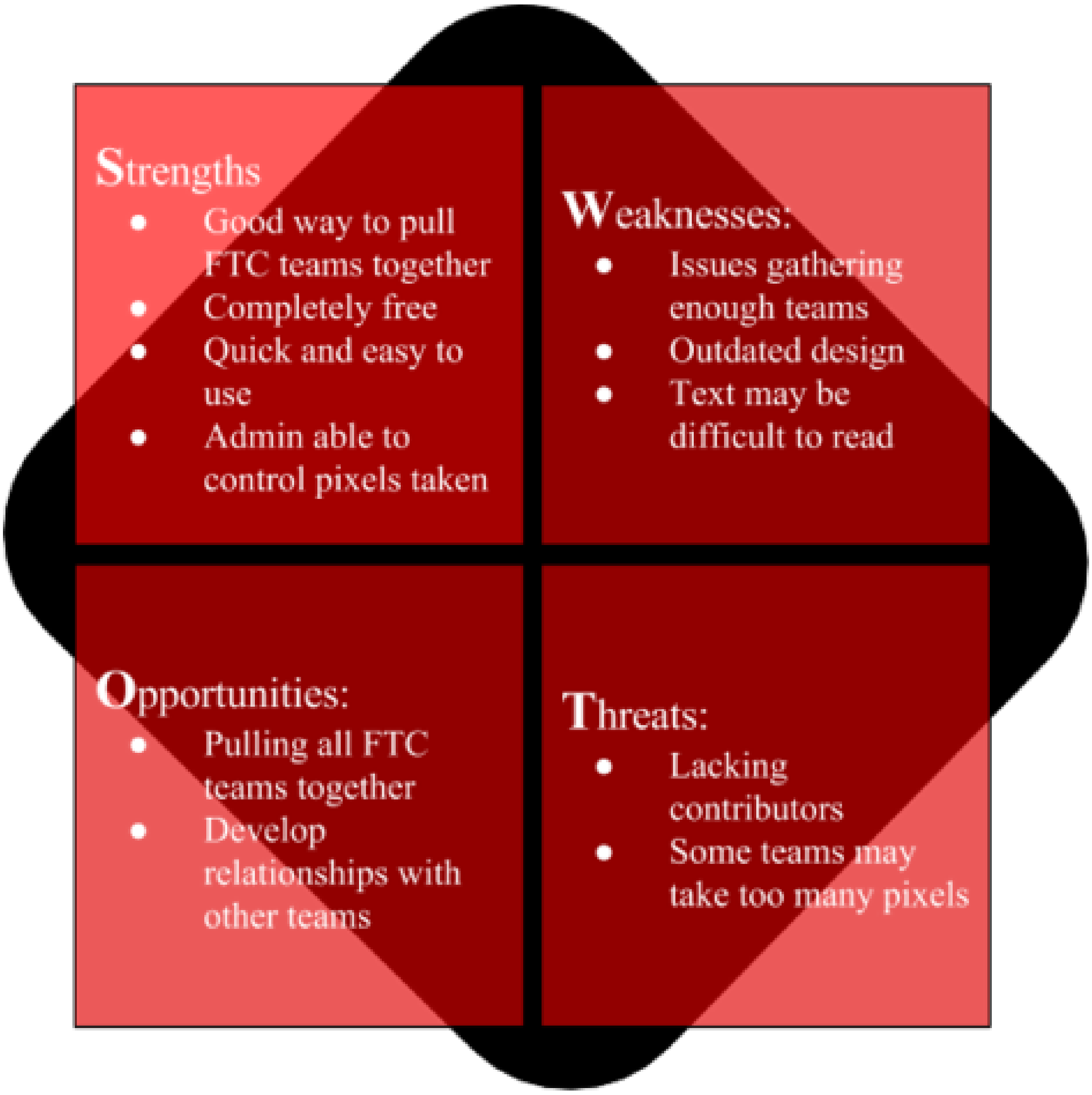


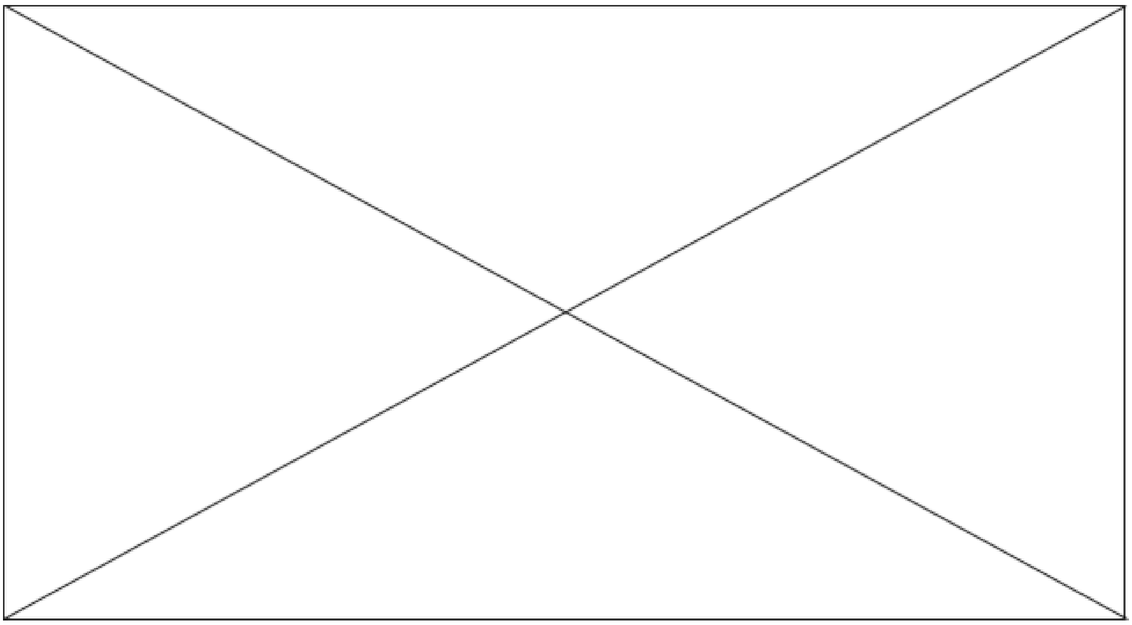
SWOT Analysis
From examining the SWOT analysis chart on the next page, it can be seen that the One FTC is a well-rounded idea with a few issues which hopefully can be taken care of. On the the facet of strengths, as the Nano Ninjas, we are good at reaching out to the community, so we are confident that we can have at least twenty teams on our homepage by the end of this season. Of course, we are hoping to continue this until we have no more space on our page. Other high points include the convenient layout and simplicity of the website. As seen above, there is only a navigation bar and then the pixels. This helps with not causing any confusion. Also, we do not have any pesky side advertisements which people usually do not care for. The administrator of our page also has the power to control the amount of pixels a team takes, yet it is still a pain and a waste of time if we must constantly readjust pixel counts. And the best part is, the entire thing is free. No team has to pay a single penny to have their team or logo represented on our website. This truly is a good way to get all the FTC teams of the world onto a single mat of one million pixels.

As every products comprises of its own weaknesses, ours has issues with the obverse of mass outreach. We are a very capable team, but we will not be able to reach out to enough teams to create a substantial one million pixel website. We will really need major support and publicity to pull this off, something we are looking forward to trying to obtain. Our website design may become outdated and become slow after all these teams put their image and name. Hopefully, however, we can fix that it that ever occurs. The text on our website also might be slightly difficult to read due to its tiny size and may strain the eyes. But we can easily fix that, so that is not a problem.

Our opportunities with this idea is that we are pulling all the FTC teams together and we hope to develop more relationships with many other teams. Also, if this website goes viral like The Million Dollar Homepage, it would be really helpful in spreading the message of FIRST and STEM.

Threats to our idea include the lack of finding contributing teams to our page. As expressed several times, we need major help if we are to have over one hundred teams on this website. Also covered earlier, some teams may take too many pixels and causes issues with the administrator having to go an readjust the picture. Nonetheless, we have faith in this idea and hope it continues to grow even after our team is gone.


Strengths
Good way to pull FTC teams together
Completely free
Quick and easy to use
Admin able to control pixels taken
Weaknesses:
Issues gathering enough teams
Outdated design
Text may be difficult to read
Opportunities:
Pulling all FTC teams together
Develop relationships with other teams
Threats:
Lacking contributors
Some teams may take too many pixels



56. When FTC and FLL Come Together

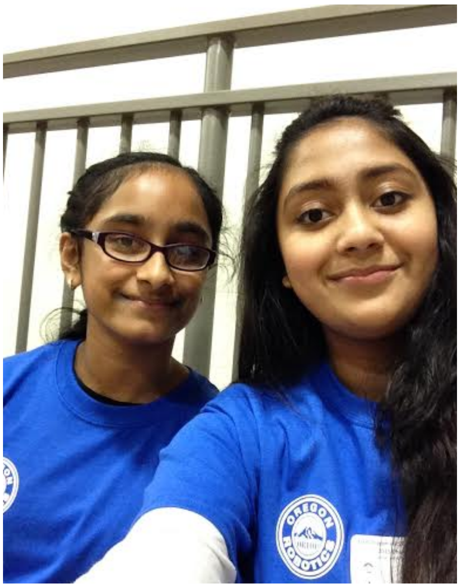
Meeting Date: Sat, 1/9/16 7:00 AM - 5:00 PM
Personnel Present: Shamamah, Irene, Adithi, Navyatha, Harini, Nandhana, Namitha, Maria, Rushali, Rhea, Ramya

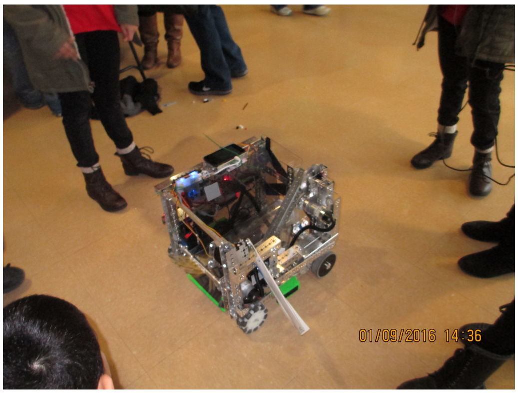
Tasks This Meeting:

- Volunteer at FLL Championship
- Talk about FTC with FLL participants
- Present our this year FTC robot

Reflections:

Volunteering
Today some of our team members, Shamamah, Irene, Adithi, Navyatha, and Harini, signed up to be volunteers at the FLL Championship. Luckily we all got assigned to be pit runners. Pit runners are supposed to take the teams up to the pit area and escort them down to the competition area when it is their robot run time. The job was very fun and exercising. We had to walk up and down the stairs a lot, but it was worth it.



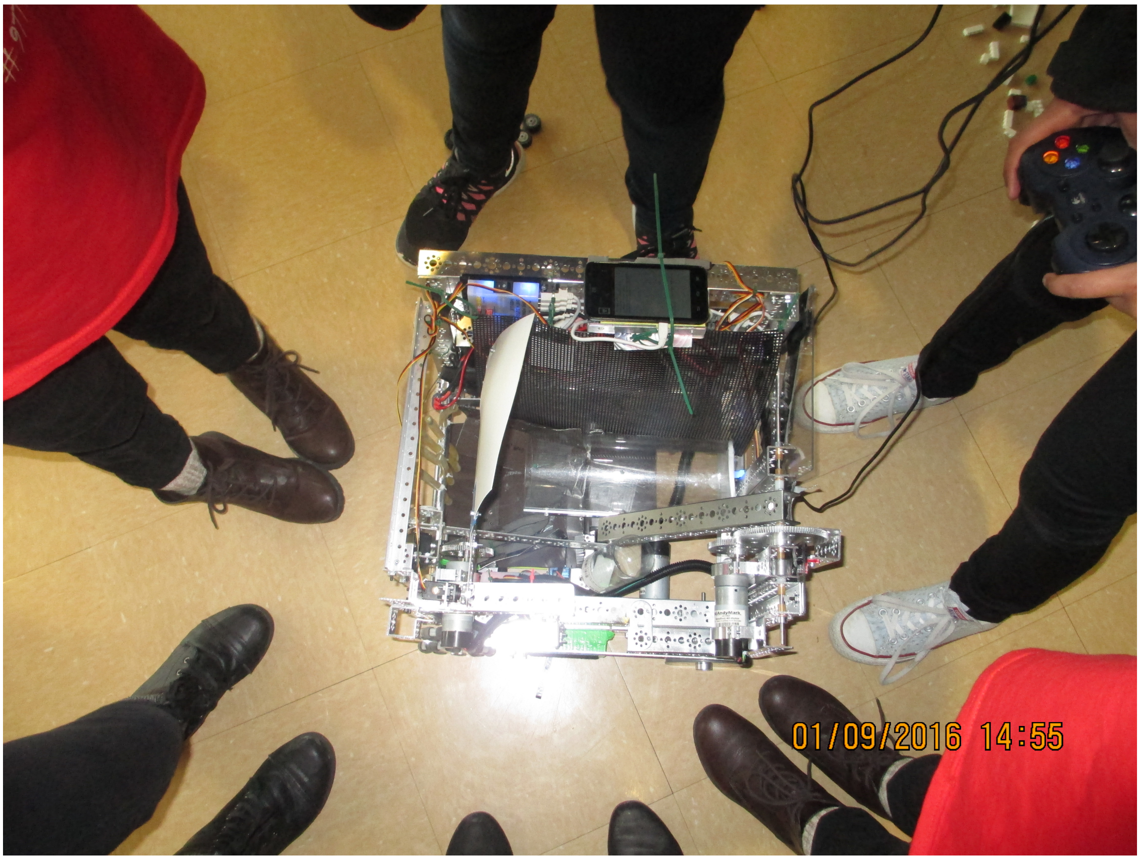


We also had a rather high visibility role and got to have many interactions. Several of the teams had very energetic team members and simply could not stop talking with us as we showed them to the gym. We enjoyed conversing with them and giving them a brief overview of our own FIRST journeys in what a minute allows. The energy in the competition was completely different than what we had ever felt. Sure, we had been to State Competitions before, but those were our own, and when it was our own teams competing, all we could do was be nervous yet try our best to love the moment. Not having the burden of anxiety, we could finally feel the happiness of true competitions of others.

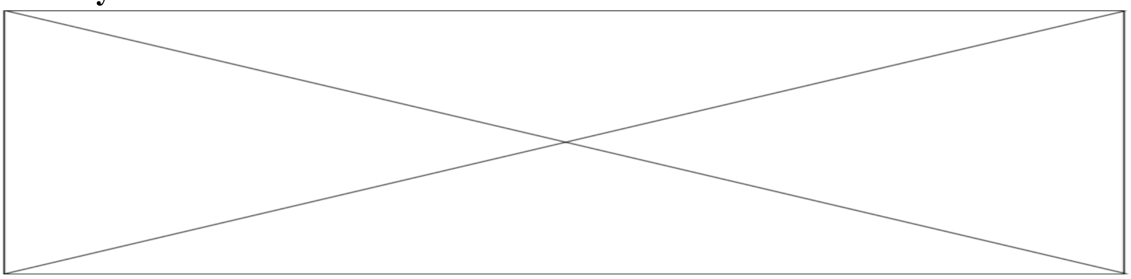
There was also a volunteer break room. Whenever we were hungry or needed a break we could go in there and rest. The room had a lot of good and tasty snacks. For lunch they served soup and salad. Our whole team thought the food was AMAZING! We could not believe that they would serve so much food.

Overall Volunteering was a very fun and great experience! All of our members who attended the volunteering decided to continue volunteering. We get to meet so many teams and we also get exercise while having fun. We hope to come back next year!

FTC Presentation
We also had a sub-team come, which consisted of Nandhana, Namitha, Maria, Rushali, Rhea, and Ramya, which presented our FTC robot and talked about FTC. We were going to have a scrimmage, but unfortunately with the many FTC leagues and competitions going on, Liberty High School could not borrow a field. Nonetheless, as it is the Nano Ninjas principle to never have anything stop us from accomplishing anything, we went without the FTC Res-Q field. And indeed we attracted quite the crowd. All sorts of people surrounded us and started fascinatingly at our robot. We took the chance to also talk about FTC and inspire several people to take up First Tech Challenge in the upcoming years.



Submitted By Adithi



VIII

Robot Design Process & Research

57. Electrical Aspects

57.1 Electrical Wiring

We are connecting the 12 volt battery directly to the Core Power Distribution Module via Tamia. This module then distributes the power to the other modules with Anderson power pole connectors and a micro USB. Each controller/module can connect to multiple things. For example the Core Motor Controller can connect with up to two motors while the Core Servo Controller has access to maximum six servos. We have found that it's the best practice to plug in one of the modules to the Core Power Distribution Module at port zero. Also connecting the Core Servo Module at port one. After multiple tests of the Electrical Wiring and the configuration system we have confirmed that with a low battery the phone does not detect all the modules, so it's best to keep a good level of charge.

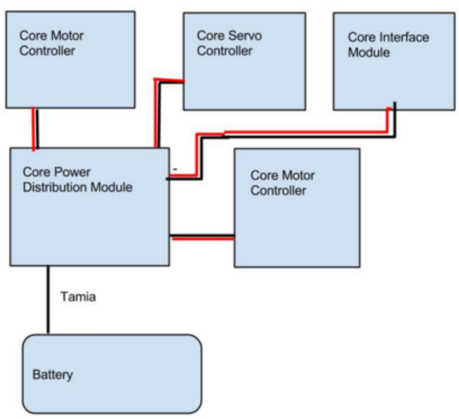


Figure 57.1: A simplified diagram of the modules connected.

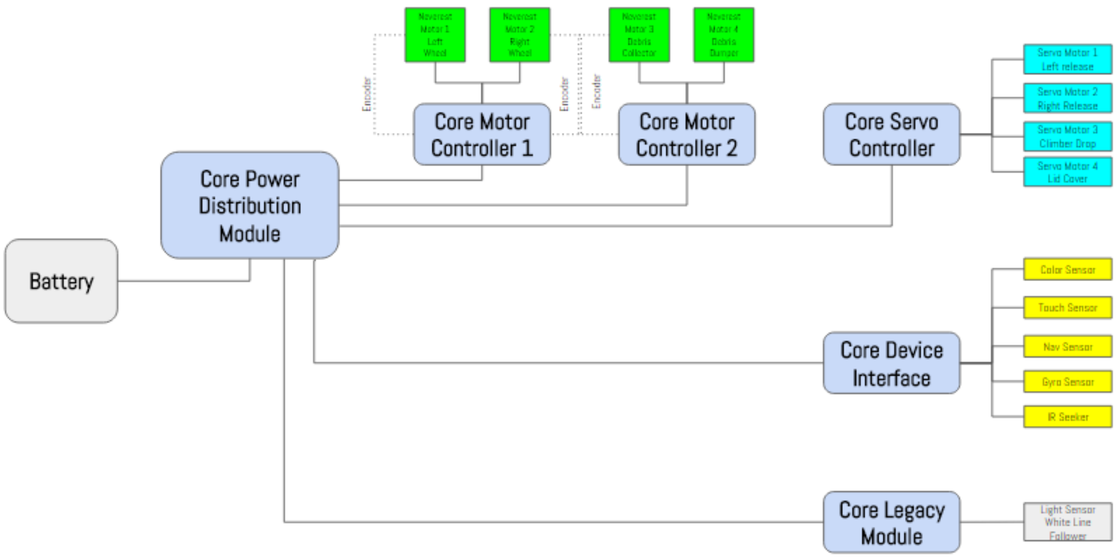


Figure 57.2: A more detailed diagram of the modules and other input and output functional parts.

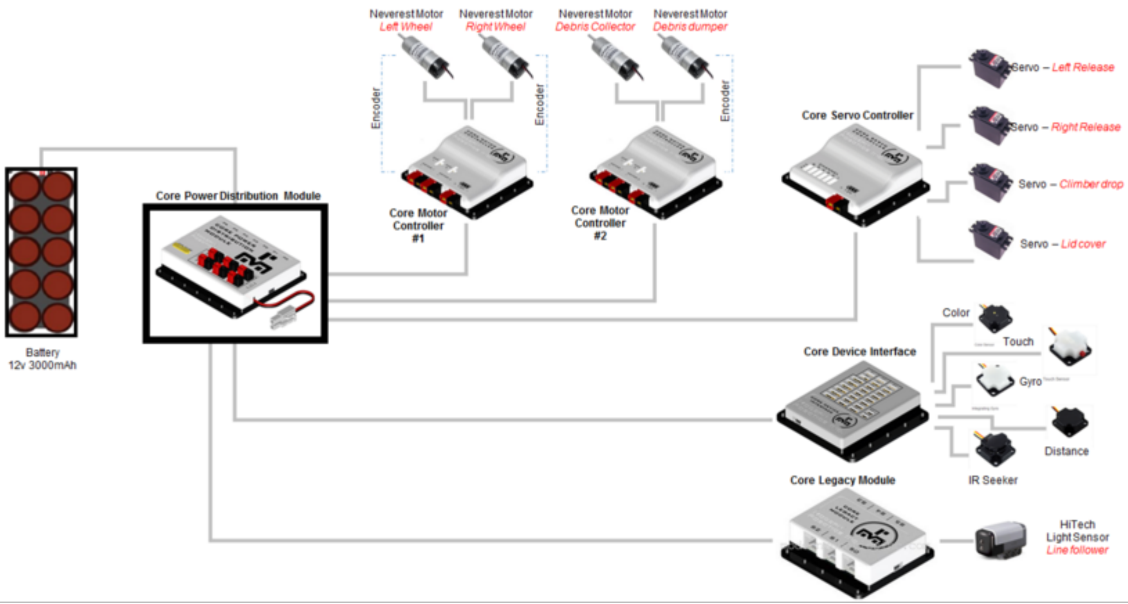
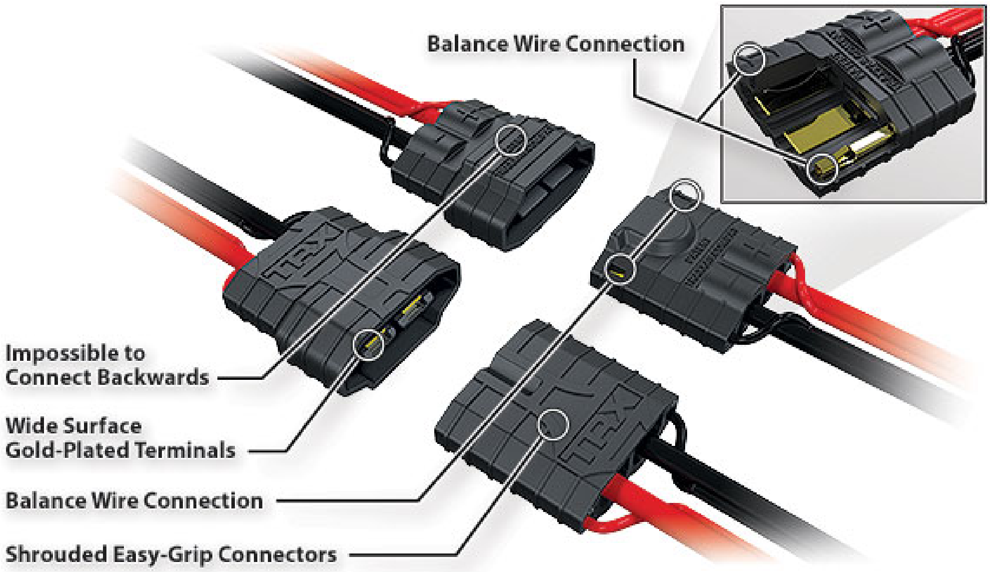


Figure 57.3: A replication of figure 52.2 except with pictures.

Connectors

- Traxxas connectors are easy to use, efficient, and high-current handling. It flows current really smoothly and it is a better engineered solution for real world use. The Traxxas connectors have large textured surfaces on the plug bodies, which makes it easier to grip and the reverse-polarity protection makes the connectors impossible to plug in backwards. Shrouded wire connections eliminate extra steps to install heat shrink tubing and the copper terminals with large spring-loaded contact areas ensure a perfect connection everytime. The Traxxas connectors are also a virtual fail-safe. Each connector is designed to go with the proper charger.



[1]

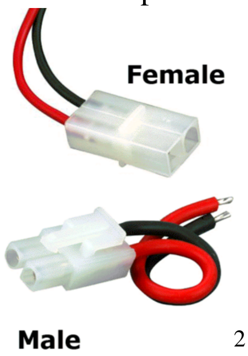
All electric Traxxas models are equipped with Traxxas High-Current Connectors
Built in balance plug on LiPo batteries
Keyed to only plug into the correct style Traxxas charger
Shrouded wire connections
Wide surface area, gold-plated terminals
Reverse polarity protection makes it impossible to connect backwards
Textured surface for easy gripping
Secure, positive locking spring loaded terminals for consistent contact
Multiple locking barbs keep terminals secure
Durability: 1,000+ connections with no resistance gain
Traxxas Connector has 24.5 times less resistance than a Molex connector

- Tamiya Connectors are a type of DC power connector which are usually used on radio-controlled model vehicle battery packs and chargers. They are also commonly used on airsoft guns. The wiring has the positive red wire going to the terminal with a square profile, and the negative black wire runs to the half circle, half square terminal. This applies for both genders of the connectors and the female sockets are and the male housing while the male pins are in the female housing. The male pins are usually on the side of the battery. The two sizes of the Tamiya Connectors are regular and mini. The outside dimensions for female connectors are:
  Regular: 14mm x 7mm x 28mm (about 17/32" x 9/32" x 1 3/32")
  Mini: 10mm x 6mm x 22mm (about 3/8" x 7/32" x 7/8")

[1] Traxxas, "Traxxas High- Current Connector," 2016

Locking mechanism does not come undone easily

Connector physically isolates the negative and positive wires so they are safe to use in damp conditions



[2]

- Dean Connectors are another type of wire adapter.


[3]

They are common
They are reusable
There is no resistance between the plugs
They are smaller and lighter than the Traxxas connectors
They may overheat
The springs on the connectors can easily pull away from the tabs
They can be difficult to pull apart

57.2 Encoder Wiring

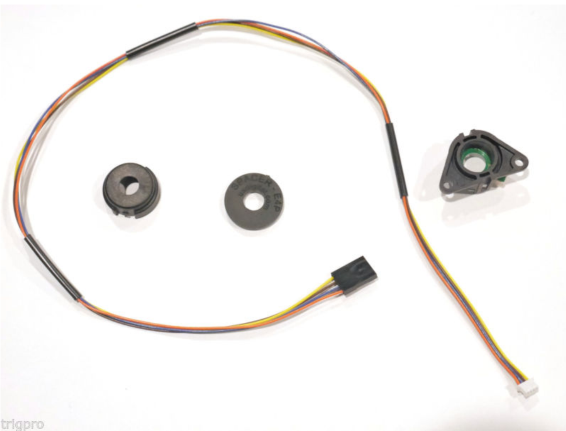
We are using the AndyMark NeverRest Motor which comes with an encoder. In TETRIX motors, we connect external encoders and the following holds good. Tetrix cable has a guide slot which help us to connect the cable in the right way. The wiring follows with M+ on the top, M- in the middle, and lastly GRD on the bottom.

The motor we are using is a NeverRest motor. There is an encoder mounted to the back side of this motor. It is seven pulse per revolution (ppr), making it stronger than other motors. Encoders allow us to set a target speed, and the motor controller will apply whatever power necessary (within its safety limits) to achieve the desired speed.

[2]Wikipedia, "Tamiya Connector," 2015

[3]AA Portable Power Corporation, "Connector/Adapter: Standard Male and Female Dean Connector with 14 AWG Wire," 2016

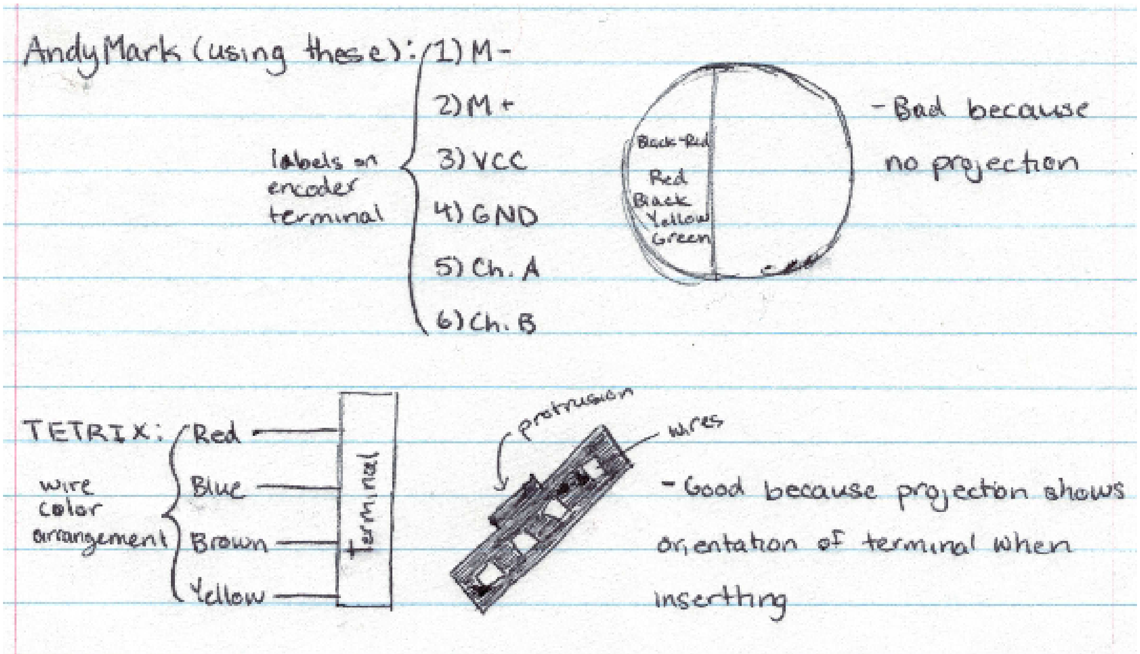
Figure 57.4: An encoder connected to a DC motor.

 [4]

These are the parts of an encoder (shown above). We connect all of these parts to are motor and then it will tell us how fast are motor is going. This can be helpful to tell us information from one format or code to another, to help us understand it better and compare the different motors.

[4]Trig Pro, "Tetrix Motor Encoder Pack," 2016

Problem
The main issue we have with the two types of encoders (AndyMark and TETRIX) is that TETRIX encoders come with terminals with a protrusion which indicates the orientation when connecting the encoder to the motor. With the AndyMark, the primary one we are using, there is no protrusion, so we do not know how to connect the TETRIX encoders.



As shown by the sketch, the TETRIX encoder terminal wire colors follow as red-blue-brown-yellow, however this is not the case with AndyMark, where the standard is redblack-red-black-yellow-green. Also, for the AndyMark, the terminal wires have a specific sequence for which wire connects to which input setting. Using this drawing, it is easier to understand to knowing how to connect the TETRIX motor encoders onto the AndyMark DC motors.

57.3 AdaFruit Color Sensor Wiring

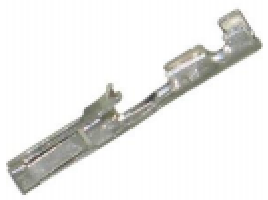
AdaFruit Color Sensor

- Four-pin
- I2C port
- Connected to Core Interface Module
- Active Mode: uses the internal LED to illuminate target surface
- Passive Mode: turns internal LED off and reads from external light sources

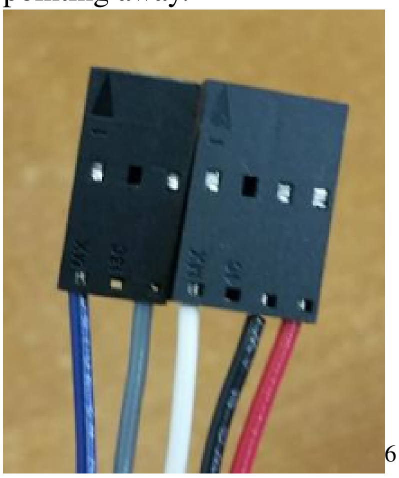
Wiring
There are two options for wiring the AdaFruit color sensor: beginning from scratch, or using already-assembled wires. With the second option, all one has to do is purchase 12C wires with terminal housings included and connect them accordingly (which shall be described in detail with the beginning from scratch option).

Beginning From Scratch

- Tools required include diagonal cutters, soldering iron and solder, wire strippers, terminal clippers, small screwdriver, pliers.
- Needed are 24AWG wires of the colors for the corresponding pins on the AdaFruit color sensor. VIN is the red wire, GND is the black wire, SCL is the white wire, SDA is the gray wire, and LED is the blue wire.
- Begin by stripping an eighth inch from both ends of all five wires.
- Crimp terminals, as shown to below, are used as contacts for the wire to the housing case. They are attached to both stripped ends of the wires by using the crimping tool to bend the terminal round the wire which is preferably stabilized by pliers.

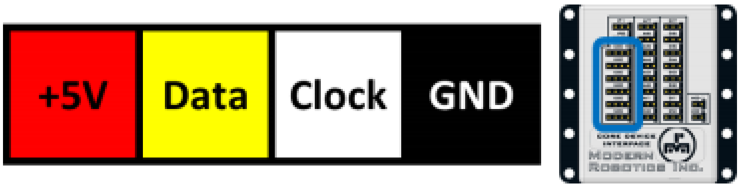

[5]

- Circuit housings (shown below) are purported to have a plastic covering for the exposed crimp terminals. It is ideal that one seventh-circuit housing is used on the side of the cable the plugs into the Sensor, one four-circuit housing to connect the Sensor to the I2C port on the CDI module, and finally one two-circuit housing to connect the LED to either the ground or digital pin of a digital port on the CDI module. The terminal-ended wire is connected to the housing which the arrow pointing away.


[6]

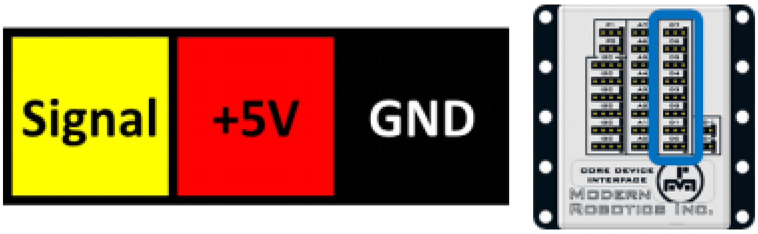
- Next is installing the wires in the 12C port on the Core Device Interface Module. The leftmost pin provides +5V power to the pin, which should map to the VIN pin on the Sensor. The next pin from the left is the I2C data pin, which should map to the SDA pin on the sensor. The next pin from the left is the I2C clock pin, which should map to the SCL pin on the sensor. The rightmost pin is the ground pin, which should map to the GND pin on the sensor.

[5] FIRST, "AdaFruit RGB Sensor Assembly and User's Guide," 2015
[6] FIRST, "AdaFruit RGB Sensor Assembly and User's Guide," 2015



[7]

- Lastly, a housing used connect the LED pin to the CDI module is to be made. Using a two connector housing, the LED pin is connected through the blue wire to the housing, using the housing to connect the LED pin to the signal pin of a digital port.

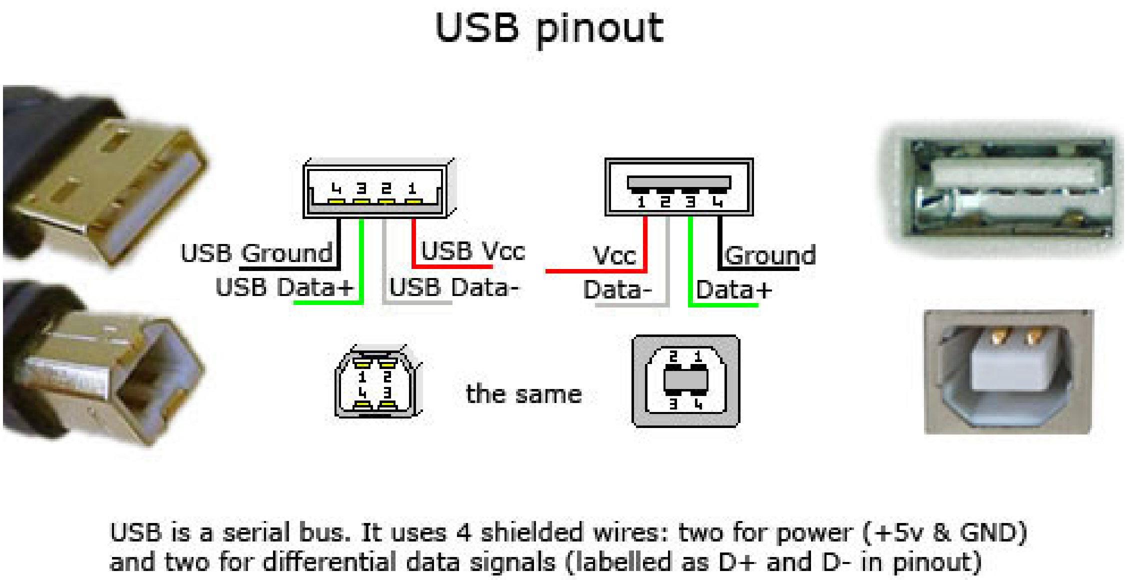


[8]

57.4 USB Connectivity

Overview of the USB
The USB is also known as the Universal Serial Bus. The purpose of it is serve a method of communication, connection, and electrical supply between two electrical devices. Two main examples can be given by USBs that connect computer peripherals (keyboards, pointing devices, digital cameras, printers, portable media players, disk drives, and network adapters) and electronic devices. The USB has replaced many of the earlier interfaces, like the serial and parallel ports, along with separating power chargers for portable devices. Each end of a USB cable is a different kind of connector, a Type-A and Type-B to be exact. The reason for this is because it prevents electrical overload and damage to equipment, for only the Type-A socket provides power.

[7] FIRST, "AdaFruit RGB Sensor Assembly and User's Guide," 2015
[8] FIRST, "AdaFruit RGB Sensor Assembly and User's Guide," 2015



[9]

USB Connections
Physical USB connections are an obvious issue and contributor to loss of communication between electrical constituents of the robot. This may occur due to risky and jerky actions performed by the robot. It may also happen even when the robot is just slowly moving because a loose USB is vulnerable to be pulled out. To solve this issue, it is highly recommended to properly and securely fasten all modules and devices to the frame of the robot and make certain that all USB cables are secured tightly so they do not move during the running of the robot and risk unplugging. The two tabs of the male end of USBs make a clicking noise when they are inserted correctly, thus we have to make sure that we follow through with all USB cable connection protocols.

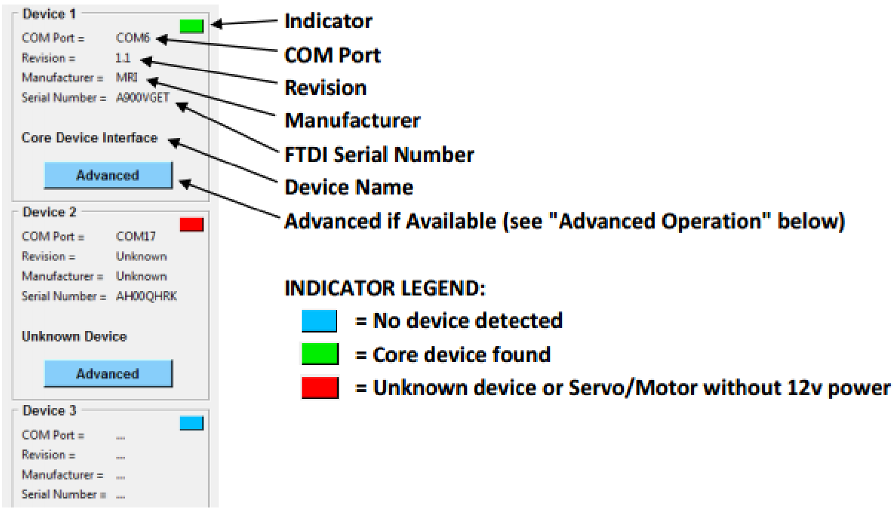
Battery Voltage
Battery voltage is a crucial aspect of USB functionality. If the voltage is too high or too low in regards to the standard of twelve volts, it is expected that the USB module disconnection issues will arise. Battery power is also an issue, but it must drop a fair amount to show any changes. The Core Power Distribution Module has a built-in voltage regulatory which reduced the input voltage to 5V for the USB modules. However, if the voltage level on the main battery is low, large current draws may cause the input voltage to drop enough that the Power Module fails to relay power to the other devices. When a test was done on a 12V motor on a 9.6V battery, it was observed that there was a loss in communication one the motor direction was reversed, most likely due to a drop in battery voltage. To fix such issues, paying close to the power usage is crucial. It is important to check the battery often and have a spare charged battery just in case.

Scanning Issues
Complications when scanning the robot for configuration are also possible. This can occur when the Core Power Distribution Module and the Robot Controller is unable to detect one

[9]Pinout.ru, "USB Pinout," 2015.

or more of the USB modules on the Power Module's USB bus. Power cycling the robot, closing/re-installing the application, restarting the phone, and disconnecting the USB cable all seem to not work. This problem can be attributed to the error that happens when the USB microchips within the Core Power Distribution Module wait indefinitely to receive a reset signal as they are powered one, resulting n where one or more devices are not able to be detected on the USB bus. There is still more research that is to be made towards Modern Robotics and the reliability of their Power Module.

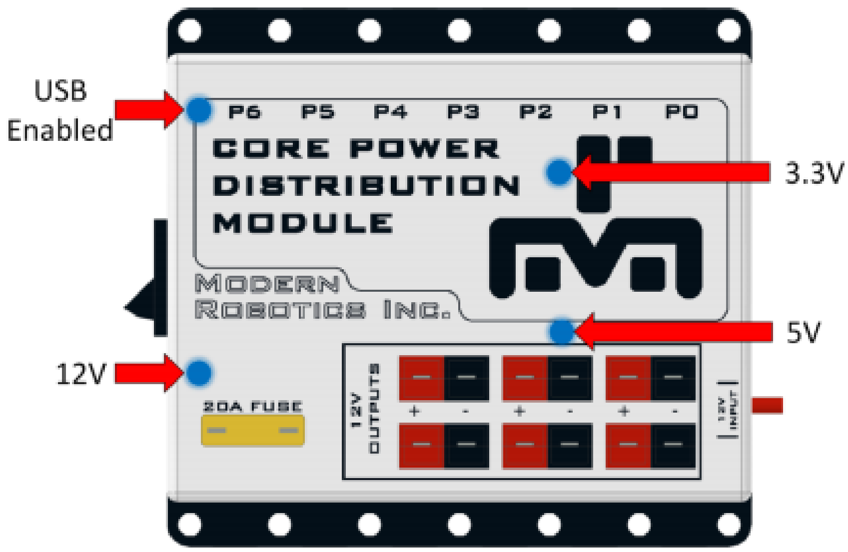
Modern Robotics Core Device Discovery
The Core Device Discovery utility enables retrieval of module information and serial numbers, test connectivity and most functions of each module. The Core Distribution Module is comprised of four LEDs which all are supposed to be lit up after connection to a host device. If not, that indicates an error status.



[10]

Core Power Distribution Module
The Core Power Distribution Module is equipped with four LEDs as status indicators. Under normal operation, all four LED's should be illuminated after the module is connected to a host phone or computer. 12V indicates that the 12v supply is connected and the power switch is on. 5V indicates that the 5v power supply is operating and supplying 5v to the USB ports. 3.3V indicates that the 3.3 volt supply to the internal electronics are operating. USB Enabled indicates that a host device is connected to the USB input port.

[10] Modern Robotics, "Core Device Discovery Utility," 2015



[11]

Core Motor Controller
Motors can be controlled in three operation modes and their encoder values displayed. The mode can be switched using the three buttons labeled Constant Power, Constant Speed, and Run to Position. The button will appear white when selected indicating the current mode enabled. Motor values can range from a power of -100 to 100 and encoder values can range from -2147483648 to 2147483647.

- Pressing key or “Update Values” will update controller with the user input
- Pressing key will set the power of both motors to 0
- Pressing “Reset Encoders” will set motor power and encoder values to 0
- Pressing the or arrows on the keyboard will adjust the values +/-5

Core Servo Controller
Servos can be enabled or disabled using the selection buttons in the bottom right. The button will appear white when selected indicating the current mode enabled. Servo values can range from 0 - 255 (1.5uS to 2.5uS). Also, it is important to note that most servos range from (1.75uS to 2.25uS) and extending the range to the mechanical limits can cause damage to the servo over time. It is recommended to find the limits of each servo by increasing and decreasing the value until the servo "hums" indicating it has hit a mechanical limit and not exceeding this range in the design.

- Pressing key or “Update Values” will update controller with the user input
- Pressing the or arrows on the keyboard will adjust the values +/-5

Core Device Interface
The Core Device Interface has multiple inputs and outputs to be used with Modern Robotics Inc. Core sensors as well as user created sensors and devices. These functions include on board indicator LEDs, Analog input and outputs, Digital input and outputs, I2C communication, and PWM outputs. Also note that the PWM outputs are for sensor design only and not to be used directly with servos as the power circuitry cannot support the current needed for servo operation.

[11] Modern Robotics, "Core Device Discovery Utility," 2015

- The onboard LEDs can be turned on and off using the checkboxes in the top left
- PWM output can be controlled using the left frame
  PWM time and period can range from 0 - 65534 uS
  Pressing “PWM Update” will update the controller with the user input
- Analog output can be controlled in the top right frame
  The output mode can be changed for each port using the buttons associated
  Voltage in “Volt” mode can range from -4v to 4v peak
  Voltage in all other modes can range from 0v to 8v peak to peak
  Pressing “Update Analog Out” will update the controller with the user input
- Analog and Digital ports can be read in the bottom right and are auto-updating
  These ports are floating when no sensor is connected and all data received on unconnected ports should be ignored during use
- I2C Address List shows all the discovered I2C addresses connected to the I2C port
  Pressing “Refresh List” will scan for all compatible I2C addresses and display the ones found and the Device type if it is a MRI branded sensor
- I2C Commands allows one to read and write values to a register on a specific address
  Checking “Poll Read” will continuously update the value field with the contents of the register selected
  Pressing “READ” will perform a single read transaction to the sensor
  Pressing “WRITE” will perform a single write transaction to the sensor
- Change Address form allows modification of the address of a specific sensor if allowed
  Change Address form allows modification of the address of a specific sensor if allowed
  Only MRI brand I2C sensors support the address change functionality
  When changing the address only one device should be connected at one time to avoid multiple devices on the same address.
  Pressing the “Change Address” button will change the address of the device and update the address list to display to ensure the address has been successfully changed
  Addresses can range from (16)0x10 to (254)0xFE and have to be even numbers

Core Legacy Module
The Core Legacy Module has six ports for connecting Legacy sensors and controllers. Each port incorporates 10kHz I2C speed transactions as well as Legacy standard analog input. All I2C values can range from 0x00 - 0xFF accordingly.

- Pressing the "I2C Address" button located in each port form will auto-detect the i2c address of the device connected
- Checking the box next to "Poll Read" will read the register info and analog values continuously
- The Onboard LEDs may be enabled using the checkboxes on the left side of the screen

57.5 Battery Power Options

How a Battery Works
[12] The anatomy of a battery consists of two terminals at each end, marked with (-), or negativ, or (+), or positive. These indicate the anode (-) and the cathode (+). The two

[12] Marshall Brain, Charles Bryant, & Clint Pumphrey, "How Batteries Work," 2001

electrodes are separated by a separator that ensures that the anode and cathode do not touch as the electrical charge flows between them. However, on a 9-volt battery, which is one our robot utilizes, the terminals are situated next to each other on top of the battery. When these two terminals are connected by a wire, the electrons from the negative end flow to the positive end as fast as possible. To avoid possible danger of the high-energy electromagnetic reaction of the battery, a load is connected, which in this case is the Core Power Distribution Module. The medium which the electrons flow through is known as the electrolyte, and the collector conducts the charge to the outside of the battery and through the load.

Desired Battery Setup
The basic desired setup of the battery is that the 9-volt unit is connected to the Core Distribution Power Module directly, with nothing else interfering. This ensures the most direct flow of electricity and decreases the possibility of other variables that could disrupt the electricity flow.

Battery Failure
Batteries can fail for a number of reasons. One cause could be faulty factory manufacturing, though that is not the main cause, as factories are usually careful about these kinds of things. The more primary reasons include aging, uncontrolled operating conditions, and improper usage.

Aging
[13] Battery performance gradually deteriorates with time due to unwanted chemical reactions and physical changes to the active chemicals. This process is generally not reversible and eventually results in battery failure.

- Passivation
  This is the resistive layer which builds up on the electrodes impeding the chemical action of the cell, increasing its impedance and at the same time reducing the quantity of active chemicals in the cell
  The gradual build up of the SEI layer is the prime cause of ageing in the cells
  Ultimately the SEI layer can block the porous surface of the electrodes resulting in critical failure of the cell
- Corrosion Consumes Some of the Active Chemicals in the Cell Leading to Increased Impedance and Capacity Loss

[13]Electropaedia, "Why Batteries Fail," 2005

- Chemical Loss Through Evaporation

  In some cell designs, gaseous products resulting from over charging are lost to the atmosphere causing capacity loss
- Change in Physical Characteristics (Morphology) of the Working Chemicals
- Crystal Formation

  Over time the crystal structure at the electrode surface changes as larger crystals are formed

  his reduces the effective area of the electrodes and hence their current carrying and energy storage capacity
- Dendritic Growth

  This is the formation of small crystals or treelike structures around the electrodes in what should be an aqueous solution

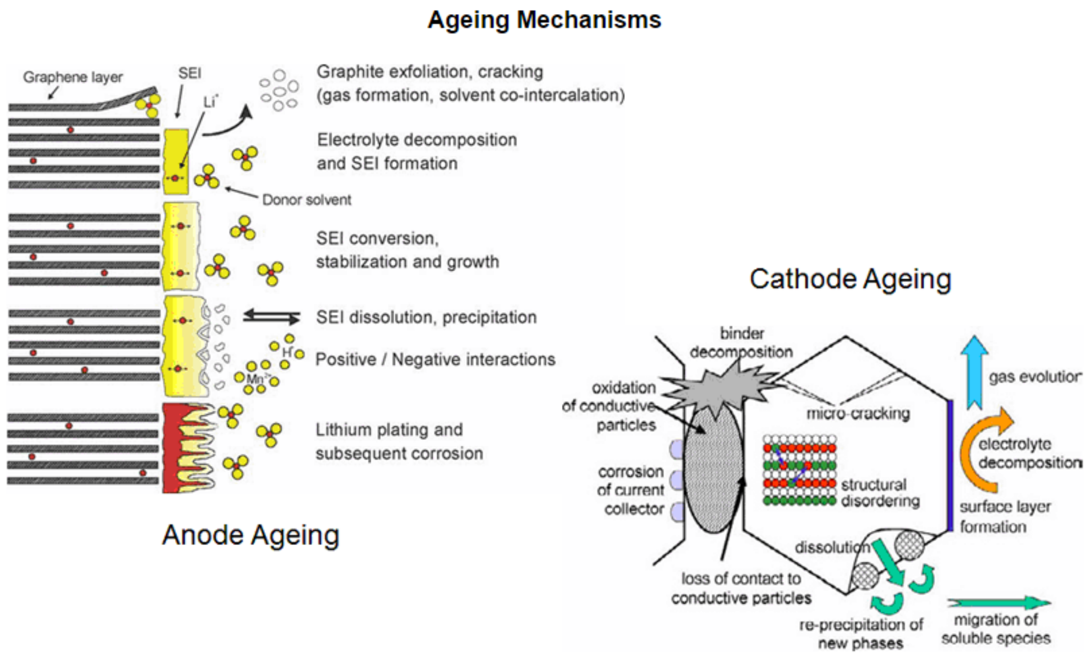
  Initially these dendrites may cause an increase in self discharge

  Ultimately dendrites can pierce the separator causing a short circuit
- Shorted Cells

  Cells which were marginally acceptable when new may have contained latent defects which only become apparent as the ageing process takes its toll

  This would include poor cell construction, contamination, burrs on metal parts and separators damaged by welding operations on the electrode current collectors which can all cause the electrodes to come into contact with each other causing a short circuit
- Electrode or Electrolyte Cracking

  Some solid electrolyte cells such as Lithium polymer can fail because of cracking of the electrolyte



[14]

Uncontrolled Operating Conditions

Good batteries are not immune to failure which can be provoked by the way they are used

[14] Vetter et al., "Aging Mechanisms in Lithium-Ion Batteries," 2005

or abused. High cell temperature is the main killer and this can be brought about in the following situations.

- Bad applications design
- Unsuitable cell for the application
- Unsuitable charging profile
- Overcharging
- Environmental conditions
  High ambient temperatures
  Lack of cooling
- High storage temperature
- Physical damage is also a contributing factor

Improper Usage

- Dropping
- Crushing
- Penetrating
- Physical impacts
- Immersion in fluids
- Freezing or contact with fire

How Batteries Fail

- Active Chemicals Exhausted
  In primary cells this is not classed as a failure since this is to be expected but with secondary cell it is expected the active chemicals to be restored through recharging
  Aging will cause the gradual depletion of the active mass
- Change in Molecular or Physical Structure of Electrodes
  Even though the chemical composition of the active chemicals may remain unchanged, changes in their morphology which take place as the cell ages can impede the chemical actions from taking place, ultimately rendering the cell unusable
- Breakdown of Electrolyte
  Overheating or over-voltage can cause chemical breakdown of the electrolyte
- Electroplating
  In Lithium cells, low temperature operation or over-current during charging can cause deposition of Lithium metal on the anode resulting in irreversible capacity loss and eventually a short circuit
- Increased Internal Impedance
  The cell internal impedance tends to increase with age as the larger crystals form, reducing the effective surface area of the electrodes
- Reduced Capacity
  This is another consequence of cell aging and crystal growth
  It is sometimes recoverable through reconditioning the cell by subjecting the cell to one or more deep discharges
- Increased Self Discharge
  The changing crystal structure of the active chemicals as noted above can cause the electrodes to swell increasing the pressure on the separator and, as a consequence, increasing the self discharge of the cell
  As with all chemical reactions this increases with temperature
- Gassing

Gassing is generally due to overcharging; this leads to loss of the active chemicals but in many cases this can also be dangerous

In some cells the released gases may be explosive; lead acid cells for instance give off oxygen and hydrogen when overcharged

- Pressure Buildup

  Gassing and expansion of the chemicals due to high temperatures lead to the buildup of pressure in the cell and this can be dangerous

  In sealed cells it could lead to the rupture or explosion of the cell due to the pressure build up unless the cell has a release vent to allow the escape of the gasses

  Pressure buildup can cause short circuits due to penetration of the separator and this is more of a problem in cylindrical cells which tend to resist deformation under pressure compared with prismatic cells whose cases have more output thus mitigating the pressure effect somewhat
- Penetration of the separator: Short circuits can be caused by penetration of the separator due dendrite growth, contamination, burrs on the electrodes or softening of the separator due to overheating
- Swelling

  Before the pressure in the cell builds up to dangerous limits, some cells are prone to swelling due to overheating

  This is particularly true of Lithium polymer pouch cells

  This can lead to capacity loss due to deteriorating contact between the conductive particles within the cell as well as external problems in fitting the cell into the battery enclosure
- Overheating

  Overheating is always a problem and is a contributing factor in nearly all cell failures

  It has many causes and it can lead to irreversible changes to the chemicals used in the cells, gassing, expansion of the materials, swelling and distortion of the cell casing

  Electrolytes are particularly vulnerable to heat, breaking down at temperatures as low as seventy degrees Celsius

  Such temperatures can be reached in the interior of a parked car, possibly exceeding the recommended maximum temperature of Lithium ion batteries used in devices such as laptops left in the vehicle
- Preventing a cell from overheating is the best way of extending its life
- Thermal runaway

  The rate at which a chemical action proceeds doubles for every 10 degrees Celsius increase in temperature; the current flow through a cell causes its temperature to rise

  As the temperature rises the electro-chemical action speeds up and at the same time the impedance of the cell is reduced leading to even higher higher currents and higher temperatures which could eventually lead to destruction of the cell unless precautions are taken

How to Fix Battery Failure

Sometimes when the reason for battery failure is due to some connection issue, one way to fix it is to replace the battery with Anderson pole connectors or Tamiya connectors. Changing the connectors will help eliminate the issue. The same applies with chargers.

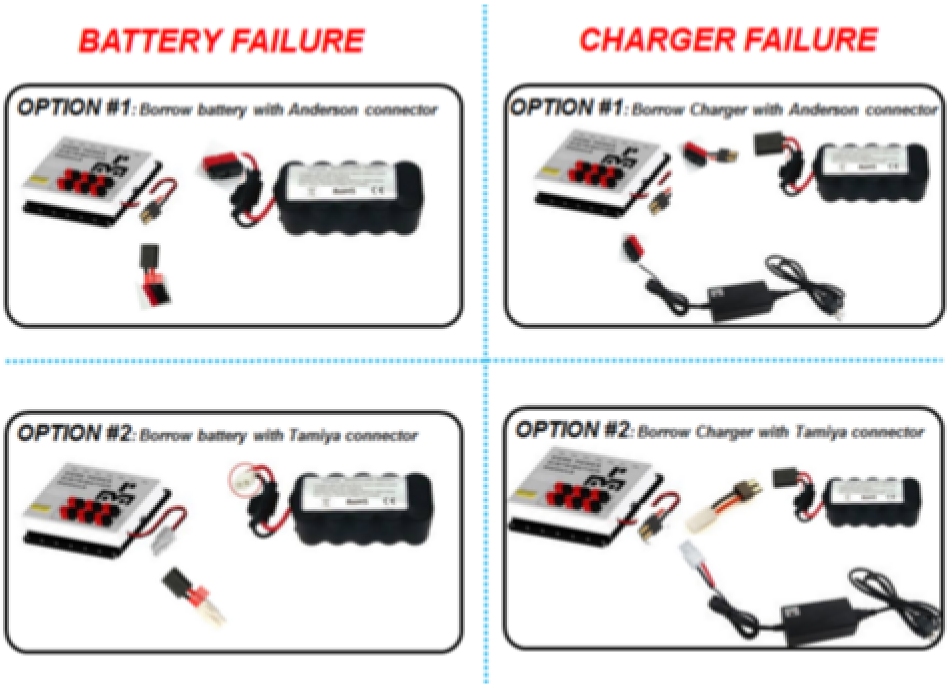
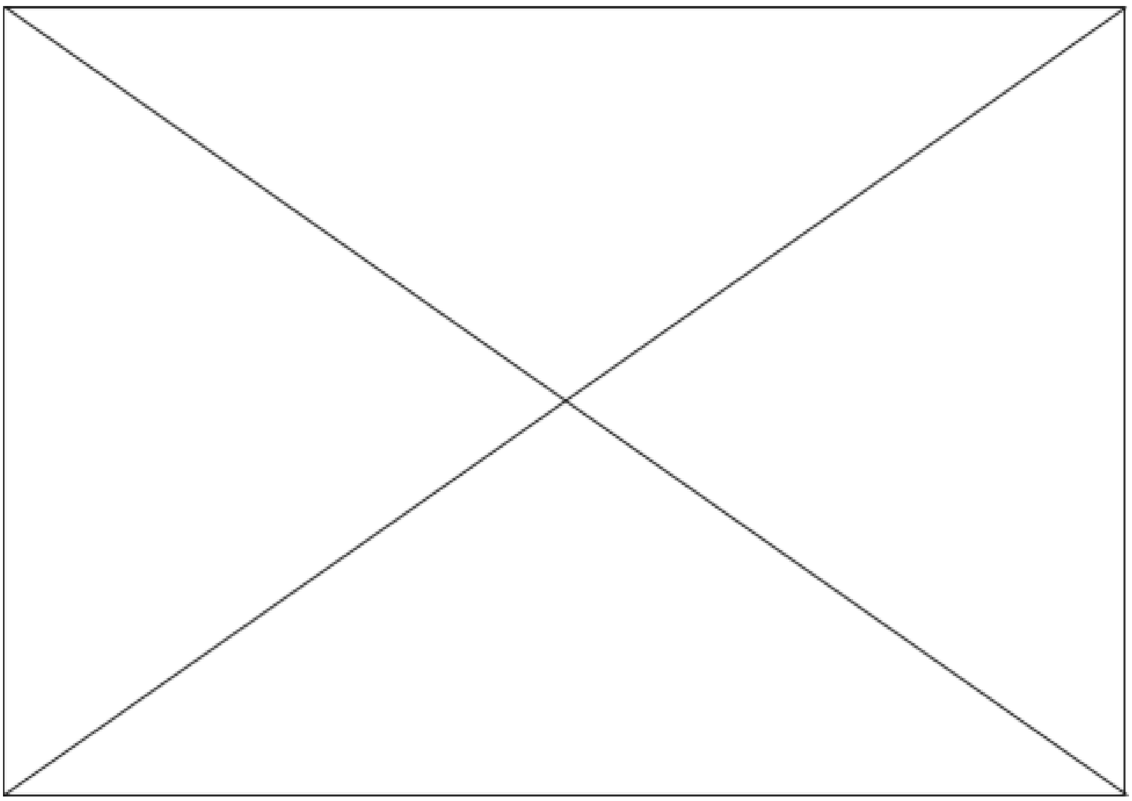


Figure 57.5: Chart depicting the steps needed to be taken in order to solve battery and charger failure.



58. Mechanical Aspects

58.1 Servo Motors

A servo is a controllable motor and there are many kinds of them. A servo is made up of a two wire DC motor, a gear train, a potentiometer, an integrated circuit, and an output shaft.

- Standard Servo
  Geared down motor that has a limited range of rotation
  Uses an internal electronics to identify the current angle of the motor, and using an input signal, are told what position is desired
- Continuous Servo
  Does not have a limit on its range of motion
  Relates the input to the speed to the output and direction
- 180 Degree Servo
  Has a limited rotation range, cannot rotate past 180 degrees
- 90 Degree Servo
  Has a limited rotation range, cannot rotate past 90 degrees

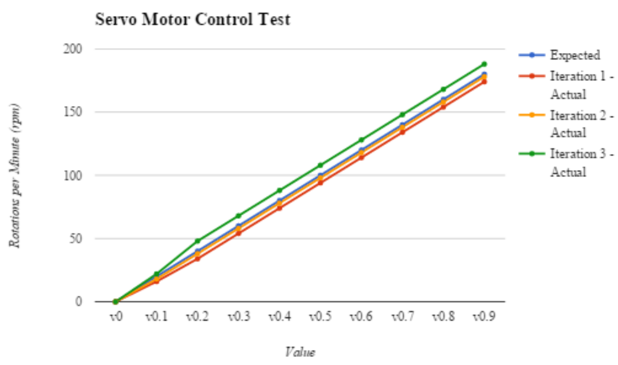
On the game field, we can use the 180 degree servo to pull down the lever to send the climber down the zipline. We can also use the 90 degree servo to close the lid of the container that holds all the debris we collected.

Problem
Servo motor rotation for releasing the climbers was not working consistently.

Detection
We learned that servo motor rotation is based on the parameter value passed to function “xxxxxx” in program “yyyyyy”.

Solution

We tested the servo multiple times, recorded actual readings and compared against expected values to establish the average parameter value to be used for predictable performance.



Value	Expected	Iteration-1 Actual	Iteration-2 Actual	Iteration-3 Actual
v0	0	0	0	0
v0.1	20	16	18	22
v0.2	40	34	38	48
v0.3	60	54	58	68
v0.4	80	74	78	88
v0.5	100	94	98	108
v0.6	120	114	118	128
v0.7	140	134	138	148
v0.8	160	154	158	168
v0.9	180	174	178	188

As seen from the data presented above, it can be seen that the expected values correlate rather well with the actual achieved results. The expected values showed a linear pattern of where the change in value by 0.1 corresponded to an increase in rpm of 20, followed very strictly by iterations one and two. Iteration three almost perfectly presents this linear pattern, however at v0.2 there is a jump from v0.1 possible reason for which could include human error or just the fact that there is more than one pattern and more research must be put in.

58.2 Wheels

Types of Wheels

- Standard Wheel

  Standard cylindrical shaped wheels with rubber on the outer edge for traction are not high tech nor is it expensive

  More traction than omni-wheels, mecanum wheels, and even treads

  More open to traction upgrades

  Zip-tied standard wheels can be used for robot on the heavy side (>30lbs), and is a cheap way to gain extra grip on the field
- Omni-Wheel

  Wheels with smaller wheels embedded on their outer edge

  Gives a vehicle equipped with these wheels the ability to move in any direction it wishes, by turning specific wheels in a given direction

  The wheels are placed rather unconventionally on the corners of the robot at a 45 degree angle to give the robot the correct vectors and orientation
- Stealth Wheel
- Tread

  High chance of coming off during competition

  More likely to break than wheels are

  Treads do not necessarily need to use four motors (two on each side) in order to have decent speed

  A simple gear system could allow one motor to run and entire side length of the robot; thus freeing up two motors to be used elsewhere on the robot

  Have good grip and traction

- All-Terrain Wheel
- Mecanum Wheel

  Can be used to create drive trains capable of moving any direction

  With each wheel independently driven, the robot will move forward, backwards, and sideways

  These polycarbonate wheels are designed for superior traction

58.3 Gears

Overview of Gears

Gears are simple machines which transmit power from one part of a machine to another. Any number of gears of all shapes ans sizes can be fitted together to do one of the three following options:

- Increase Speed

  If the first gear has more teeth than the second gear, the second one has to turn round much faster to keep up

  This arrangement means the second wheel turns faster than the first one but with less force
- Increase Force

  If the second wheel in a pair of gears has more teeth than the first one, it turns slower than the first one but with more force

  Also known as increased rotational torque (describes later in more detail)
- Change Direction

  When two gears mesh together, the second one always turns in the opposite direction

  Specially shaped gears can be use to make the power of a machine turn through an angle

Four Ways to Use Gears

- Gears for Speed

  As explained above, if the gear ratio is greater, the greater the speed will be
- Gears for Force

  Also mentioned above, the lower the gear ratio, the more increased the force and torque

  Torque is defined as the tendency for something to produce torsion or rotation
- Worm Gear

  A worm gear is comprised of an electric motor and a screw-like gear to drive a large gear wheel

  It reduces the speed of the motor to make the large wheel turn with more force, but it's also useful for changing the direction of rotation in gear-driven machinery
- Rack and Pinion Gear

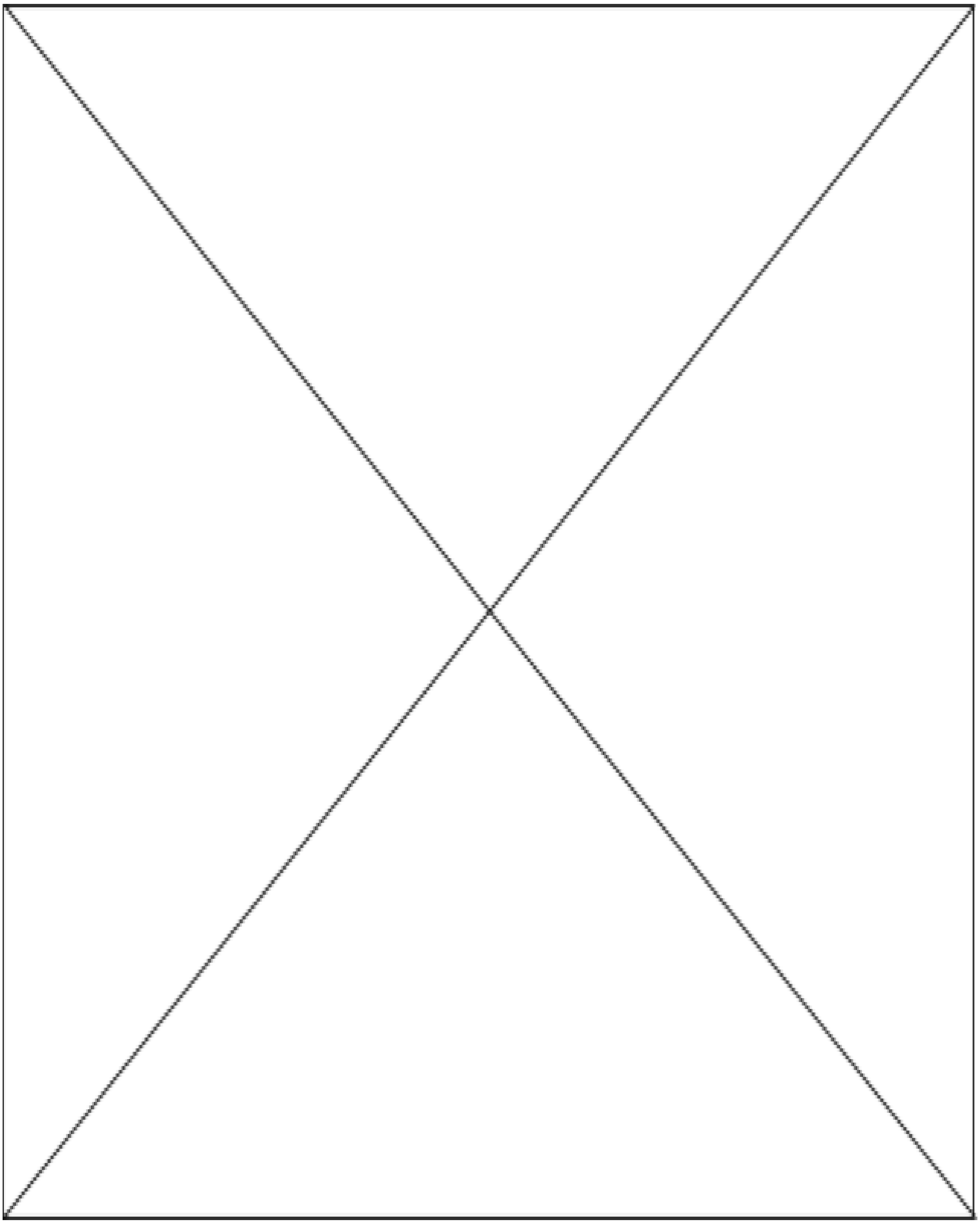
  In a rack and pinion gear, a slowly spinning gear wheel (the pinion) meshes with a flat ridged bar (the rack)

  If the rack is fixed in place, the gear wheel is forced to move along it

  If the gear is fixed, the pinion shifts instead

58.4 Screws

We are thinking about using nylon lock nut inserts or nylon nuts to stabilize our robot. They are used to prevent turning of screws. We are going to use them instead of the 6-32 kep nuts provided in the TETRIX kit. We were thinking we could use them on the flap system because the screws used on it may be more perceptible to loosening.



59. Robot Design Process

59.1 Chassis

Overview of a Chassis
The chassis the most important part of a robot. It is a physical frame of the robot structure and its very foundation. Nothing else can be added to the robot without first a created chassis. Analogously, it can be referred to as an animal bone skeleton. No muscles or tendons or ligaments can be added to an animal body when its skeleton is missing. The main components of a universal chassis include wheels, connecting structural components, and possibly gears.

Objective
The objective of the chassis is to create a rudimentary frame which is strong enough to support the rest of the robot without being to large (and obeying the eighteen inches by eighteen inches by eighteen inches rule) and too heavy.

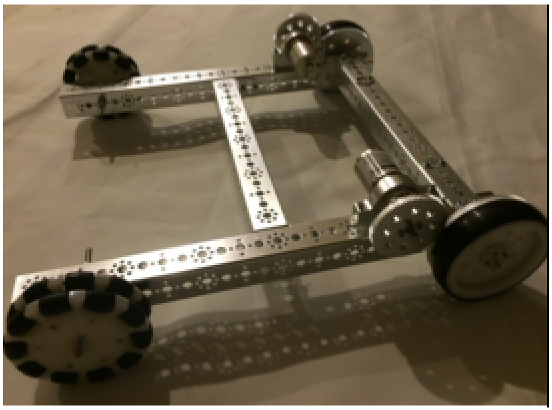
What to Consider
The purpose of the chassis is to provide a simple frame. Thus, we cannot make the chassis unnecessary large and heavy. Weight comes into play in concern of the mountain. In order to have a robot which can climb the slope, so it is best if we create a robot with as little weight as possible. A thin and sleek design would also be very helpful.

Presented below is the steps we took to create our fundamental chassis along with a few extra additions to the robot.

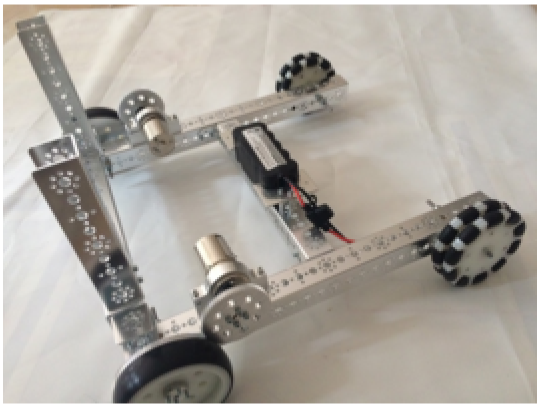
1. Basic wheel assembly with a gear

2. Corner of the base

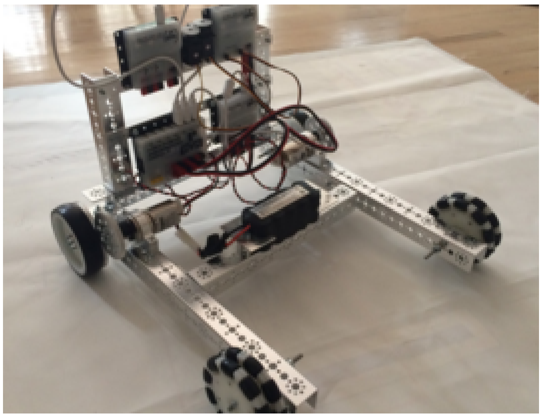
3. Created both sides of base as well as support channel



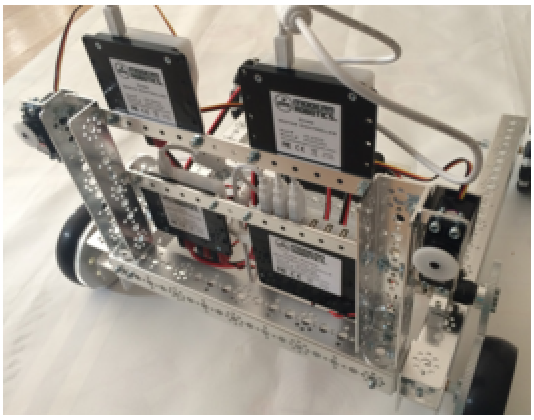
4. Added 9-volt battery and structure for electrical wiring



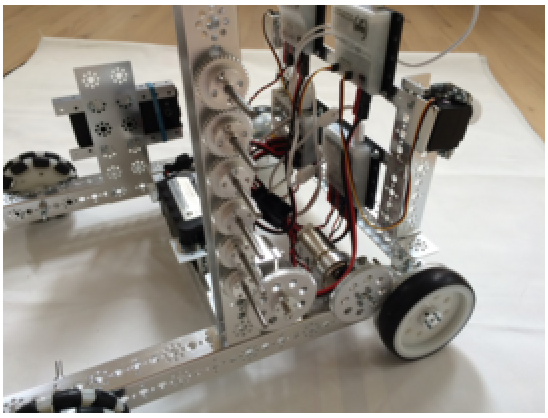
5. Finished wiring onto vertical structure



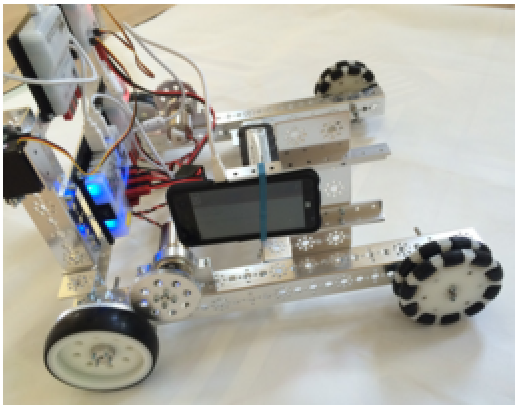
6. Servos in back for testing



7. Made a gear chain for attachments



8. Configured and tested with phone



59.2 Mountain Climbing System

Objective
The objective of the mountain climbing system is that the robot has some method of climbing higher up the mountain. This is because certain amounts of points can be scored depending on the position of the robot in relative to the mountain. For example, parking in Autonomous gives certain amounts of points, as well as scoring during Driver-Controlled, and parking in End Game. Below are tables of the possible mountain-related points. [1]

For Autonomous (Robot Parked):

Floor Goal	5
Rescue Beacon Repair Zone	5
Tile Floor and Mountain	5
Mountain Low Zone	10
Mountain Mid Zone	20
Mountain High Zone	40

For Driver-Controlled (Debris):

Floor Goal	1
Low Zone Goal	5
Mid Zone Goal	10
High Zone Goal	15

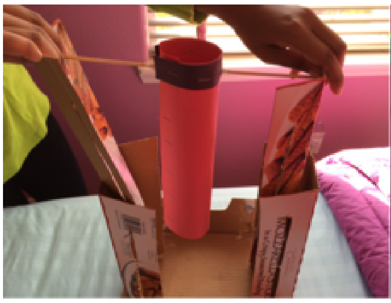
For End Game (Robot Parked):

Tile Floor and Mountain	5
Mountain Low Zone	10
Mountain Mid Zone	20
Mountain High Zone	40

What to Consider
Weight is a recurrent concern when dealing with the mountain. We must create a mountain climbing system along with taking head to how much our robot weighs. If it is too heavy, the force of gravity will drag down our robot and make it difficult to go up.

[1] FIRST, "Game Manual Part 2," 2015

Prototypes
One prototype we made was a model for picking up the debris. The prototype was made out of cardboard and little plastic tubes. The model simulated how the attachment would pick up the debris. We used a piece of cardboard to make the ramp and at the end of the ramp, we put two holes and stuck a cardboard tube in them horizontally. On the cardboard tube we made holes for the little plastic tubes to go in. The plastic tubes stick out of the cardboard tube like tiny spikes, so when the motor turns the plastic tubes will collect the debris.



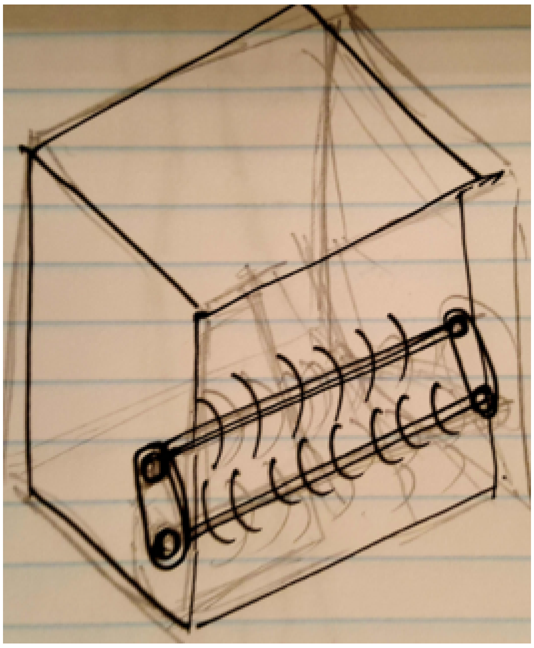
Another model we built was a prototype for the slider we have to lift up the tube that holds the debris. The prototype was built out of cardboard, screws, nuts, paper, and a chopstick. First we cut the cardboard into two “C” shaped channels, and two “L” shaped channels. We cut two lines on both sides of the L channels and cut lines on the same two sides of the C channels. Then we put screws in the cuts and on the other side we screwed the nut on to stop the screw from falling out. Now you could slide the L channels up and down. Next we rolled paper into a cylinder to use as the tube. We poked a chopstick through it and also attached it to the L channel. Now when we slid the L channels up, the tube would come with it too (and could also rotate).

59.3 Debris Collection System

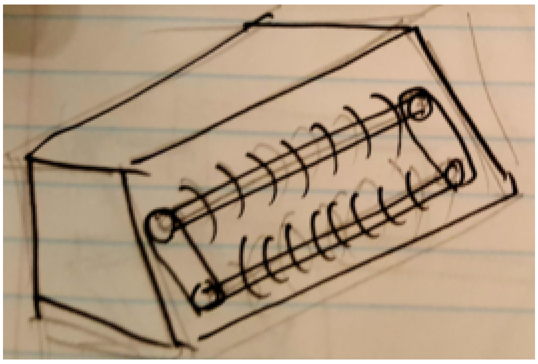
The objective of the ball collector is to collect all the debris laid out on the game field and store it in one place and eventually, throw it into the baskets on the mountain.

We decided to go with a sweeper which would move the balls and cubes into a tube. We are making the flat out of garage insulator because they are strong but flexible. This would be the most efficient way to put the balls and cubes into the bins on the ramp. Pictures of our idea of the design are presented below.

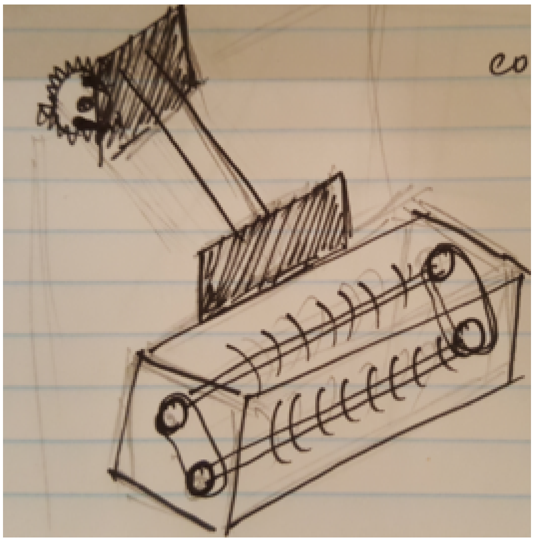
1. This image shows the original design for the ball collector. It was very tall and has lots of space to store debris in the back.



2. In this picture, it shows that the design has shrunk in height. It still has the same amount of space for the storage of the debris.



3. In this image, it shows the ball collector have in a long “spinal” figure in the back that is slanted upward. This is much like a conveyor belt system but instead of a rubber material running through the “spine” so that the debris would move upward, the power of the arms will forcefully push up the debris to the top.



4. We created a three-dimensional model out of cardboard and little plastic tubes. The model simulated how the attachment would pick up the debris. We used a piece of cardboard to make the ramp and at the end of the ramp, we put two holes and stuck a cardboard tube in them horizontally. On the cardboard tube we made holes for the little plastic tubes to go in. The plastic tubes stick out of the cardboard tube like tiny spikes, so when the motor turns the plastic tubes will collect the debris. This helped us visualize how we are going to create our real debris collecting system with TETRIX and FTC-allowed parts. Our idea for creating a model came from our Hot Wired sessions. Thanks to them, we have very professional and helpful methods in conducting the building of our robot.

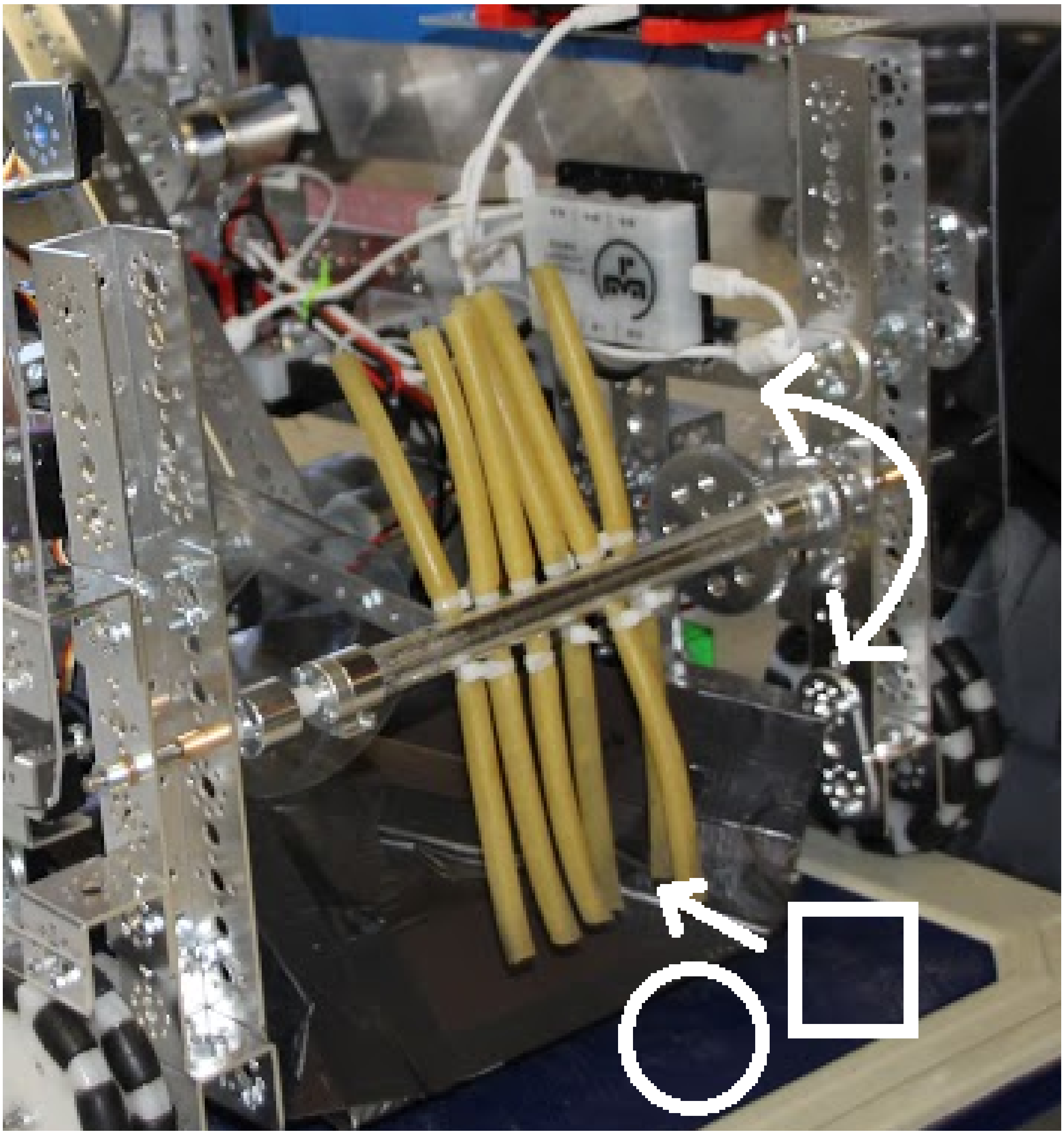


Figure 59.1: The debris collection design implemented on our robot. The debris is to be sweeped in by the sweeper which rotates by a DC motor.

59.4 Debris Deposition System

Objective
The objective of depositing debris is to get the spheres and balls in the buckets on the mountain. The higher the bin is on the mountain, the higher the points are. Below is a table which expresses the amount of points for each goal.

[2]

Floor Goal	1
Low Zone Goal	5
Mid Zone Goal	10
High Zone Goal	15

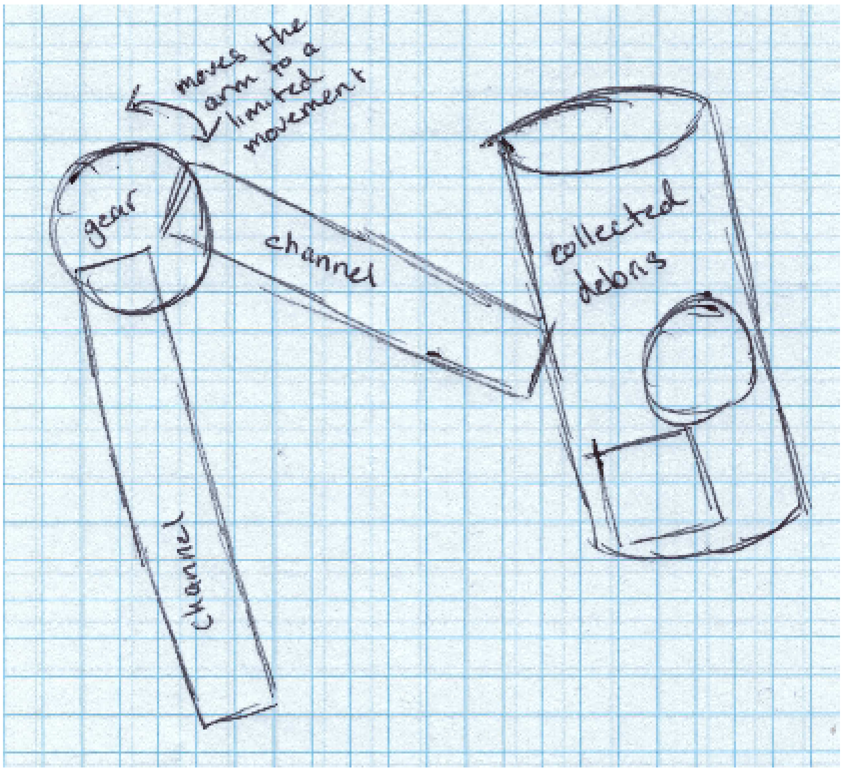
What to Consider
We have decided to go with the floor goal and low zone bucket and possibly the mid zone bucket due to the heaviness of our robot causing it to have difficulty to climb further on the mountain. We have also considered to have a extendable and retractable approach, however the center of our robot is already very filled, so we must consider a method which does not require to must space of our robot.

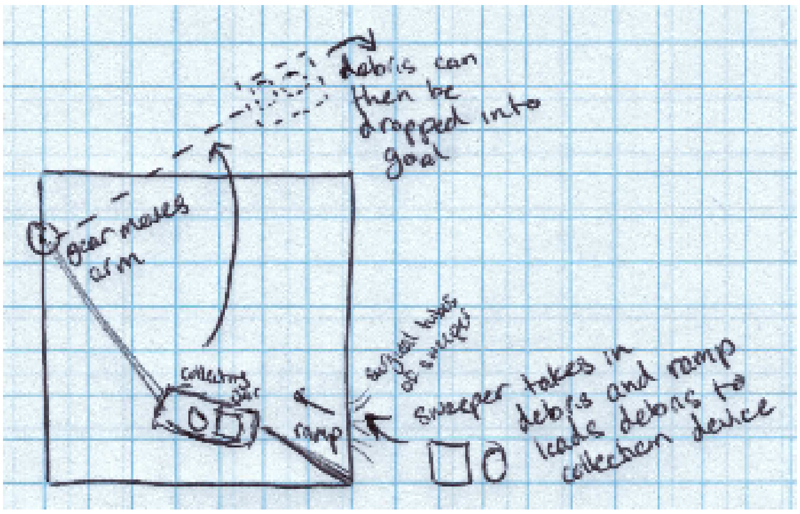
Typically, there are three methods for getting the spheres/blocks to the basket:

1. The Catapult Method
   In this method, the balls are hit with a movable flat bracket or wheel sub-assembly
   Can score even when other robots are in front of the mountain
   Very difficult to make consistent
2. The Conveyor Belt Method
   In this method, the balls are moved forward and backward on a track, and after reaching the end of the track, they are projected into the basket
   Possibility for conveyor belt to slip off
3. The Hand Method
   So, instead of throwing the ball, taking the debris using a stretchable lift-arm strategy might be easier and more effective
   The debris can be delivered using a slide that is mounted on the arm, or we can add a gripper to the arm that can hold the box/tube containing the debris, and lift/drop them into the basket
   Simple and easy to construct
   Cannot score when other robots are in front of the mountain and blocking access to the scoring goals

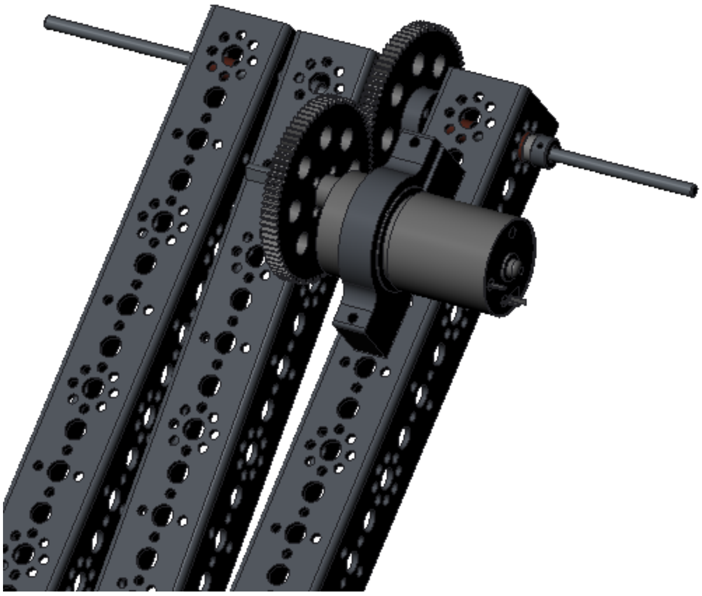
We went with the third option, the hand delivering system. The system consists of an arm which consists of structural elements and a collection container and a gear and motor which allow for the movement of the arm. On the next page are napkin sketches of first just the arm portion and then second the design implemented in the robot.

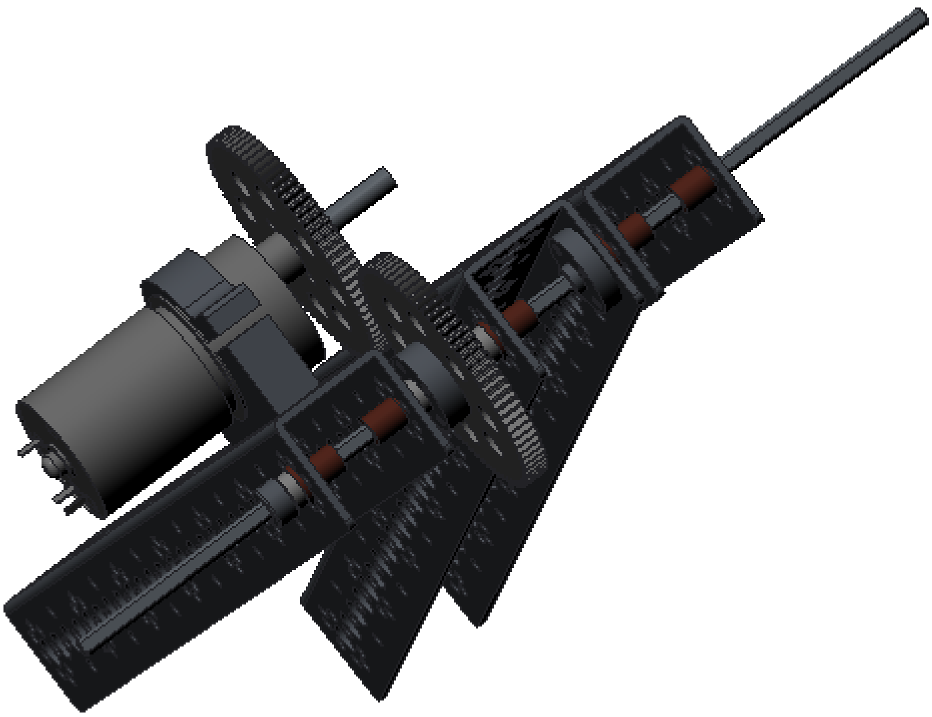
[2] FIRST, "Game Manual Part 2," 2015



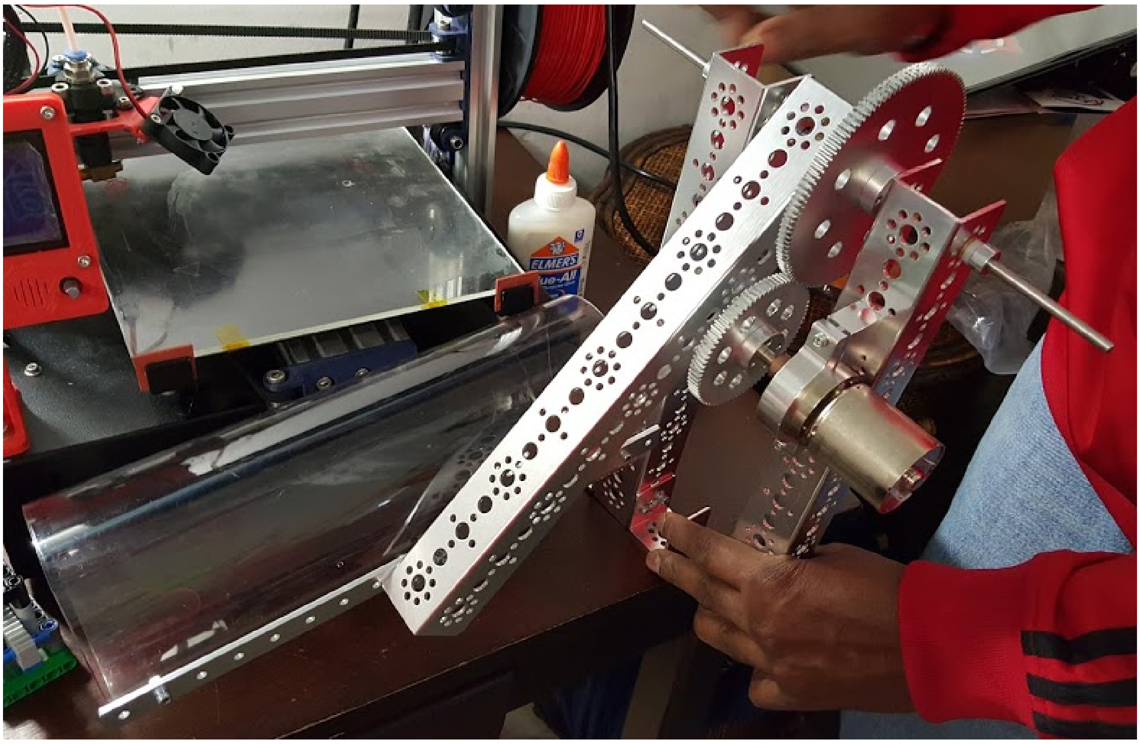


On the next page are CAD renderings of the arm collecting system without the container.





Now, shown on the next page are photographs of the actual system.


ELMERS

59.5 Beacon Repair System

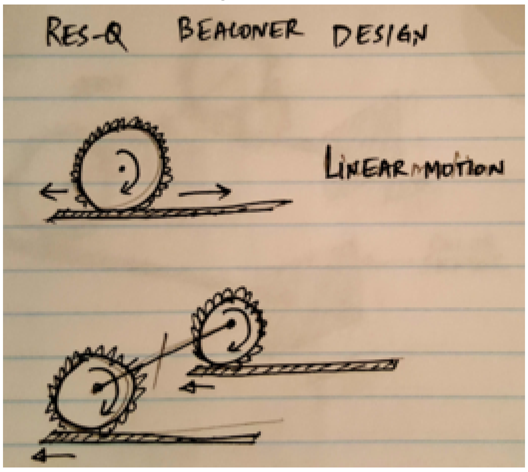
Objective
The objective of the IR Beacon Repair Zone challenge is that after the rescue beacons have randomized, the robot will sense the color specified by the rescue beacon and push the correct button. For the first time the correct color is pressed, twenty points is awarded to the alliance. The second time the correct buttons is pressed, and note that this can only be done by the other alliance partner, not the one whom had previously pressed the button, another twenty points if awarded. If the incorrect button is pressed, the other alliance is awarded points.

What to Consider
Our robot still has issues with weight, so our Beacon Repair strategy cannot be too heavy. Also, it should not include anything that reaches out far because that decreases the strength of the protrusion and induced the risk of the attachment to snap and break in two. To add in, as the other alliance can be awarded points is we mistakenly press the incorrect beacon color button, we must ensure that our program for the challenge must be fail-proof. We also have to do something that is simple and straightforward so it lessens the possibility of other errors and complications. It also makes it easier to pinpoint the specific issue and

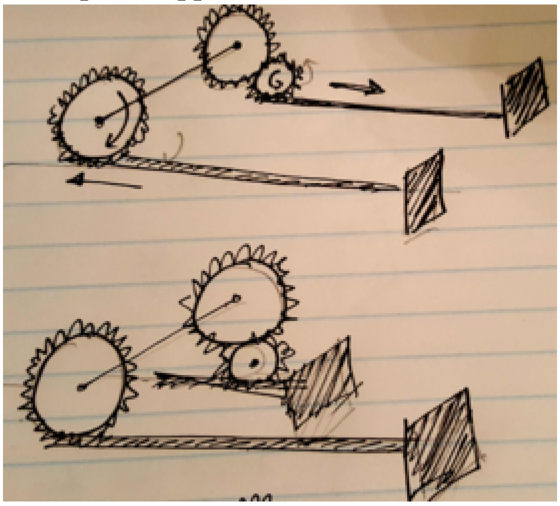
how to debug it in the code.

Shown below is the sketch of the Beacon Repair strategy design.

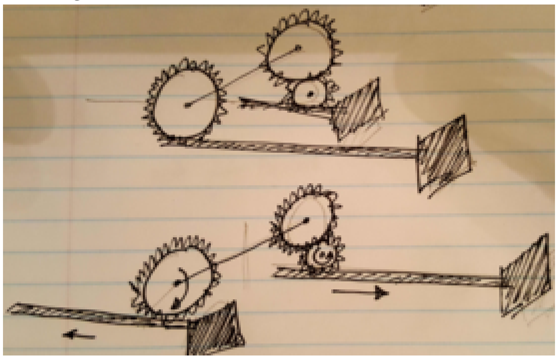
1. In this image, it shows the linear movement of the design. Because both sides have the same number of gears, the move in the same direction at the same time.



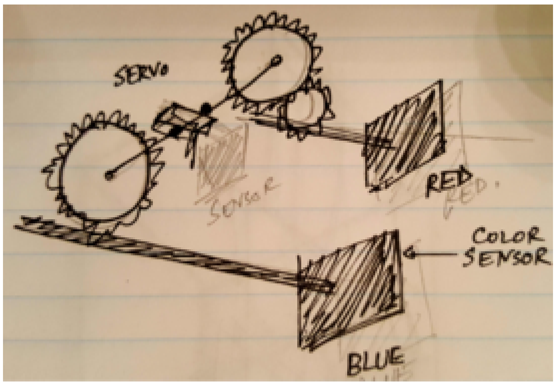
2. In this image, it shows that once another gear is added only to one of the sides, they both spin in opposite directions.

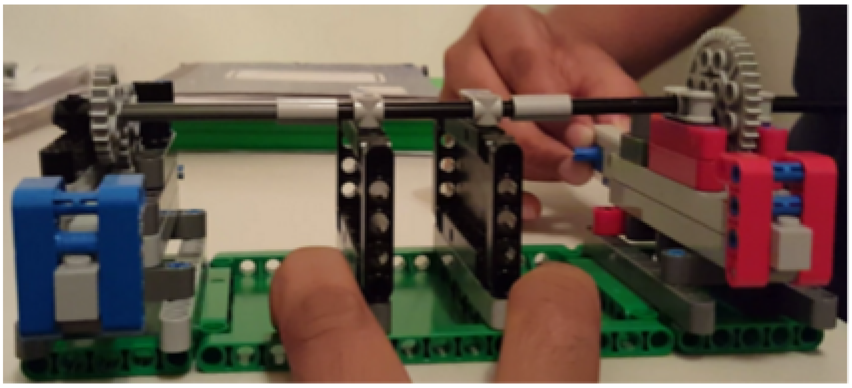


3. This image shows that if the front panels are extended, there is a much larger chance of hitting the button.



4. In this image, it shows that once a servo motor is put in the middle, the beacon will be able to rotate. Also, if a color sensor is put underneath the servo motor, we can tell which color the rescue beacon is so we can press the correct button.





Stage 1-Built with legos

Stage 2- Built with tetrix parts

Depicted above is the LEGO model and the TETRIX real part. As it is blatantly obvious, the TETRIX portion is far more simplified than the LEGO construction. This is because when we created the LEGO model, we got to have a simulated view of the design, and it serves as a system which allow us to see how everything will work out and be laid out. We later decided that there were many ways which we could simplify and improve the design, resulting in what is now as part of our robot in TERIX pieces.

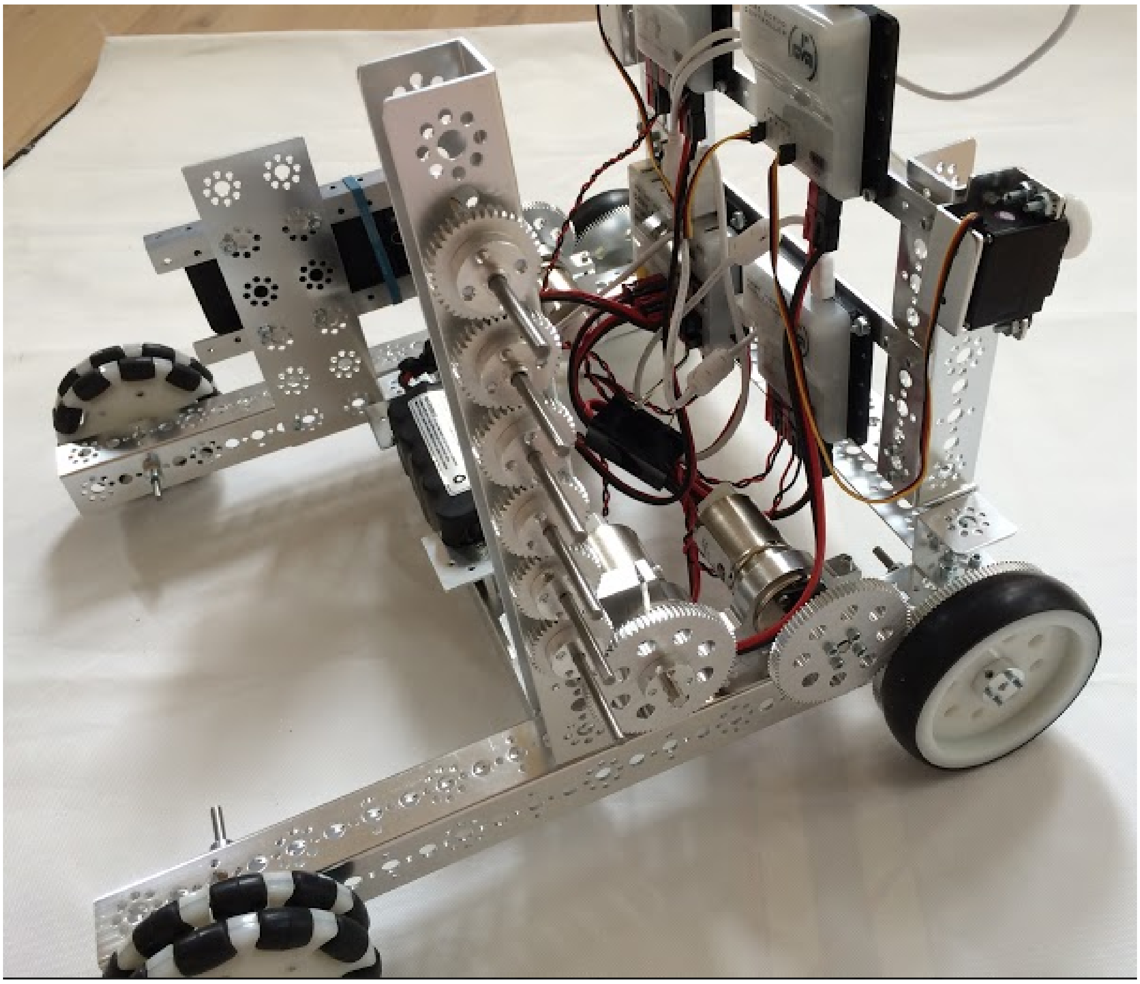
Below is a table which shows our IR Beacon Repair strategy. This is expressed in our autonomous program.

1	Detect the beacon color using the color sensor
2	If red color is detected, robot moves to the right
3	If blue color is detected, robot moves to the left
4	Move the robot forward to press the corresponding button
5	Continue with remaining steps of autonomous program

59.6 The Robot All Together

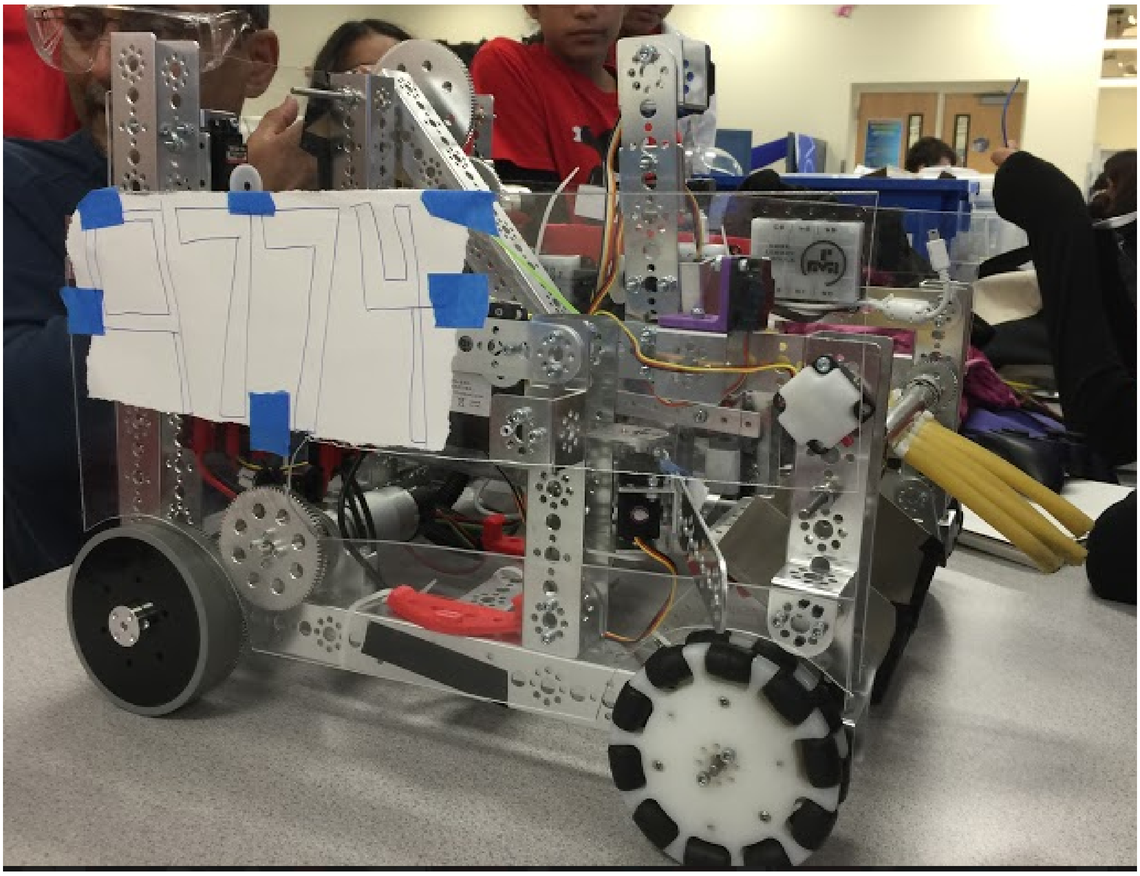
On the next page are pictures of the robot with all its components.

Before League Zero



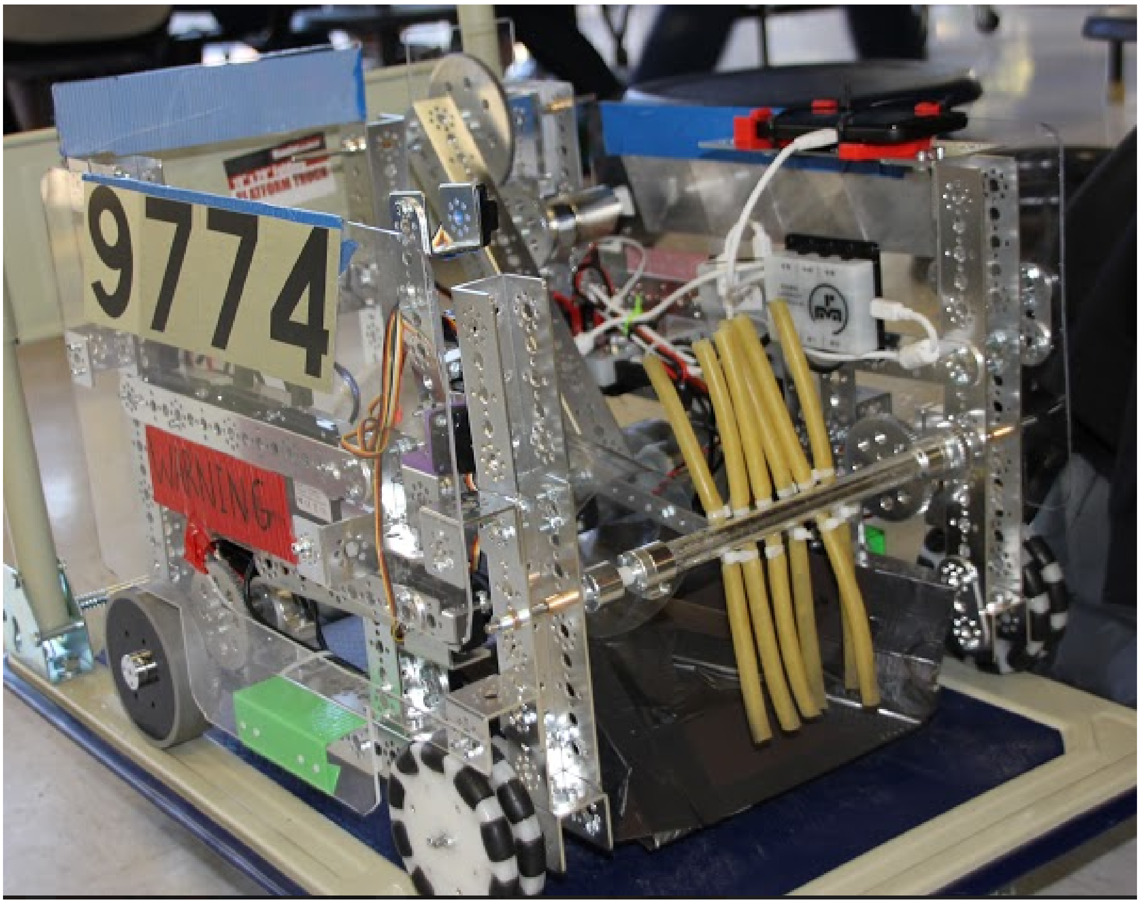
Before League Zero, our robot was merely an advanced chassis. It consisted of the elementary wheels, beams, gears, and electrical components. The line of motors seen were placed there just to keep everything together, they were not actually used like that. Our robot was able to do the rudimentary actions of driving. There were no sensors or servo motors, no advanced input or output functional attachments. This design however is not acceptable in the perspective of this year's challenge. We are not able to do anything that can give us points besides pushing debris of spheres and cubes into the floor goal, but that is not sufficient. We can also park on the mountain to the high zone, but just pushing debris into the floor goal and climbing the mountain will not be enough for us to score enough points to have a good handle in competition. Thus, we have decided we have to add a lot more to the robot. We will be adding many more attachments and mechanisms which will allow our robot to complete the challenges in the Res-Q game field. Other issue that come with this fundamental design is the fact that there is a wide gap and opening which opens up to all the crucial elements of the battery and electrical components. Outside things and other robots can get stuck inside the opening and ruin our robot. Nothing is protected nor supported, so there is little hope we will be getting anywhere with this current robot design.

League Zero



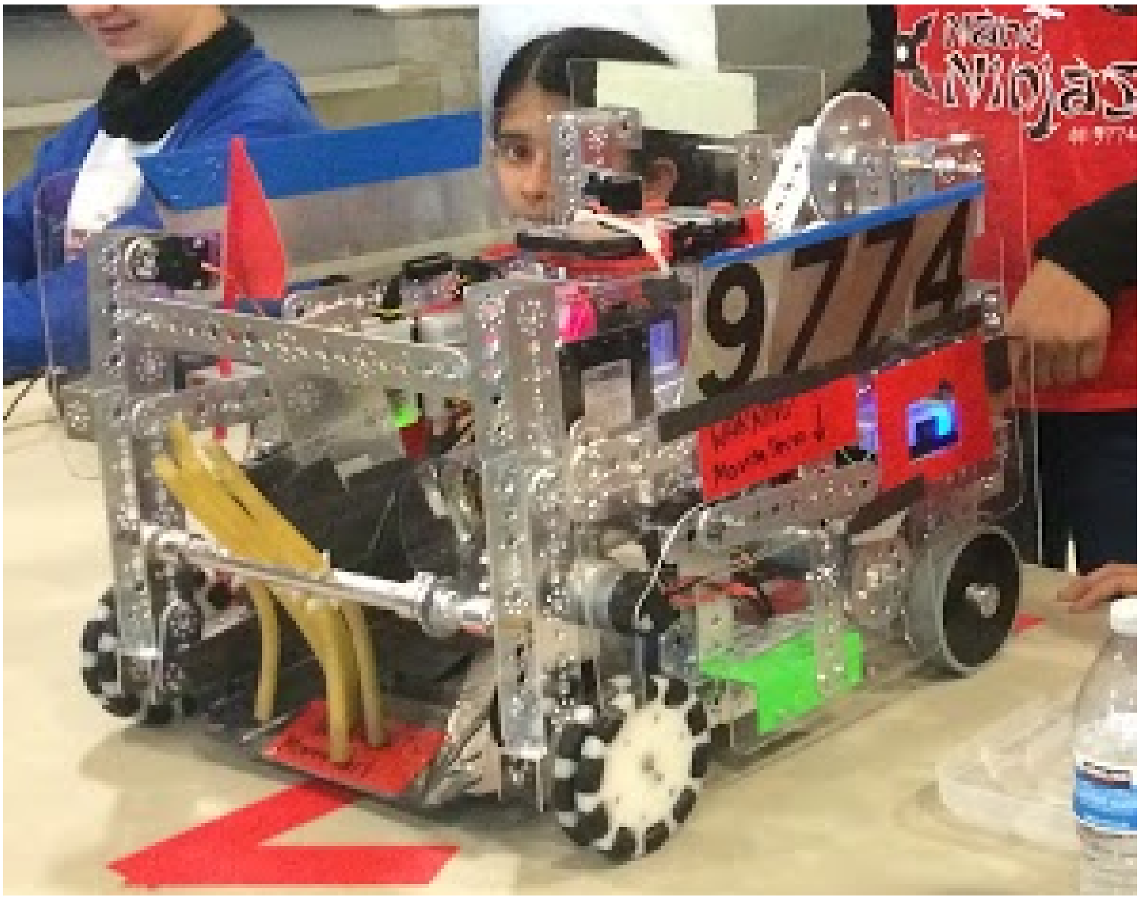
During League Zero, our robot was no longer an advanced chassis, but a basic functional robot with several more capabilities. As seen by the picture of our League Zero robot, it can be noted that our robot is now much larger and has many more attachments and additions. We also now have a system of protection which is the plexiglass that forms the strong walls of the robot. With this addition, we have lowered the possibility of things getting stuck in our robot or putting out of breaking anything in our robot. We have removed the chain of DC motors that used to be on the side of our chassis robot. To address the functional attachments in more detail, we have added a sweeper in the front which we use in the debris collection process. The spheres and cubes that are collected by the DC motor-powered rotating sweeper are lead into the debris collecting container, which is a cylindrical plastic structure with the bottom covered so the debris does not fall out. The container is connected to the arm and is powered by yet another DC motor and moves up and down. At the moment, our robot is only able to score in the aspect of scoring debris in the low zone goal, pushing debris into the floor goal, and parking in the low zone during End Game. We hope to add more to the robot so we can have a wider range of robot capabilities. We are anticipating on adding a climber activation system for Driver-Controlled Period, a climber deposition system for Autonomous, and a IR Beacon Repair system strategy for Autonomous Period.

League One

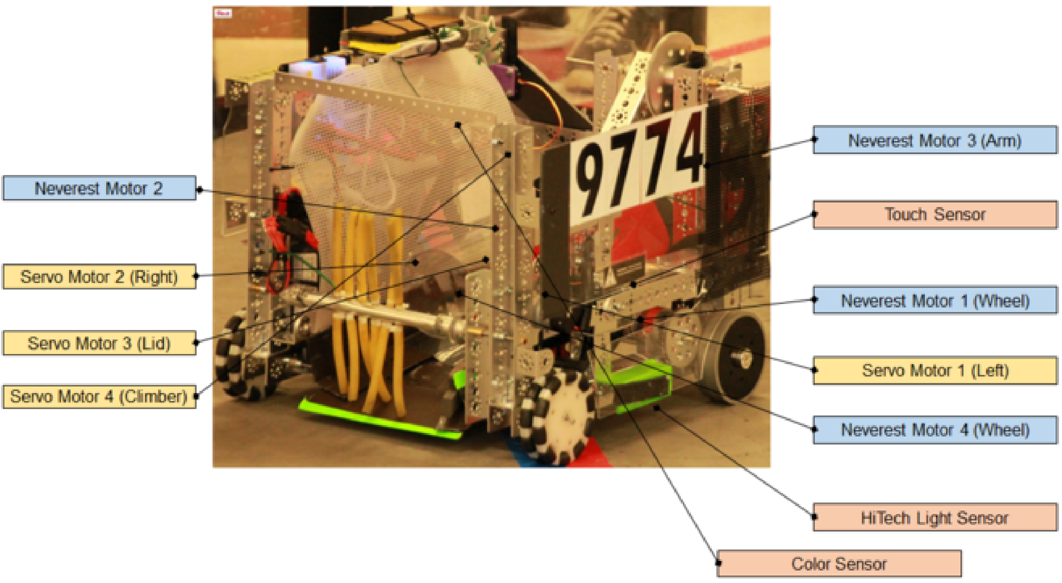


As seen by the image of the robot at League One, our robot manifested a few changes. All in all, the mechanisms and attachments stayed the same. Our main addition was better done plexiglass and team number signs and warning labels. For League One, our robot was far better in the prospect of aesthetics. We did clean up the debris collection and deposition systems, but all together the robot functioned the same as it did during League Zero.

League Two



League Three



After League Three

59.7 Bill of Material

Included below is our bill of all foreign materials used for the constitution of the robot.

FTC Robot Bill of Material

Team Number: 9774
Team Name: Nano Ninjas

Part Description	*Quantity*	*Game Rule/Forum Reference*
Surgical tubing	6 height ~ 22cm radius ~ 0.5cm	Game Manual Part I: <RM01.b>
3-D printed plastic (mount)	1 surface area ~ 18cm^2	Game Manual Part I: <RM01.b>
Tape (duct, electrical, packaging, painters)	74cm all together	Game Manual Part I: <RE05.j>
Window blind sheet	1 length ~ 10cm width ~ 5cm	Game Manual Part I: <RM01.a>
Plastic sheet	1 length ~ 25 cm width ~ 15cm 1 length ~ 10 cm width ~ 6 cm	Game Manual Part I: <RM01.a>
Cardboard sheet	1 length ~ 15 cm width ~ 15cm	Game Manual Part I: <RM01.a>
Plexiglass sheet	2 length ~ 40cm width ~ 35cm 1 length ~ 37cm width ~ 33cm	Game Manual Part I: <RM01.a>
Metal sheet	2 length ~ 14cm width ~ 11cm	Game Manual Part I: <RM01.a>
Polyurethane/foam sheet	2 length ~ 26cm width ~ 14cm	Game Manual Part I: <RM01.a>
Mesh netting	2 length ~ 15cm width ~ 10cm	Game Manual Part I: <RM01.a>
Cable/zip tie	34 strips	Game Manual Part I: <RE05.i>
Wire sleeve	3 length ~ 30cm	Game Manual Part I: <RE05.i>

IX

Computer Aided Design (CAD) & 3D Printing

60. 3D Printing

How 3D Printers Work

First, CAD is used to design 3D models of the object being created. After being converted through a special software it is put usually into a STL format. The printer then "slices" the model into thousands of horizontal layers that is processed layer by layer.

Types of 3D Printers

- Stereolithography (SLA)

  Oldest type of 3D printer

  First create a 3D model on CAD then using a software convert into STL format which can be read by the printer

  It makes the object layer by layer so it's precise and in scale with the CAD model

  There could be up to 10 millimeters per layer
- Fused deposition modeling (FDM)

  Takes a longer time to process

  This method uses CAD in the same way as SLA does but it includes heating and cooling systems for each layer

  FDM is the only 3D printing technology that builds parts with production-grade thermoplastics, so things printed with really good mechanical, thermal and chemical qualities
- Selective Laser Sintering (SLS)

  The main difference between SLS and SLA is that it uses powdered material in the vat instead of liquid resin

  Unlike other way's of 3D printing it does not need support structures that are dissolved after the print

  Because it can use material from nylon to metal it is very popular for customized parts
- Selective laser melting (SLM)

  Is a technique that also uses 3D CAD data as a source and forms 3D object by means of a high-power laser beam that fuses and melts metallic powders together

The process fully melts the metal material into solid 3D-dimensional part unlike selective laser sintering

This method of printing is widely applied to parts with complex geometries and structures with thin walls and hidden voids or channels

- Laminated object manufacturing (LOM)

  Layers of adhesive-coated paper, plastic or metal laminates are fused together using heat and pressure and then cut to shape with a computer controlled laser or knife

  It is not one of the most popular ways of 3D printing but it is the most affordable and fast

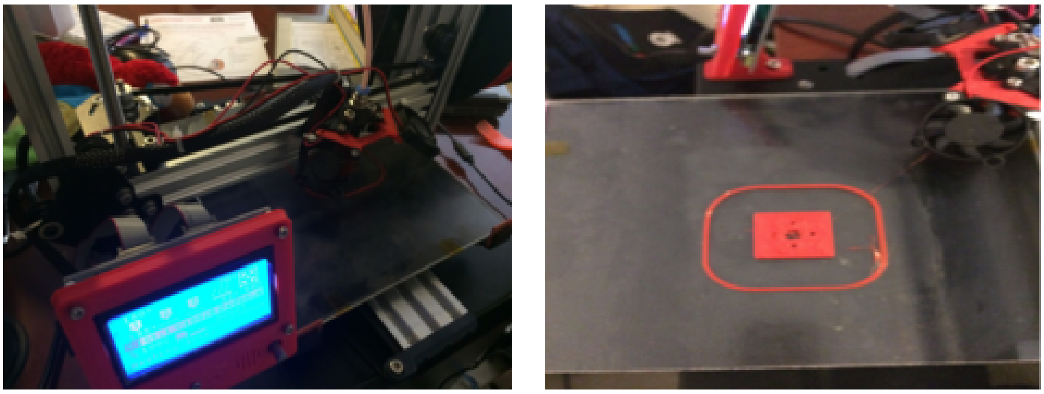
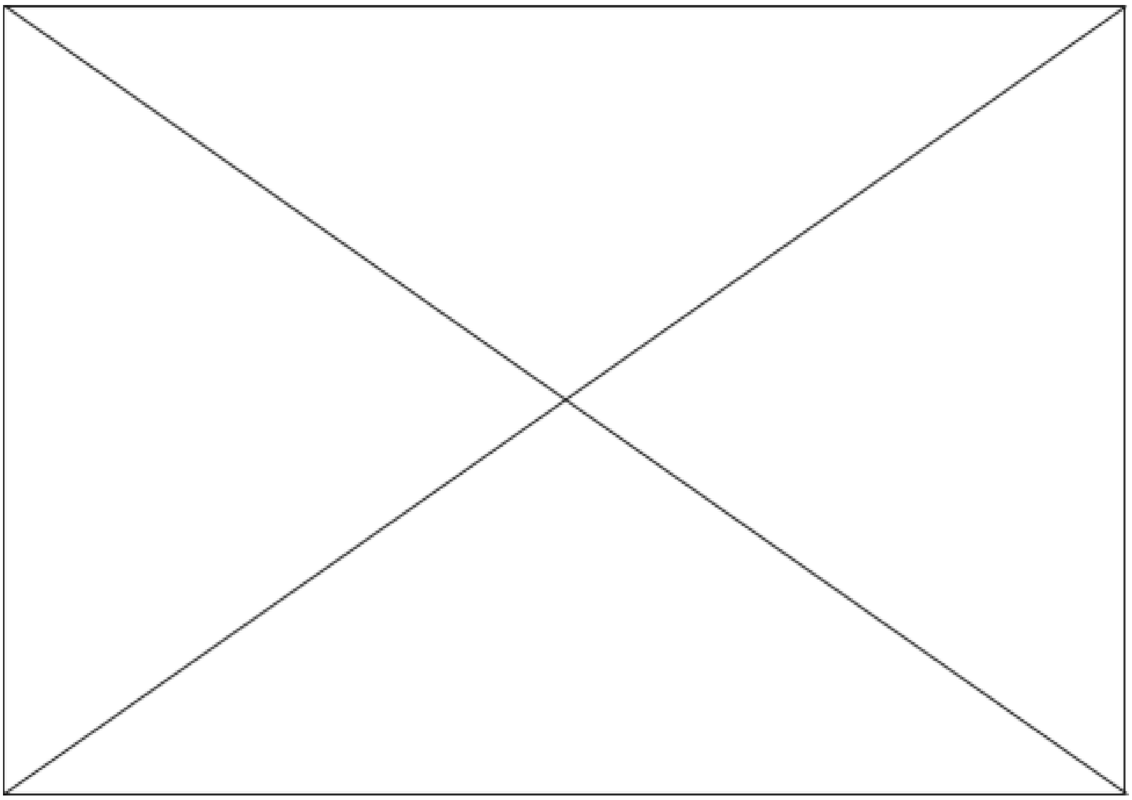
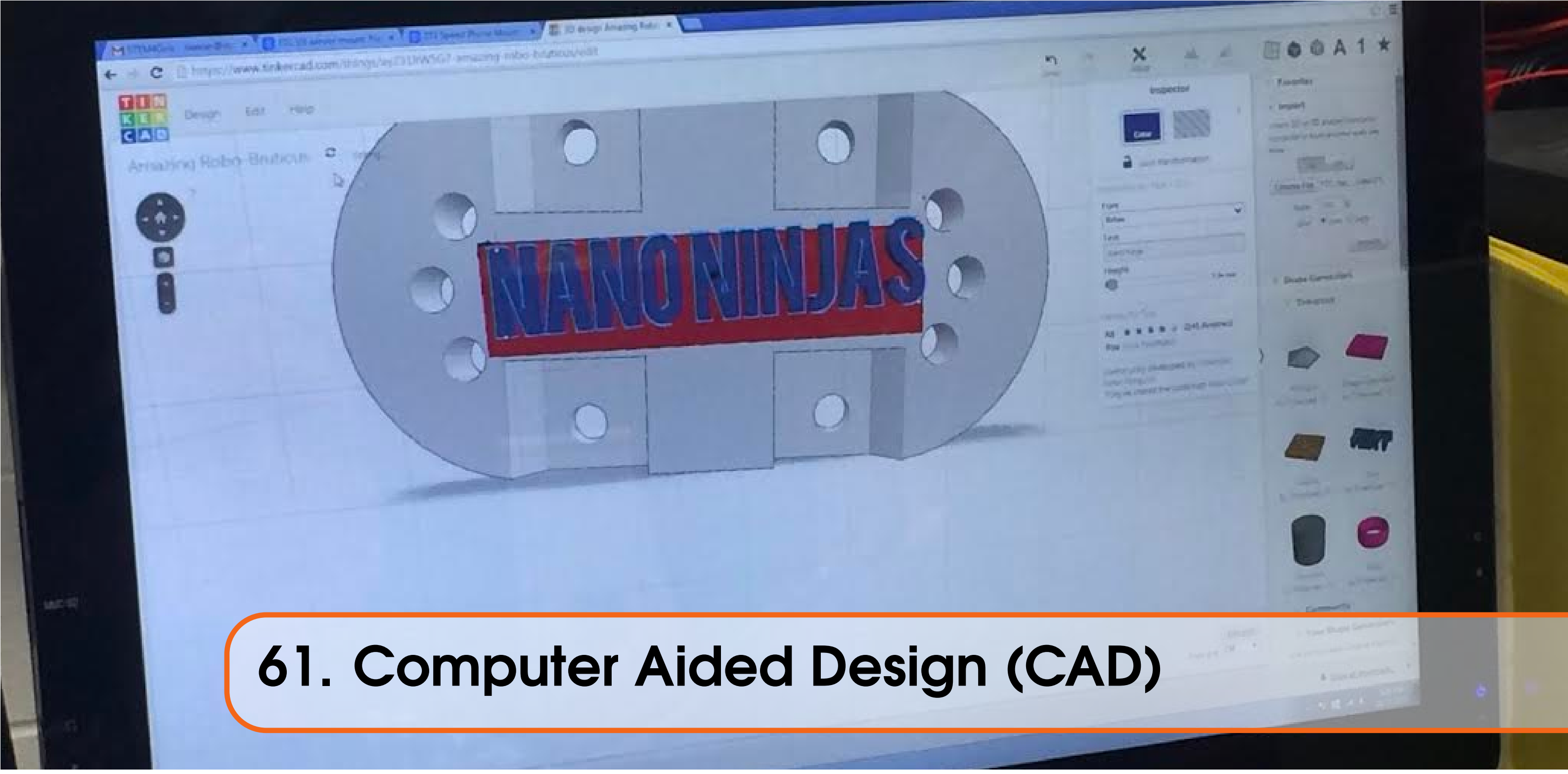


Figure 60.1: Using the 3D printer at PCC to create a robot controller phone mount.





61. Computer Aided Design (CAD)

Overview of CAD

CAD stands for computer aided design and is as the name addresses. It is the use of computer technology for digital designing. It replaces manual drafting with automated drafting. CAD allows for both two-dimensional and three-dimensional creations, but for FTC, the three-dimensional aspect is obviously used. Through photo-realistic renderings it is very simple and helpful to simulate a design in real life situations.

In product and industrial design, CAD is used mainly for the creation of detailed 3D solid or surface models, or 2D vector-based drawings of physical components. However, CAD is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies, to the definition of manufacturing methods. This allows an engineer to both interactively and automatically analyze design variants, to find the optimal design for manufacturing while minimizing the use of physical prototypes.

History of CAD

Dr Patrick J. Hanratty developed the first commercial numerical-control programming system in the year 1957. He had greatly contributed to the field of CAD design and manufacturing and he was known as "the Father of CAD."

In year 1960, Ivan Sutherland produced a project called SKETCHPAD as the first step to CAD industry. SKETCHPAD allowed the designer to interact with computer graphically where the design can be fed into the computer by using a light pen to draw on a monitor. Thus, making it as an indispensable feature of modern CAD software.

The first commercial applications of CAD were in large companies in the automotive and aerospace industries as well as in electronics. This was due to only large corporations could afford the computers capable of performing the calculations. In year 1964, Dr Patrick J. Hanratty had utilized Design Augmented by Computer (DAC-1) in his company projects.

In year 1971, UNISURF was developed by Pierre Bézier at Renault. It was a pioneering surface CAD system for car body design and tooling. The founding of Manufacturing and Consulting Services Inc. (MSC) in year 1971 by Dr Patrick J. Hanratty enhanced the development of CAD. He then supplied the codes to many companies such as Control Data, Autotrol, Garber, Calma and many.

The application of CAD expanded gradually when computer became affordable. The development of CAD software for personal desktop computers was the momentum for almost universal application in all areas of construction.

Key points in the 1960s and 1970s such as IBM, Intergraph and Intergraph IGDS became the foundation of CAD systems. Since then, the implementation of CAD had evolved dramatically. 2D graphic was design with CAD software initially in the 1970s and limited to producing drawings similar to hand-drafted drawings. Variety applications of CAD were allowed when programming and computer hardware became advanced.

In year 1982, Autodesk was founded by John Walker which then led to the 2D system AutoCAD. In year 1988, Pro/Engineer was released and required greater usages of feature based modeling methods. The development of graphics engines ShapeData and ACIS at the end of the 1980s inspired by the work of Ian Braid. The inspiration then led to the release of SolidWorks in year 1995 and SolidEdge in year 1996.

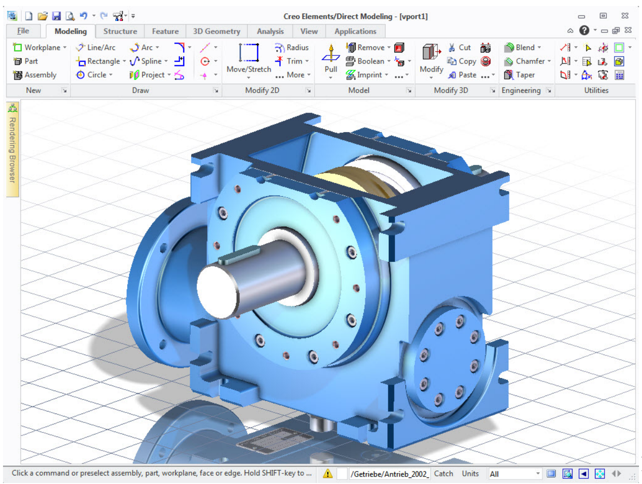
Today, in 21st century, there are many CAD software products in the market. The famous CAD software producers are Autodesk, PTC, UGS Corp and many. Generally, the package of CAD software can be classified into 3 types, there are 2D drafting systems, mid-range 3D solid feature modellers and high-end 3D hybrid systems.

Applications of CAD

- Architecture
- Mechanical, electrical, and plumbing (MEP) engineering
- Medical apparatuses and prosthetics
- 3D printing
- Seat Design Environment (SDE) (software fully integrated into commercial 3D CAD systems, for designing and manufacturing innovative transportation seat systems and interior components)
- Solid Edge (portfolio of software tools that address all aspects of the product development process of 3D design, simulation, manufacturing, design management, and more due to a growing ecosystem of apps; Solid Edge combines the speed and simplicity of direct modeling with the flexibility and control of parametric design, which is made possible with synchronous technology)
- Syncrofit (family of specialized engineering products for designing and manufacturing complex assemblies and large aerostructures; allows authoring and managing the assembly interfaces and hundreds of thousands of fasteners that are typical in an airframe)
- Fibersim (suite of software that supports all of the unique and complex design and manufacturing methodologies necessary to engineer innovative, durable and lightweight products and parts made of advanced composite materials)

Skill Requirements for CAD

- General knowledge and skills
- English writing and speaking
- Communication
- Critical thinking
- Problem solving
- Mathematics and science skills
- Interpersonal skills
- Basic drafting knowledge and skills
- Basic drafting
- Descriptive geometry
- Technical standards
- Coordinate systems
- Multiview drawings
- Isometric drawings
- Geometric dimensioning and tolerance Basic mechanical drafting Basic architectural drafting Basic civil drafting Computer knowledge and skills
- Computer fundamentals
- Computer file management
- Word processing
- Computer software
- Spreadsheets
- Basic application of Internet
- Ability of understanding customization of CAD program
- Basic engineering analysis and technical knowledge and skills
- Special knowledge and skills
- Design application and practices
- Special projects in the field
- Marketing and sales
- Basic knowledge of laws
- Troubleshooting skills
- Teamwork
- Leadership skills



[1]

[1] PTC, "PTC Product & Service Advantage," 2015

CAD Features

- Apply multiple light sources
- Rotate objects in three dimensions
- Render designs from any angle
- Find magnitudal measurements (surface area, volume, etc.)
- Simulate a creation
- Dynamic mathematical modeling
- Layering

Advantages of CAD

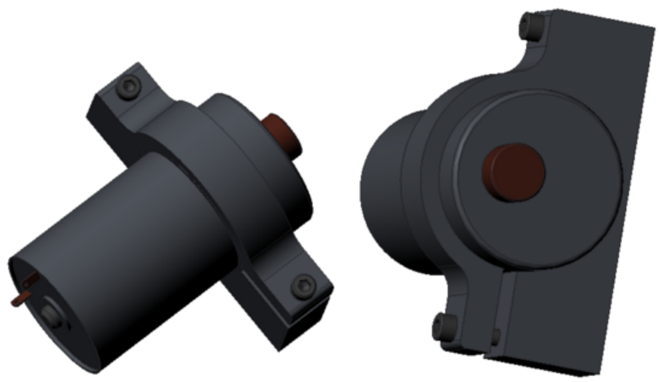
- Better visualization of the final product, sub-assemblies and constituent parts in a CAD system speeds the design process
- CAD software offers greater accuracy, so errors are reduced
- CAD system provides easier, more robust documentation of the design, including geometries and dimensions, bills of materials, etc.
- CAD software offers easy re-use of design data and best practices
- Lower product development costs

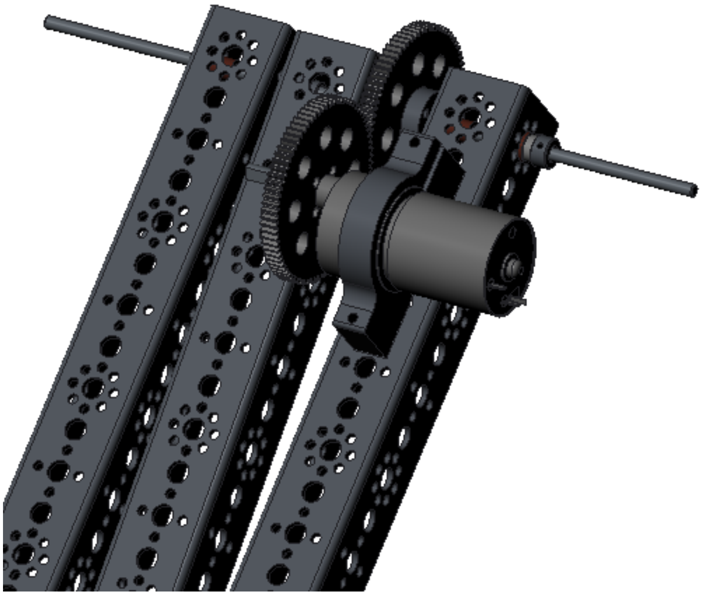
Disadvantages of CAD

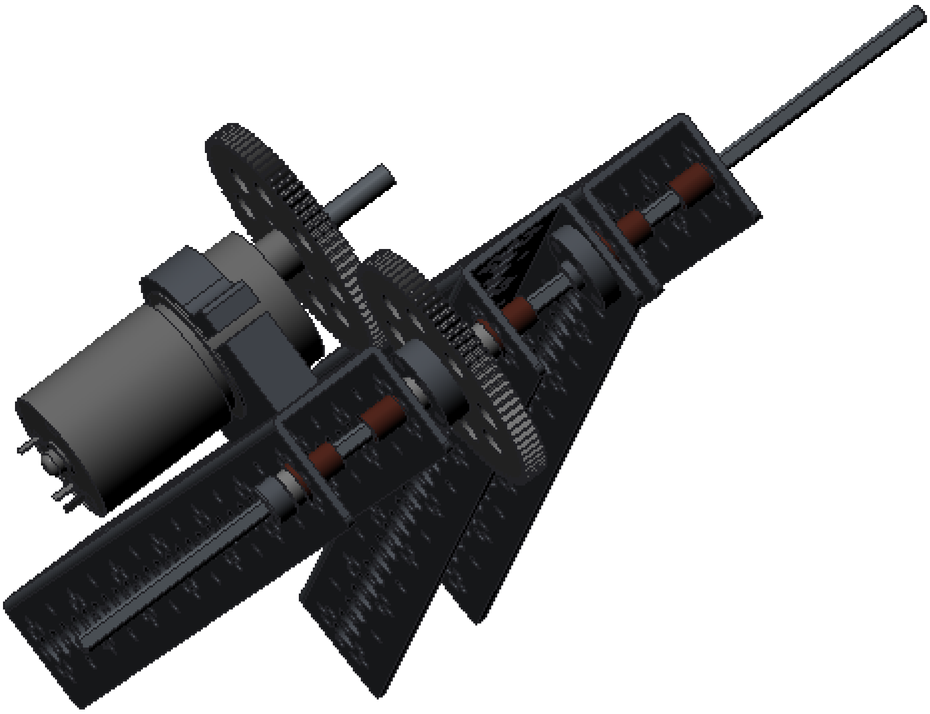
- Risk of technology failure must be taken into consideration when implementing CAD as computer used may break down
- The risk is highest when the company relies on assembly-line structure as failure will affect all points of production instead of an isolated production area
- To become an expert in CAD, time and expensive training is required

Our Experience With CAD

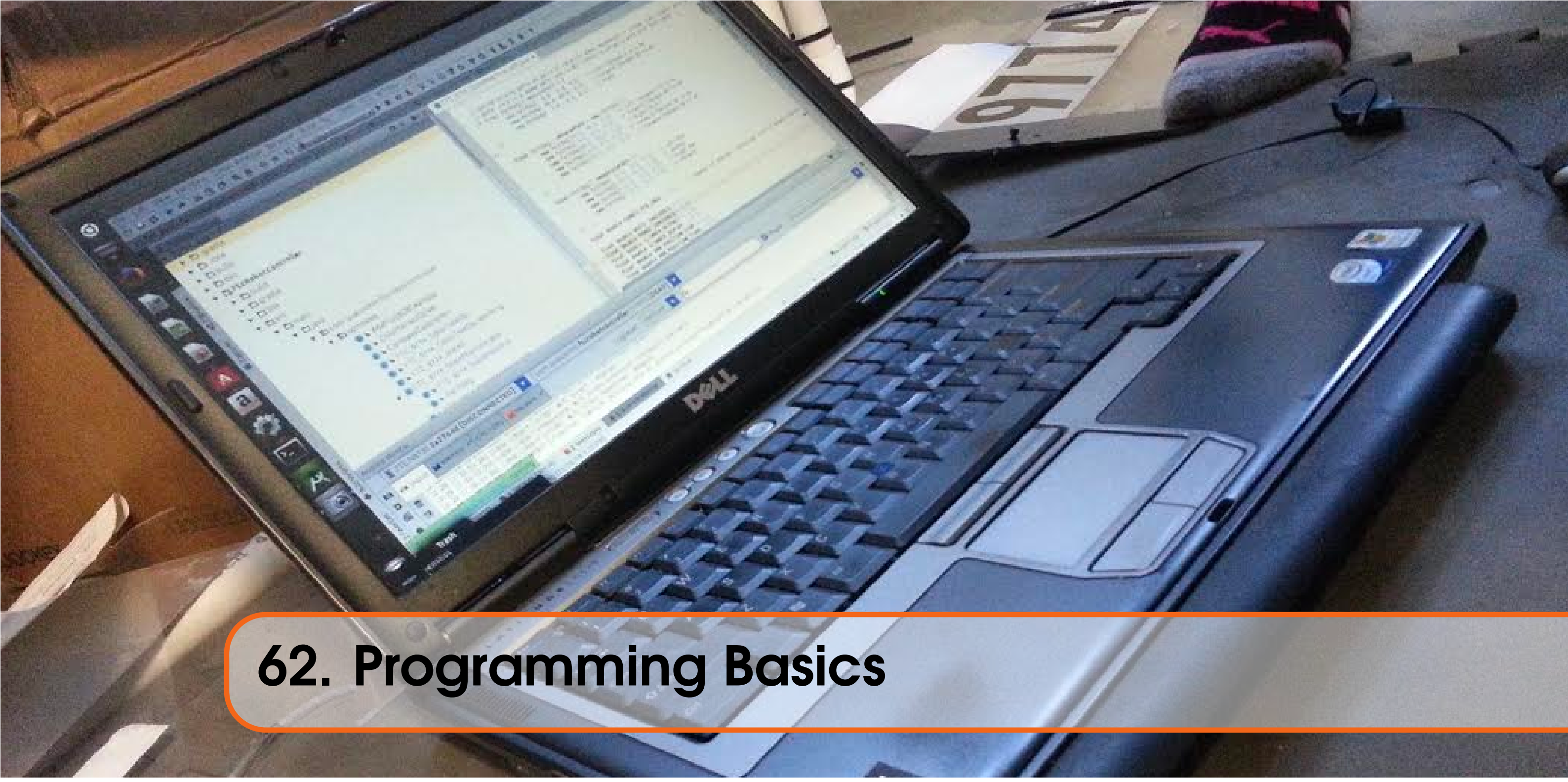
All in all, CAD has been a very simple software to use when making simple objects, however we have found that the difficulty of using the software increases with the complexity of the target object. As we are a rookie team, we do not have as much experience with CAD as we wished we had, but we tried it out and made a couple designs. Our CAD creations are still works-in-progress, and we hope we may master the software to use it much more efficiently. Below is a CAD render of a motor and motor mount connected, and on the next page is our arm mechanism.







X Programming: Autonomous & TeleOp



62. Programming Basics

Standard Naming Conventions
We created a chart of standard naming conventions for the purpose that when programming and in the need of a name of a certain robot functioning part, it is a waste of time to keep going back to the part where all the parts are named. Instead, this chart will help us know what all the parts are named in the code with just knowing the standard rule of naming. Also, this comes in handy with robot configuration.

Motors	m1... m2...
Servos	s1... s2...
Touch Sensor	t1... t2...
IR Seeker	ir1... ir2...
Color Sensor	cs1... cs2...
Optical Distance Sensor	od1... od2...

62.1 Finite State Machine

Finite State Machine Principles
To better explain our autonomous mode strategy, we would like to borrow State Machine principles explained by Phil in FTC forum.

Main principle includes three elements: State, Event, Action.

Allow us elaborate this with an example: you are watching TV and getting a call from your co-worker to come-to-work, and you are taking actions correspondingly.

Here, State A is the task of watching TV, the Event is getting called to work, the Action follows as getting dressed to go to work, and finally State B finishes with going to work.

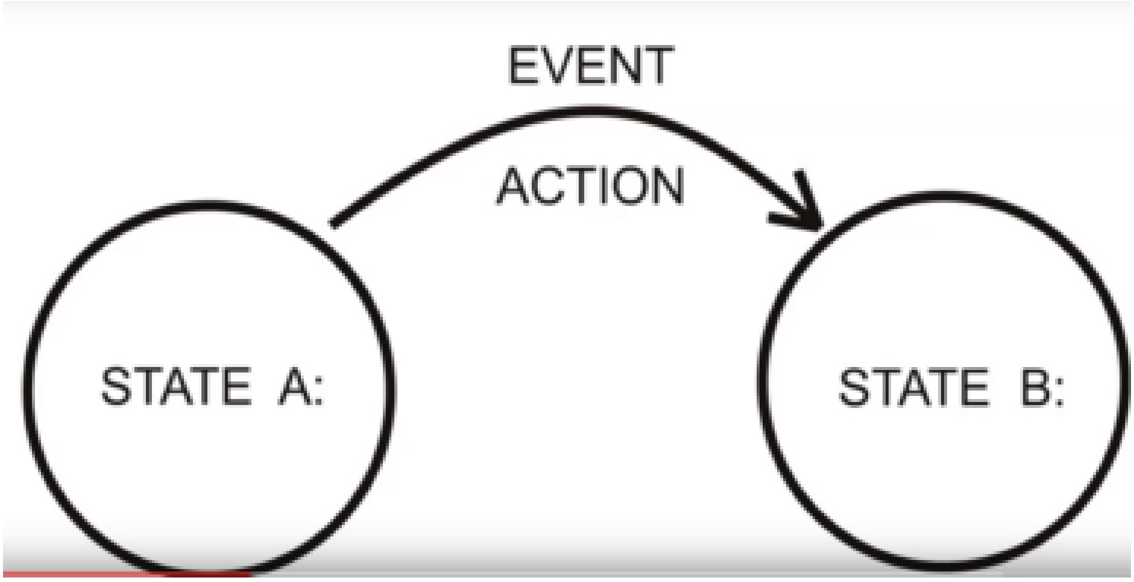


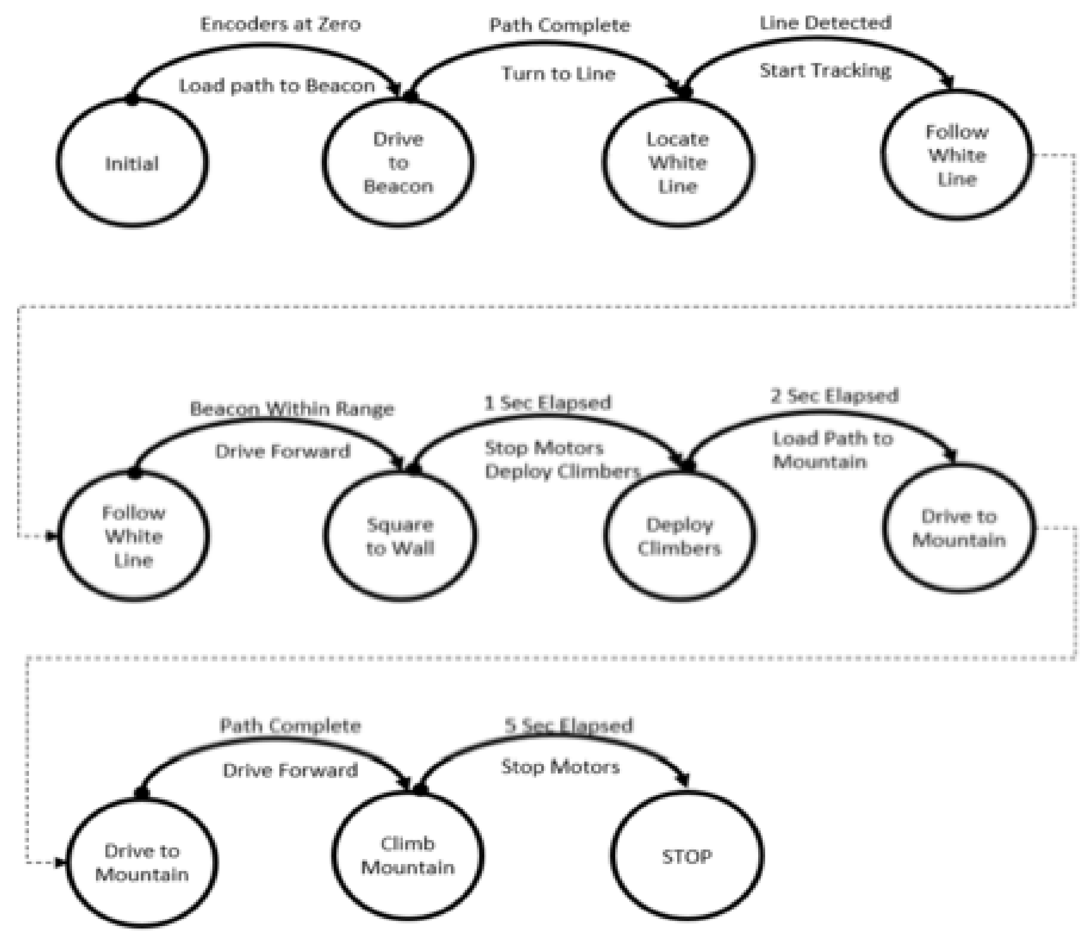
Figure 62.1: Diagram presenting flow of state machine principles.

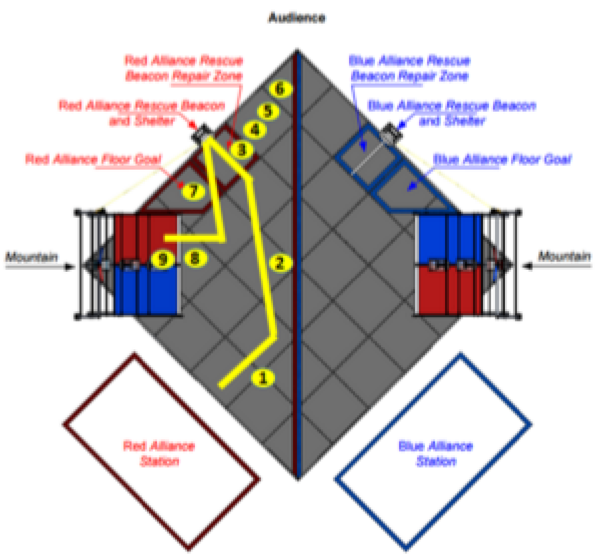
Finite State Transition Diagram
For autonomous part of the robot mission, creating a simple transition diagram before creating or updating the program is very critical. Doing so will not only allow us to have well thought-out plan of action but also help us explain the flow of actions well. This enables the programmer to see an simple and brief overview of the components of the program and how they all should be put together in the code.

The machine state flow has following components (included are all the possible states/events/actions done during the Autonomous Period):

- State
  Initial, Drive to beacon, Locate white line, Follow white line, Square to wall, Deploy climbers, Drive to mountain, Climb mountain, Stop
- Event
  Encoders are zero, Path complete, Lines detected, Beacon within range, One second elapsed, Two seconds elapsed, Path complete, Five seconds elapsed
- Action
  Load path to beacon, Turn to line, Start tracking, Drive forward, Stop motors/Deploy climbers, Load path to mountain, Drive forward, Stop motors

Autonomous Mode Strategies
We evaluated multiples strategies explained below and picked the one that consistently worked. Flow diagrams are shown below depicting the possible strategies.





1	Initialize
2	Drive to Beacon
3	Locate White Line
4	Follow White Line
5	Square to Wall
6	Deploy Climbers
7	Drive to Mountain
8	Climb Mountain
9	Stop

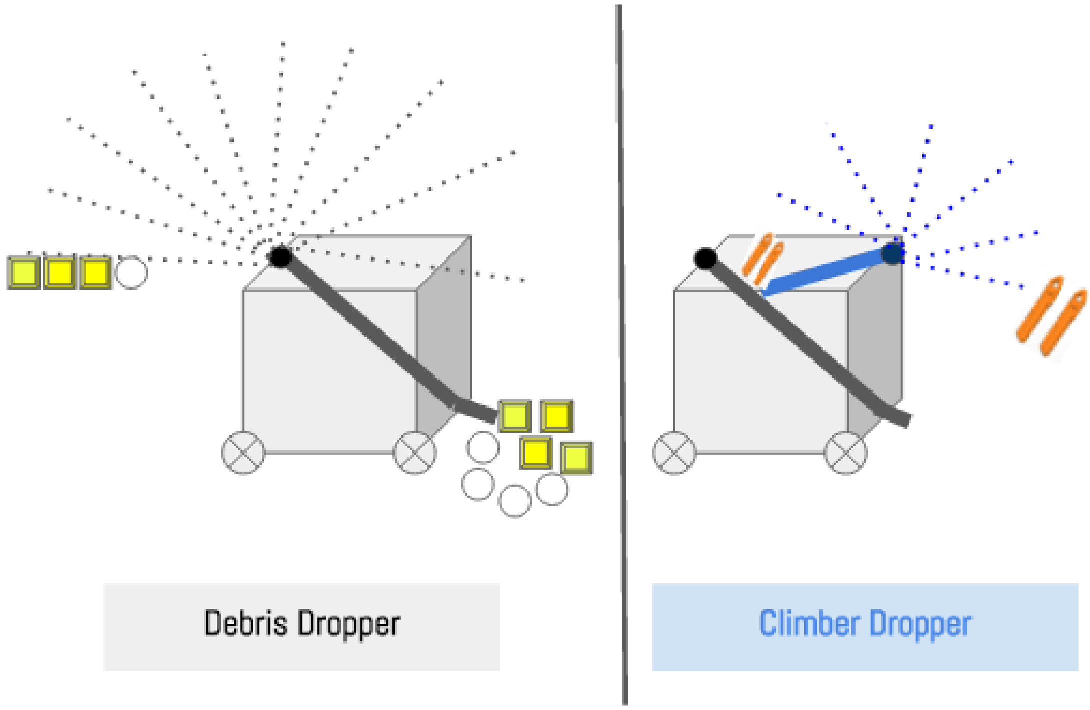
62.2 Intelligent Motor Control

Problem

Debris collector arm (Neverest Motor 4) and Climber dropper arm (Servo 3) are on the same path blocking each other. If the robot driver forgets to move climber dropper out of way before operating debris collector, we get into deadlock situation, and potentially robot damage.

Solution
Implemented software based control system that automatically moves Climber dropper arm out of the way before moving the debris dropper arm.

Benefits
Programmatically implemented a control system method to avoid human errors.



62.3 AutoCheck Application

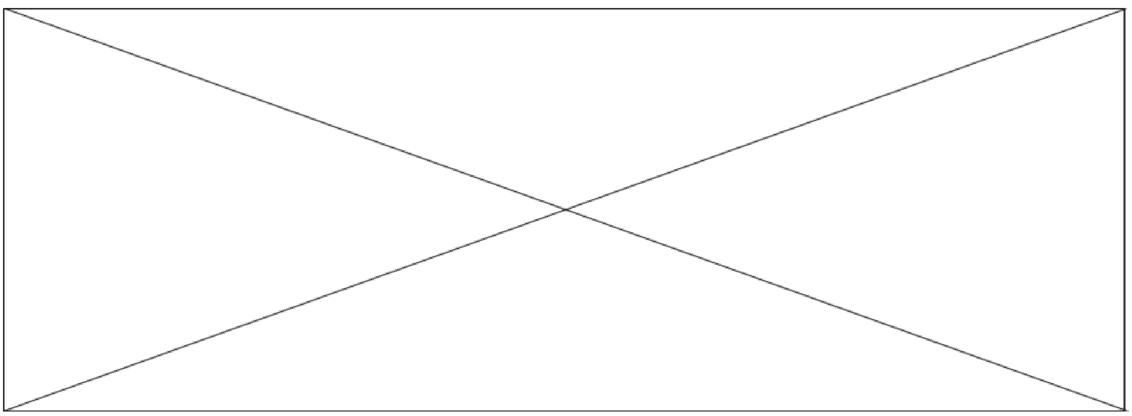
Problem
The problem stand that when during matches, if any unexpected errors appeared without warning, there was no way to detect prior to the match and ended up in failure of the robot and thus the match. The main issue is that all motors, servos, sensors, and gamepads are at risk if not checked beforehand from this possible complication.

Solution
To solve our problem we created an app called FTC AutoCheck, using MIT App Invento,r which detects malfunctions and other possible errors programmatically. By running this app on the phone that is connected to the robot (motors, servos, etc.), it probes various connected devices and within a few seconds, shows green if the device is working properly and red otherwise, as shown in the Stage 1 picture.

Benefits

The benefits include that all errors that could be detected prior to the match can be detected beforehand, so that the robot can run as planned during the match. This will help us in our competition and robot runs.

Stage 1 Mock-up Stage 2 (Final)



63. Autonomous

Mission Name	Description	Points
(1) Rescue Beacons	Each Robot may trigger the Rescue Beacon on its Alliance's side of the Playing Field one time. The Rescue Beacon is triggered by pressing a button under either the red or blue LEDs; the Alliance matching that color will receive 20 points, even if it is the opposing Alliance, so Robots should choose carefully.	20
(2) Climbers	Climbers In an Alliance-specific Shelter earn ten points per Climber for the Alliance.	20
(3a) Mountains	A Robot will receive only one Score based on its position. For example, a Robot that is In both the Rescue Beacon Repair Zone and the Floor Goal earns only five points. Choose one of the three following options: 3a, 3b or 3c. Robots earn points based on where they are On the Mountain at the end of the Autonomous Period. Robots earn points for the lowest zone that they are On. Playing Field = 5 points Low Zone = 10 points Mid Zone = 20 points High Zone = 40 points	10
(3b) Rescue Beacon Repair Zone	Robots Parked In their Alliance's Rescue Beacon Repair Zone earn five points.	5
(3c) Floor Goal	Robots Parked In their Alliance's Floor Goal earn five points	5

Autonomous is defined, by Game Manual II, as "a thirty second period in which the Robots

operate and react only to sensor inputs and to commands pre-programmed by the Team onto the on-board Robot control system. Human control of the Robot is not permitted during this time."
[1]

Explanation of Code
We began with downloading the FTC state machine program from GitHub which we learned from the State Machine FTC Forum. For the autonomous program, we did multiple states, but we skipped some items which would either take us over 30 seconds or we didn't think were important enough to do. We kept the state initial the same as the pre-made code. Our first change in the autonomous code was the values for the state drive to beacon. We changed the values and added many more segments

Now, our robot goes forward, turns left, goes forward again, turn left and then go a little forwards. Before, our robot would turn left, go forward and then turn left again. We did not change anything for the state after, which was state locate line. The next thing we changed was the range threshold for the follow line. We changed the value from 0.5 to 0.1 so that we can stop at the position that will make one of the next states easier.

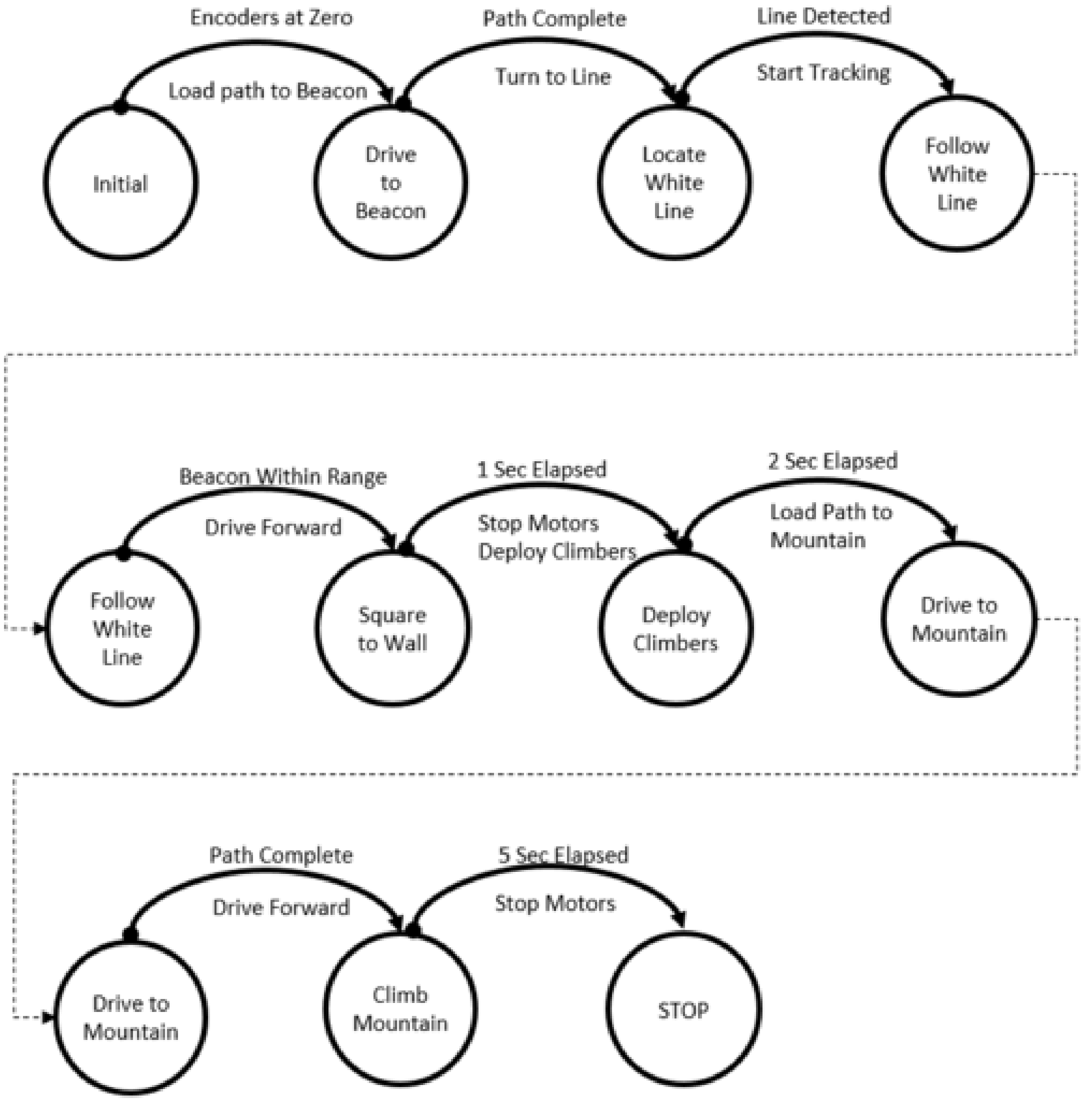
Then, we skipped the state square to wall by saying in the previous state to go to deploy climbers.

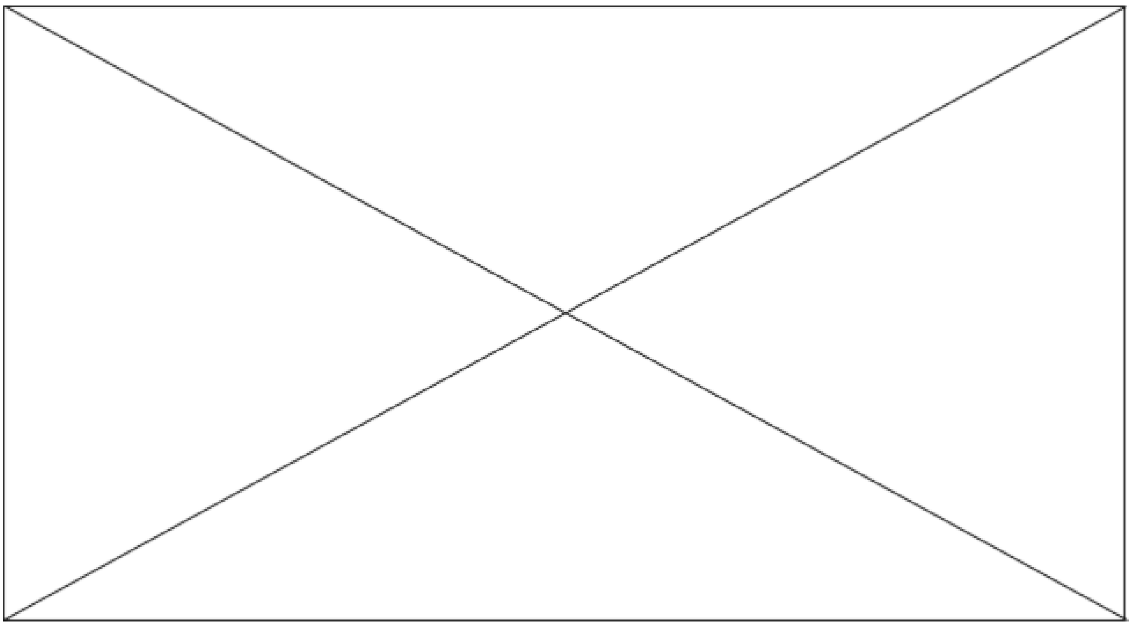
We didn't change anything for the state deploy climbers from the pre-made code. After that we went straight to state stop and we end in the beacon repair zone. We skipped the state drive to mountain and state climb mountain because we didn't find it beneficial. Our autonomous program gets us a total of forty-five points; forty from putting the climbers in the basket and five points from ending the beacon repair zone.

We have programmed it to go forward a little bit away from the central dividing tape, then turn left towards the Beacon. Our robot then goes forward again, turn left to align our light sensor with the Beacon and then follows the white marker line. A big issue we were encountering was the range threshold for the optical distance. The program follows the line until the optical distance sensor measures .01 which was the most accurate. In the end of the program the robot drops the climbers into the shelter and stops the robot. Stopping the wheels when dropping the climbers led to more consistency.

Our autonomous program gets us a total of 45 points; 40 from putting the climbers in the basket and 5 points from ending the beacon repair zone.

[1] FIRST, "Game Manual Part 2," 2015.


Encoders at Zero
Load path to Beacon
Path Complete
Turn to Line
Line Detected
Start Tracking
Initial
Drive to Beacon
Locate White Line
Follow White Line
Beacon Within Range
Drive Forward
1 Sec Elapsed
Stop Motors
Deploy Climbers
2 Sec Elapsed
Load Path to Mountain
Follow White Line
Square to Wall
Deploy Climbers
Drive to Mountain
Path Complete
Drive Forward
5 Sec Elapsed
Stop Motors
Drive to Mountain
Climb Mountain
STOP



64. Control Award

Control Award Content Sheet

Team # 9774	Team Name: Nano Ninjas

Autonomous objectives: Set ResQ Beacon, Place two preloaded climbers in the shelter, Park on near or far mountain mid-zone

Sensors used:

Color Sensor – used for reliable beacon color state detection
Light sensor – used for detection and alignment to white navigational aid line
Ultrasonic Sensor – measure distance to beacon and detect objects in path
Motor encoders – measure distance travelled
Touch sensor – detect when debris scoop contains hits the back wall of the robot
Nav sensor - Navigation sensor used to accurately direct the robot based on its location relative to other objects in the field
IMU (Inertial Measurement Unit) – used for driving straight and control turns

Key algorithms:

Navigation from start to beacon – use combination of IMU, light, ultra-sonic and motor encoders to reliably navigation to the beacon
Beacon state detection – use color sensors to check both color states and avoid false detection and pressing wrong button

Driver controlled enhancements:

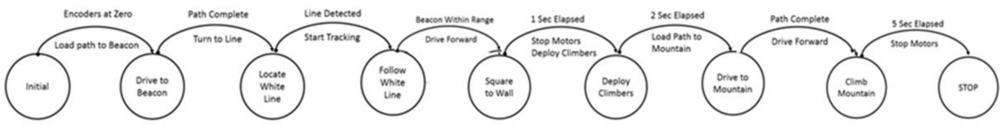
Automatic debris scoop full detection and signal to operator.
Motor feedback algorithm to minimize slippage while climbing mountain.
Debris dumper and Climber dumber arm control system

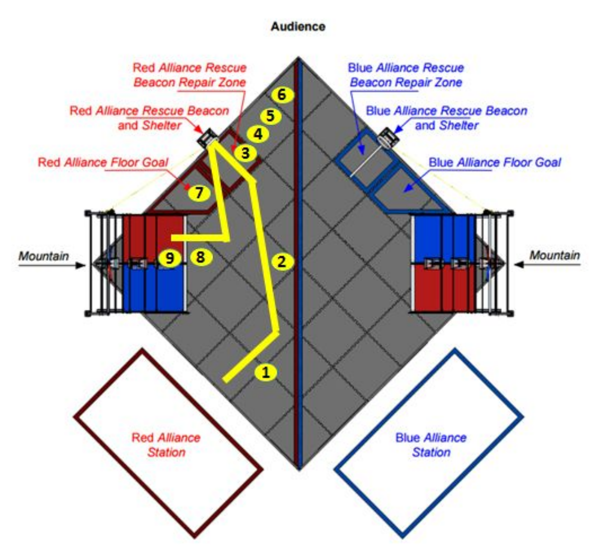
Engineering notebook references:

Feature	Notebook Pages
Autonomous goals and strategies	120, 130
Autonomous performance requirements	130, 121
State machine autonomous	145
Autonomous penalty prevention	160-161
Mountain climbing system	220-221
Beacon strategy	229-231

Control Award Content Sheet

Autonomous program diagrams:





1	Initialize
2	Drive to Beacon
3	Locate White Line
4	Follow White Line
5	Square to Wall
6	Deploy Climbers
7	Drive to Mountain
8	Climb Mountain
9	Stop

Note: When operating on the blue alliance, the paths and operations are a mirror image

Additional summary information:

FTC AutoCheck - Application that programmatically checks all connected devices and shows status Green or Red; running this app prior to the game significantly improves success rate

State Machine - A programming method used to convey the purpose of the code in a simple manner where the program changes from one state to another through actions

PID Controller - Also known as proportional-integral-derivative controller, it is a control loop feedback mechanism which continuously calculates an error value as the difference between a measured process variable and a desired setpoint and calculates an error parameter to operate

65. Teleop

Teleop is a mode of programming which is utilized during the Driver-Controlled Period. It controls the gamepads and requires manual handling unlike autonomous. Driver-Controlled Period is defined, by the second game manual, as "The two minute time period in which the Drivers operate the Robots."

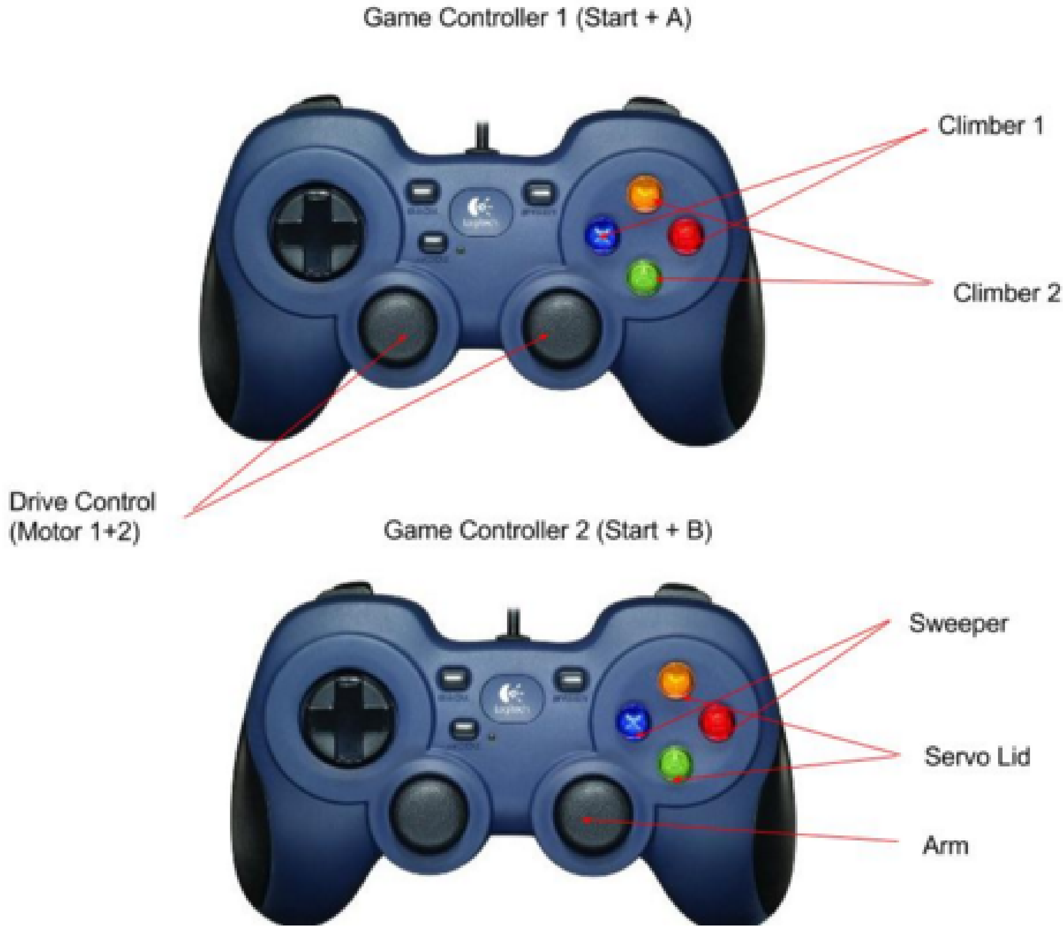
Explanation of Code
In our teleop program we are using Android Studio to program our game controllers. We used the standard K9 teleop program FIRST provided as a base to understand the structure and commands of a teleop program and used it to make our own. We have split the controls between the two gamepads so that Gamepad 1 controls the drive and Gamepad 2 controls debris collection and climbers releases.

Gamepad One
Our team decided to use tank drive

drive because it made our robot more comfortable and easier to control. We changed the code so that we could use game controller one only to move the drive train. We choose the joysticks right stick and left stick to move the drive train. To go straight, you need to push the left and right stick up and to go backwards you need to push both of them down. To turn left, you need to push the right stick down and the left stick up and to turn right, you need to push the right stick up and the left stick down. The final part button is Y which is for keeping the tube that we used to place the climbers in the beacon basket in autonomous. That is all gamepad one is capable of doing.

Gamepad Two
On this gamepad we used all four buttons for climber release, they trigger the 180 degree servos on the sides of our robot. The way the code works is that they start at position A and then move 180 degrees to position B. X and B are for Climber One and Y and A are for Climber Two. We have programmed the two bumpers to move our sweeper forward and backward. The final component we have programmed on gamepad two is to move the arm. We use the right stick to move the arm up and down to place the debris in the boxes.

```
if (gamepad2.a) {
    //climberPosition += climberDelta;
    climberPosition = .7;
    // read color sensor
    /*Color.RGBToHSV(colorSensor.red()*8, colorSensor.green()*8, colorSensor.blue()*8,

    if (( colorSensor.red()*8) > 1)

    {
        colorPosition += colorDelta;
    }
    else if ((colorSensor.blue()*8) > 1)
    {
        colorPosition -= colorDelta;

    }*/
}
if (gamepad2.y){
    //climberPosition -= climberDelta;
    climberPosition = .1;
}

// Start Second Climber
if (gamepad2.b) {
    //climber2Position -= climber2Delta;
    climber2Position = .0;

}
if (gamepad2.x){
    //climber2Position += climber2Delta;
    climber2Position = .5;
}
```



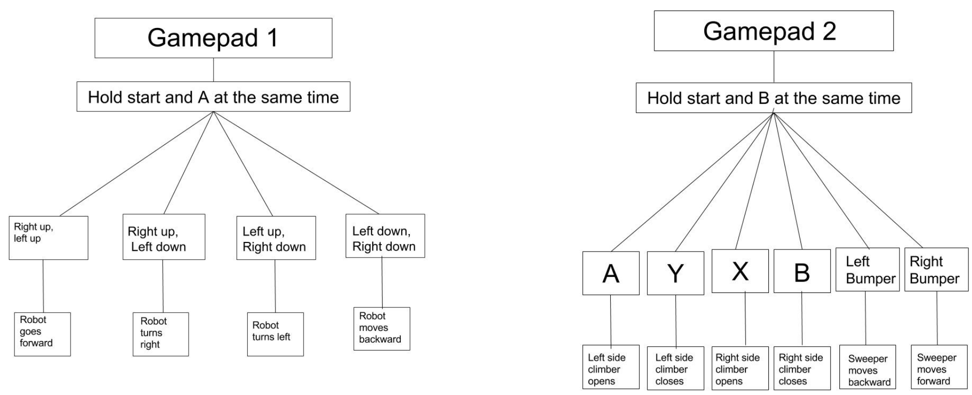
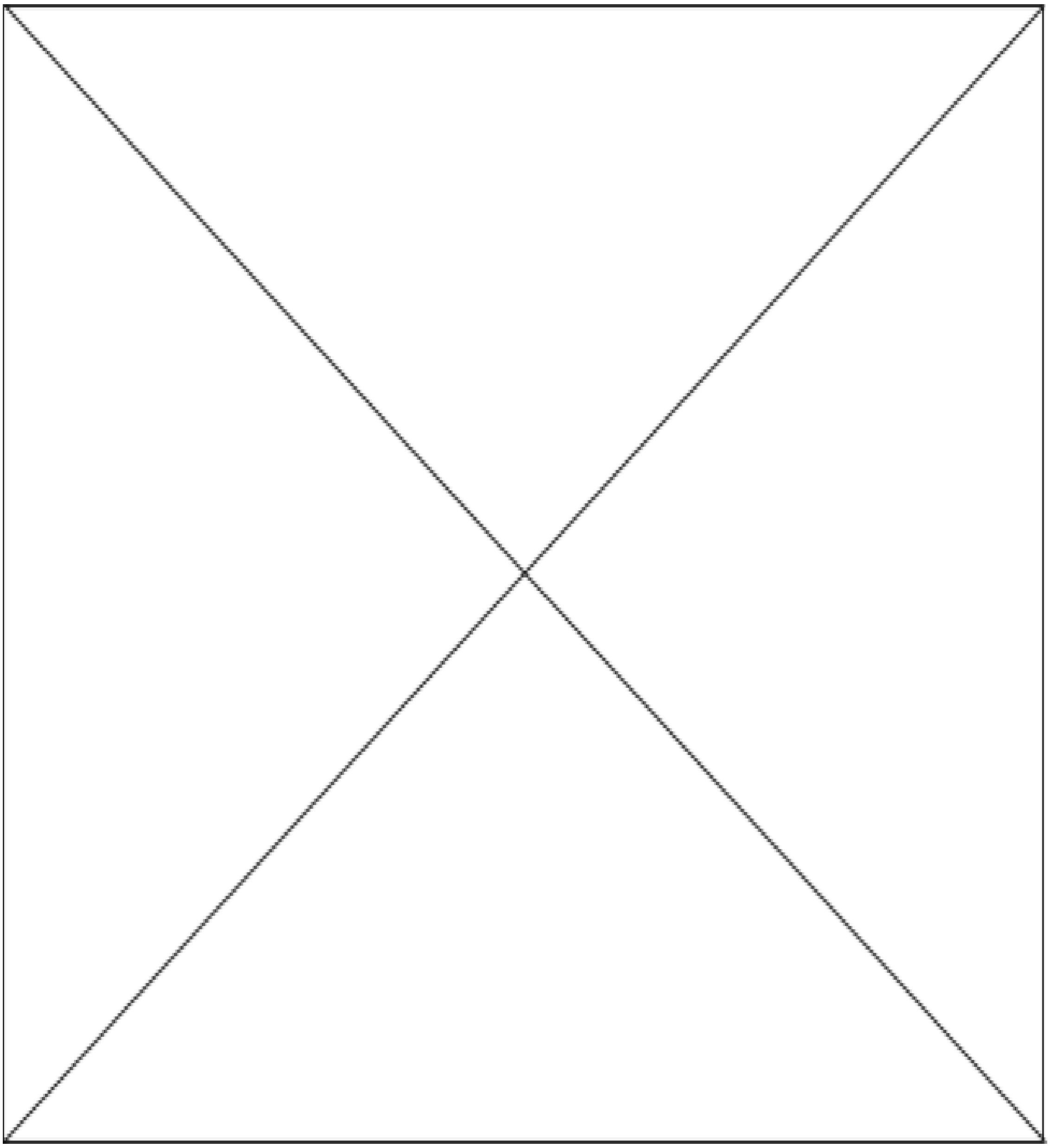


Figure 65.1: Flow chart of controls of Gamepad One (left) and flow chart of controls of Gamepad Two (right).



XI

Nano Ninjas: Business Plan

66. Executive Summary

Mission Statement
The mission of the FTC team Nano Ninjas #9774 is to promote students to partake in science, technology, engineering, and mathematics (STEM) in aspiration for a brighter future. We hope our efforts inspire the younger generations to grow up knowing that they withhold the potential to create a better world through STEM.

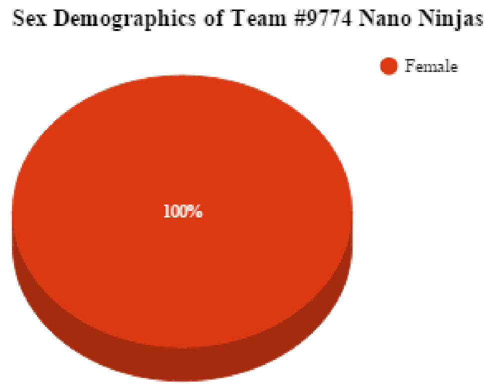
66.1 Team

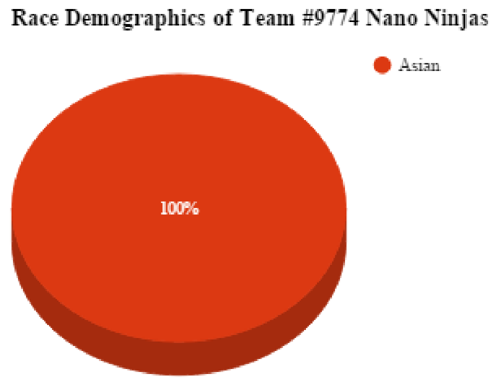
Team Members

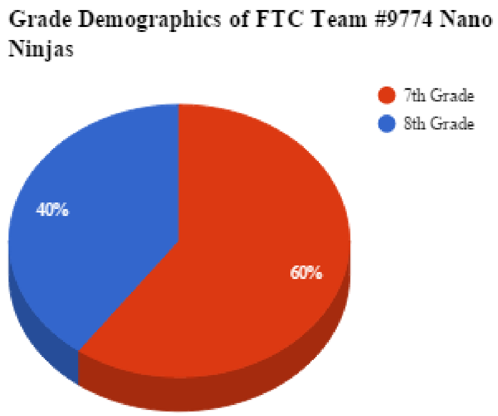
Adithi Mahankali	Aishwarya Grandhe	Esha Nagul
Harini Ganesh	Irene George	Maria Kolattukudy
Namitha Nixon	Nandhana Nixon	Navyatha Buddi
Ramya Reddy	Rhea Oommen	Rushali Desai
Sahana Inteti	Shamamah Khan	Shruthi Ananth

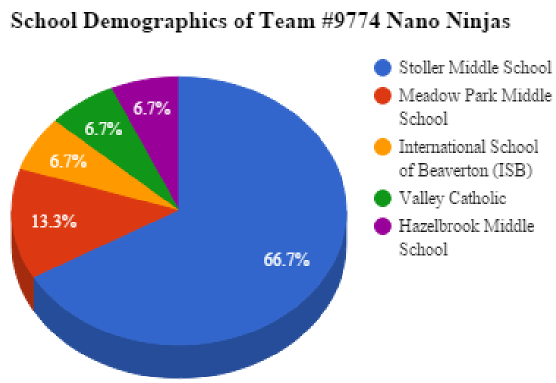
Team Demographics
Below are demographic pie charts of our team. As seen by the data, our team consists of entirely girls and everyone is Asian. We hope that in upcoming years we can have a more diverse team and possibly consider opening up our team to boys. Grade is also something which is destined to happen. Almost all of our eight graders have said they will be continuing the next season of FTC with the Nano Ninjas.

Team Organization
Our team is organized as follows. For the pre-season and early season time periods, we did not have defined divisions in specialties and sub-groups. As a rookie team, we had everyone do everything so all the members could have a taste of all the possible roles. Once league season began, each member considered their strengths and weaknesses and

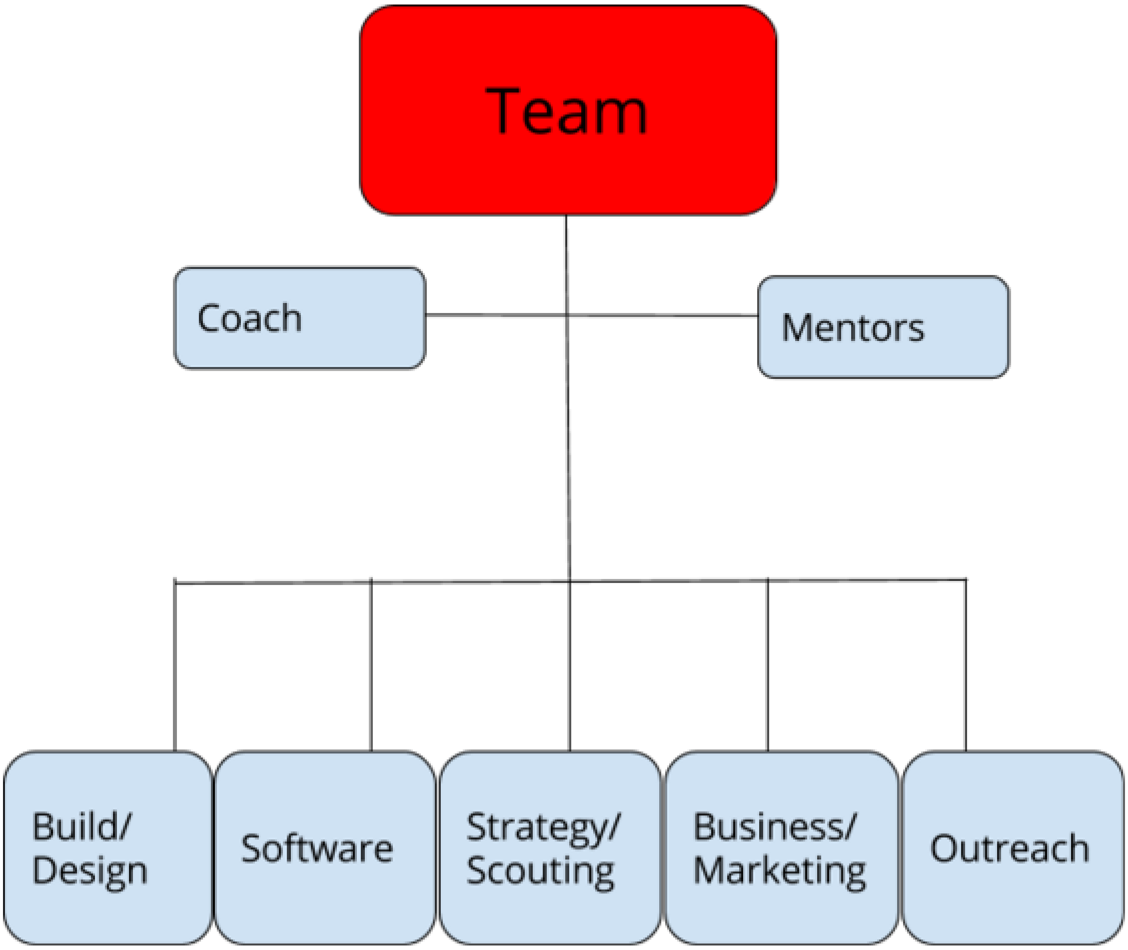








decided on which groups would be the best to join. This system of organization has really helped us it has made all the experts in the groups put their heads together to form great ideas and creations.



66.2 Connections

Affiliation

We are run under and affiliated with STEM4Girls and they have given us everything we have ever needed for FTC. They have provided us financial support and fulfilled other materialistic needs and have given us publicity. They are our mother program and our sister FIRST teams include Gears in Motion and Galaxy Dragons, teams whom we introduced to the FIRST program and the nonprofit organization of STEM4Girls. STEM4Girls was co-founded by high schooler Anna Nixon, both the daughter of our coach and our primary mentor. We are more than glad to have STEM4Girls represent us and we represent them. But most of all, we are thankful for everything Anna has done for us. As a student who has gone through the entire FIRST journey of JFLL, FLL, FTC, and now FTC, she is our secret weapon for the success of our team, #9774 Nano Ninjas. We hope we can do more to repay STEM4Girls for all they have done to support us and help us. We are truly indebted to them. We look forward to working with STEM4Girls until the very end of our team, though we hope our team will live on forever; we will allow our successors to carry on our legacy in the FIRST program.

Sponsorship

Nike has always been a proud sponsor of the Nano Ninjas since day one. They sponsor us by matching the amount give from an employee for a good cause. This is generically known as volunteer matching, and for Nike, is termed GlobalGive. We have few parents on our team whom work for or have worked for Nike, so the company is always more than happy to help us out. We thank them for all they have done for us, we truly appreciate it more than we can express. We hope in upcoming years we can do more for Nike and that they can stick with us through our FIRST sponsorship.

Intel has also always been a proud sponsor of the Nano Ninjas since day one. They have price matched all of our donation to STEM4girls our affiliate sponsor. They have contributed to us through volunteer matching. Several of our parents work for Intel and we surely know many other people whom work for Intel. Intel has always been a strong supporter of us, and we hope that we can return all their generous offers. We are grateful for everything they have supplied us ad continue supplying us with.

Board Share is a company that makes different types of electronic and interactive whiteboards. The have been a huge sponsor to our affiliate, STEM4Girls, therefore making them a positive and helpful sponsor of our team as well. We are grateful that they have joined the cause for spreading science, technology, engineering, and mathematics to young girls worldwide. We cannot allow their support to go unnoticed. We cannot wait to return all the favors they have done for us.

Qorvo is a semiconductor company based in America which designs, manufactures, and supplies radio frequency systems and solutions for applications that drive wireless and broadband communications. They have given us financial support by giving us several donations. Their financial support has allowed us to purchase robot parts, outreach materials, and all sorts of other things for FTC. We are grateful for fulfilling all our materialistic needs.

John Hammersley, the founder of Overleaf was very kind to allow us an enterprise of twenty Overleaf accounts, which would usually cost $400 per month, for entirely free. He was inspired by our FIRST story and journey and allowed us to use his amazing software to create our engineering notebook. Without him we would have never had the experience of using professional publishing software. Though why did we choose to go the extra mile to use Overleaf? It is because as being the Nano Ninjas, even as a rookie team, nothing will stop us from going above and beyond. We hope that our hard work pays off with using this professional document writing software. Also, using this brings our Engineering Notebook to a whole new level of layout and aesthetics. He has also agreed to sponsor us; we are very grateful to him.

C4 Labs is known for for their very innovative product: Raspberry Pi. They helped with funding the Ant Man Raspberry Pi Camp, and we must say we love participating in that camp with Anna. They are also a proud sponsor of our FTC team, the Nano Ninjas. They have given us financial grants. We are grateful for every single penny they have so generously donated and granted. We hope to keep in touch with C4 Labs and continue having them as a strong sponsor and supporter of out FTC team, #9774 Nano Ninjas.

Mathnasium is a math tutoring program and is a partner of STEM4Girls. The Nano Ninjas have taken some time, and have volunteered at Mathnasium. Doing so we have increased awareness and interest in FIRST, and therefore STEM as well. Mathnasium has given us financial support with a donation of $250. We are grateful for their generous contributions. Every penny they have given us will be used properly and will great thankfulness. We simply cannot express how happy we are to have Mathnasium as a sponsor, the people at Mathnasium are truly such amazing people! May we continue having the educational program as our strong sponsor and supporter.

PCC MakerSpace is an nonprofit organization which provides for the creation of creative ideas into materialistic products. In other words, they have allowed us to use their 3D printing facilities to create 3D objects for our robot. They have agreed to be a sponsor of us and giving us publicity. And not only that, without them we would not have had such a experience in discovering and exploring the fascinating world of 3D printing. We are very grateful to them. We look forward to continuing working with PCC MakerSpace and help them in their conquest of spreading STEM throughout the community.

Tualatin Valley Fire & Rescue is a special-purpose government fire fighting and emergency services district. They have allowed us to borrow their community room through their nonprofit program. We are indebted to their generous offers. We do no how we can ever return the favor. Also, thank you to the firefighters whom endanger their own lives to save others in danger. We hope we can continue using their nonprofit community room facility and have the Tualatin Valley Fire & Rescue department as our faithful sponsor.

The Christ United Methodist Church has always been known to promoting any activities of science, technology, engineering, and mathematics. They have also kindly allowed us their free facility for our FTC purposes. Without them, we could not have had our meetings in such a good, quiet, spacious area; we are thankful to have the church as a sponsor. We look forward to working with the Christ United Methodist Church more and stay in touch with them.

A public high school in Banks, OR, and in the Banks School District 13, Banks High School has greatly helped us in providing TETRIX parts for us. We are really thankful for them. We thank them for all they have done for us and have given us. Mere words cannot express our gratitude toward them. We hope to stay in touch with Banks High School and wish them very best for their FTC Journey with new system.

SCREENSTEPS

ScreenSteps is a documentation software and they have given us an entirely free account license, which would normally cost $800. Their product has been so much use to us, we thank them for their amazing creation. They have given us more than we can give them, we are forever indebted to their kindness. We are looking forward to working with them for upcoming and future seasons. They have supported us throughout our entire FTC journey and have helped us with putting up so many websites.

Based in Portland, Free Geek is a nonprofit organization which reuses and recycles old laptops and computers to avoid hazardous electronic waste buildup. Refurbished computers in good condition have been given to schools and educational organizations, or sent to thrift shops for lower prices. They have given us several laptops and computers for completely free, and we cannot express our thankfulness to them. We hope we can stay in touch with Free Geek for as long as we are in the FIRST program. They have been so supportive and helpful and we cannot lose them as a major sponsor.

FREE GEEK

aplos®
Simplify Your Nonprofit

Aplos has played a huge role in our accounting process. They have provided a full year of their software at no cost, making them a vital enterprise financial sponsor. Their enterprise financial support has really helped us with our money expenditures tracking and organization. But why Aplos? We found that Aplos was extremely simple for all users, even ones with absolutley no experience with bookkeeping. Aplos overcomes a huge barrier for some by making a complex process simple and easy to understand. The product provides ease of use while providing professional results. This system made all our different expenses clear and understandable to everyone on the team. We hope to continue working with Aplos and using their software.

We would like to thank Google for Nonprofits for supplying us with free nonprofit software that has taken us far in FIRST and FTC. Google has always been there for us since the creation of our team. We cannot thank them enough for all they have supplied us with and all they have given us. We cannot wait to return the favor to repay them for what they done for us. Everything they have done for us has not gone unnoticed or unappreciated. We look forward to working with Google for Nonprofits in upcoming and future FIRST seasons. They truly are such a supportive sponsor which we cannot lose connection with.

Google
for nonprofits

Partnership

MathWizard is a math, English, and science-providing educational program. We have volunteered there on numerous occasions. They are always happy to see us and we are also happy to see them. MathWizard is also a proud partner of STEM4Girls, and thus is a partner of our FTC team, #9774 Nano Ninjas. We are grateful to have them as a partner organization, and cannot wait to help them out more.

Facilities & Locations

- Fire Station 68 - Portland, OR

  The community room of the local Tualatin Valley Fire & Rescue station was utilized for the pre-season meetings. The reservations were all don under their non-profit program.The community room consists of ten tables, twenty Chairs, television screen, DVD player, wifi, and is ADA accessible.
- Christ United Methodist Church - Portland, OR
- Ramya's Garage - Portland, OR

  One of our team members has kindly offered her garage for our meetings and field. The garage is well ventilated and a tool section is included.

66.3 Outreach and Services Rendered

- OMSI Makers Fair
- Farmers Market fundraiser
- Mathnasium tutoring center
- Math Wizard tutoring
- Reaching out nationally
- Reaching out globally
- OneFTC (like One Million Pixels)

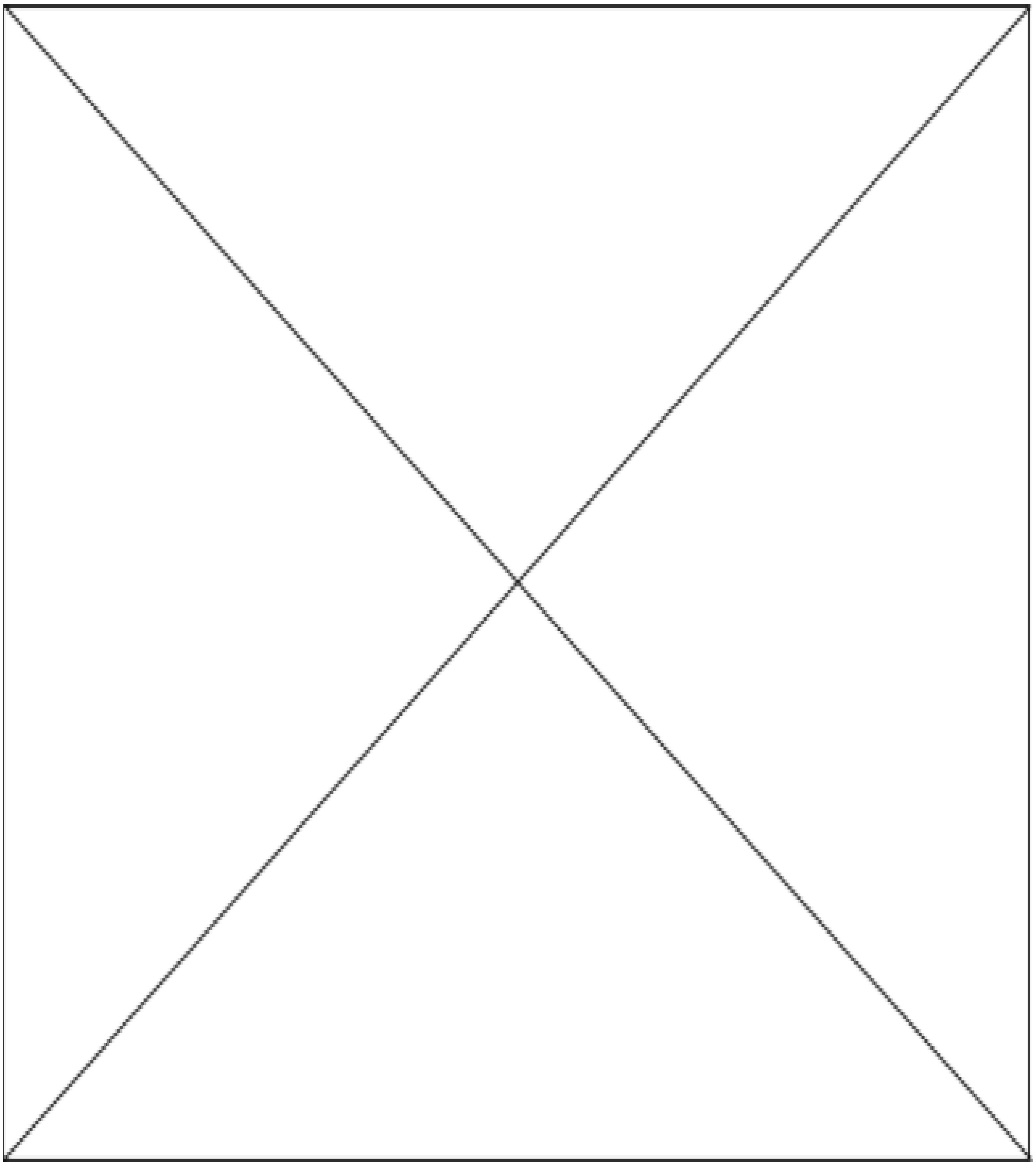
66.4 Business Analysis

"A SWOT analysis (alternatively SWOT matrix) is a structured planning method used to evaluate the strengths, weaknesses, opportunities and threats involved in a project or in a business venture." Our strengths include resilience, motivation, innovation, outreach, good image and branding, adaptability, and dedication. Our weaknesses include assigning roles and following them orderly, some inefficiency, staying connected with sponsors, Drive Team selection and practice, lack of inter-team communication, overlapping responsibilities, unevenly distributed tasks, reactive purchasing, and rushing to finish things. Our opportunities include sponsorship, STEM workshops, mentorship, and creative solutions. Our threats include lacking outreach and fundraising, loss of members, loss of financial support, and loss of space and equipment.
[1]

[1] Wikipedia, "SWOT Analysis," 2015

Social Media
Social media is key in our campaign to spread robotics and STEM throughout the world. We maintain an active Facebook page, YouTube channel, and have page on the STEM4Girls website supported by ScreenSteps. These serve to keep the community updated about our event schedule and build season.

Facebook - https://www.facebook.com/NanoNinjas/
YouTube - https://www.youtube.com/channel/UCv2wibWs-HeXrQfAqO1gcsg
ScreenSteps/STEM4Girls Webpage - http://ftc.screenstepslive.com/s/10744/



67. Financial Statement

Included below are screenshots of our Aplos accounting records.

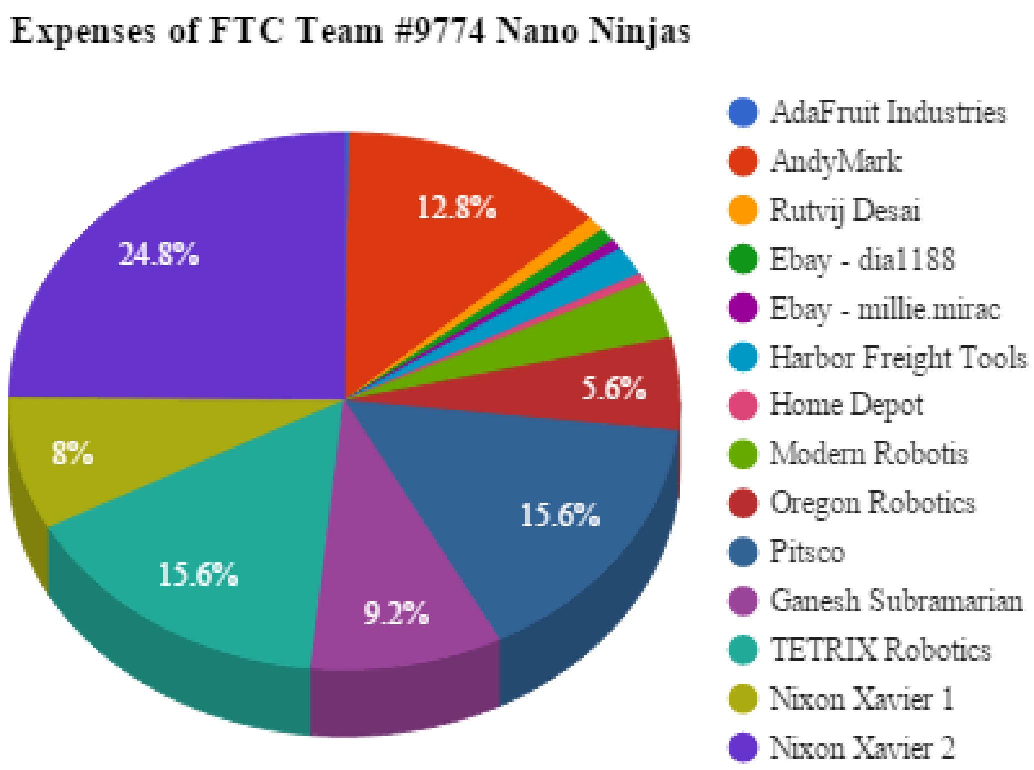
Note that with the income record log, the money under Nano Ninjas funding is a summation of all donations and profit achieved from fundraising. All the items with an income of zero were all for nonprofit and not done in search for profit.

Income

4000	Funding General contributions	$0.00
4001	Funding 15769 - Galaxy Dragons	$0.00
4002	Funding 9774 - Nano Ninjas	$4,550.00
4003	Funding 6930 - Syntax Error 42	$0.00
4100	Interest Earned	$0.00
4200	Funding NCWIT Aspire IT Grant	$0.00
4201	Funding Student Fee Camp	$0.00
4300	Math mentoring and Robotics	$0.00
Total Income		**$4,550.00**

Expenses

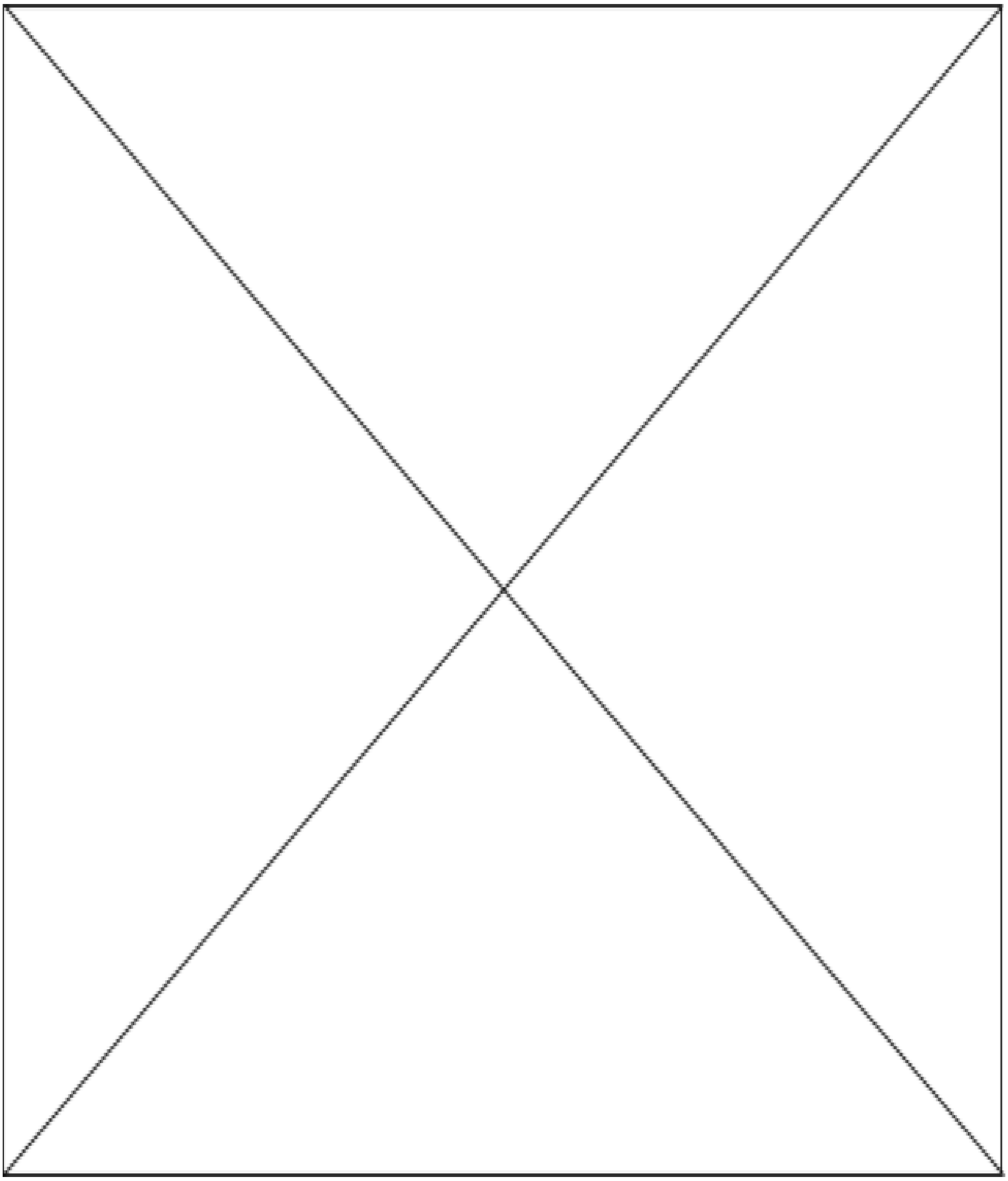
Adafruit Industries	$12.29
Andy Mark In	$518.64
Rutvij Desai	$35.91
Ebay - dia1188	$33.15
Ebay - mille.mirac	$23.05
Harbor Freight Tools	$71.91
Home Depot	$21.98
Modern	$143.15
Oregon Robotics Or	$225.00
Pitsco Inc	$630.75
Ganesh Subramanian	$372.00
Tetrix Robotics	$630.75
Nixon Xavier	$324.35
Nixon Xavier	$1,005.70
Total	**$4,048.63**



Summary:

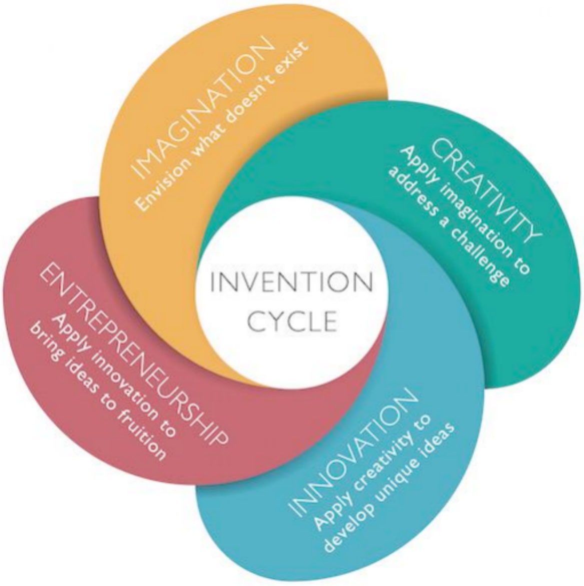
Beginning Fund Balance	**$0.00**
+ Other Fund Balance Movements	**$200.00**
+ Net Income / (Loss)	**$501.37**
= Ending Fund Balance	**$701.37**

In the end, our total current fund balance transpires as $701.37.



68. Strategy

The Nano Ninjas is a large team, fifteen girls with different perspectives on every detail. We try to use that to our advantage. There are so many of us that mistakes always get noticed. When we start brainstorming we narrow down to the problem and focus on a solution for it we all give our thoughts on what the solution may be. When we all decide on one or many solutions combined we draw and present the solution to the team. From the visual image we are able to start a prototype. The prototype is tested and worked on by the programming, build and CAD divisions. The prototype is refined and worked on until it is consistent and coordinated with the other components. The product never really becomes a final product. It is added onto and modified till the very end.



[1]

[1] Tiina Seelig, "Insight Out," 2015

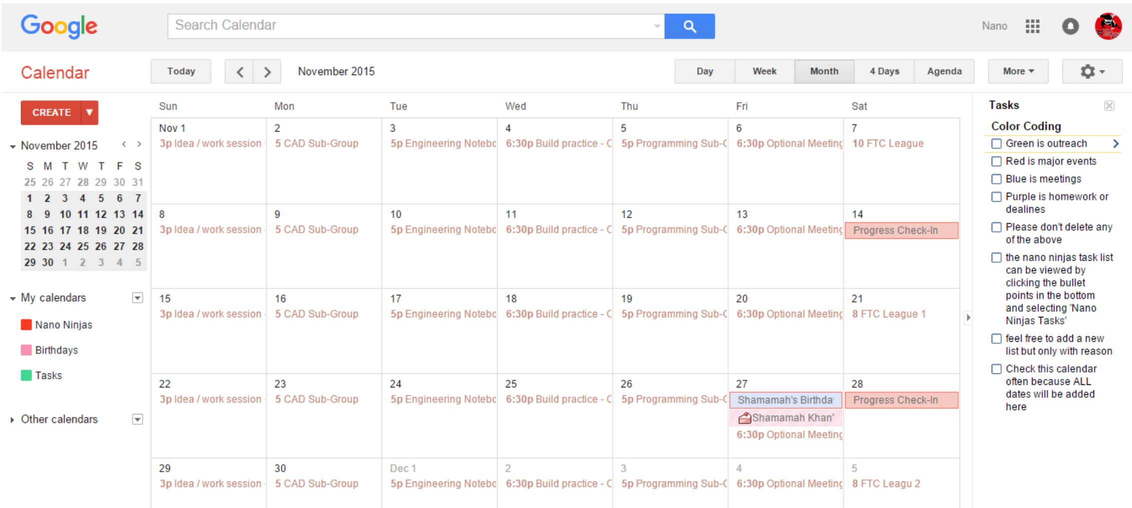
68.1 Team Fundamentals & Conduct

Team Strategies

1	Develop a diverse and strong team
2	Gain knowledge by research and experimentation and mistakes
3	Develop strong leadership skills
4	Develop excellent team financial plans and sponsor relationships
5	Spread the word about FIRST and STEM
6	Continue to prepare for the future and upcoming seasons

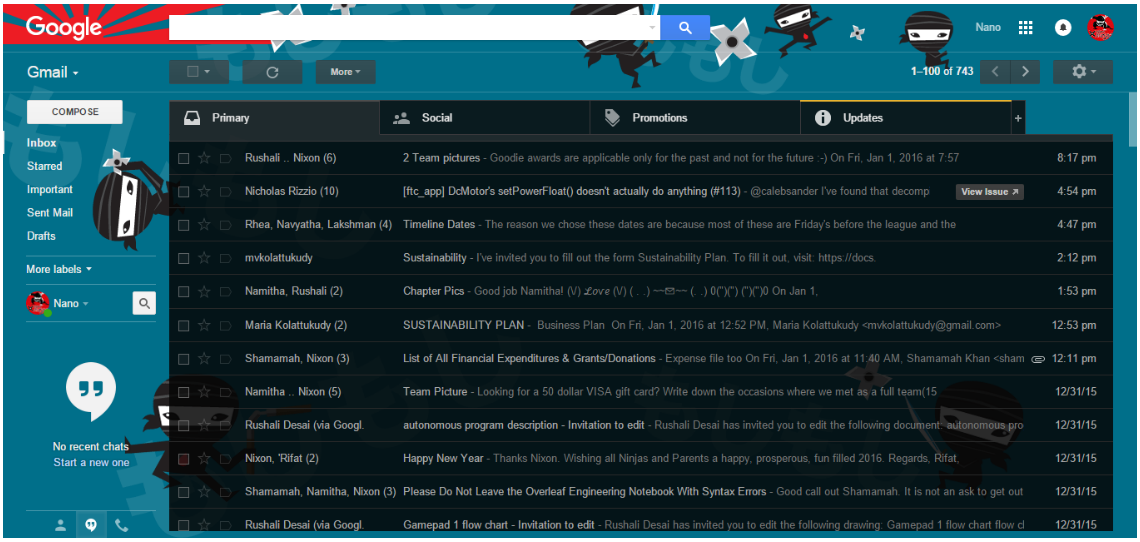
Scheduling

The Nano Ninjas use Google Calendar for scheduling and planning meetings. Each Saturday from 2:00 PM to 5:00 PM, we conduct major meetings that are attended by almost all team members. This meeting are soley dedicated to overview and status of tasked assigned over the week. We also meet at the beginning of the FIRST season, on the day after the game is announced, to conduct an initial strategy development session and begin the robot design process. Each Monday, the sub-team of CAD meet, on Tuesdays Engineering Notebook, on Wednesdays build group, and on Thursdays programming. All the sub-team schedules are determined by the sub-teams only, and no one else. We also made sure they were staggered so issues do not arise when so many members meet up together. We have also opened up Wednesdays, Fridays, and Sundays to optional robot and miscellaneous meeting days.

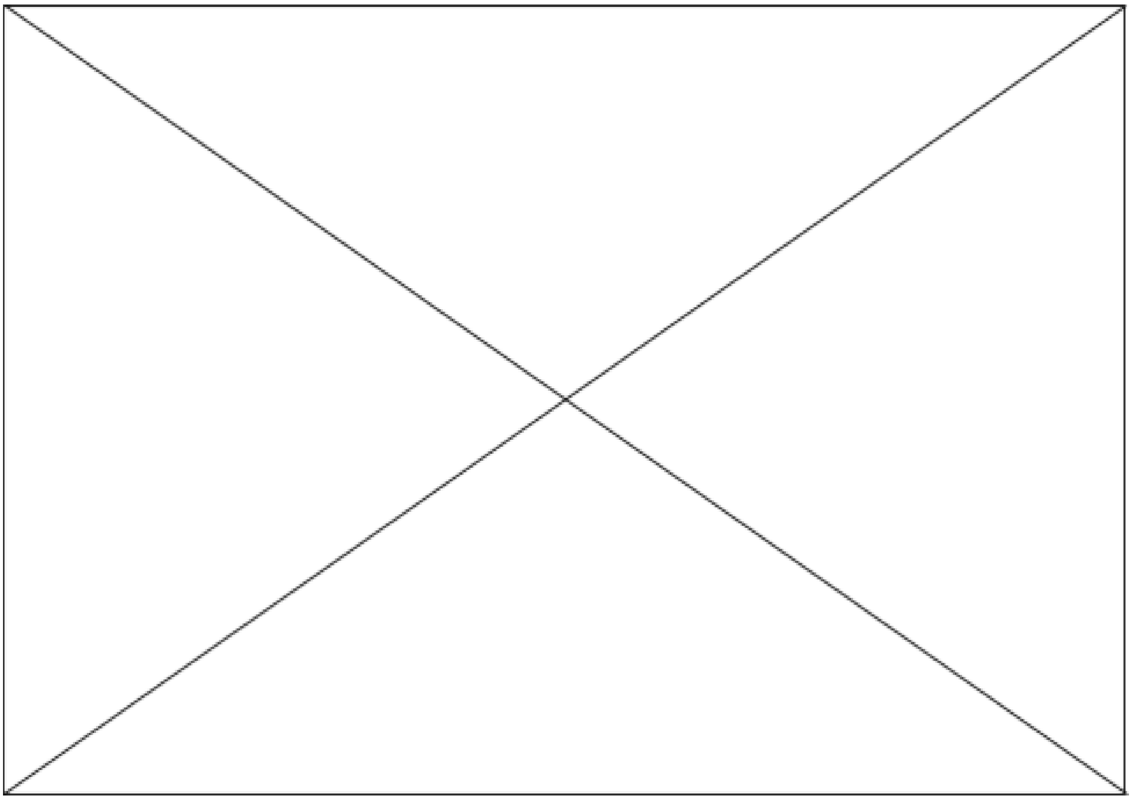


Communication

Communication within the team is accomplished with team meetings, sub-team meetings, email blasts, and member-to-member communication. Online mail is our main way of communication. We also hold online meetings and encourage phone calls. We also have a new system of email sending. To orderly address whether the email is for all members or outreach or for a specific sub-group, we use a hashtag and write the specific group in capitals. For example, it one wanted to send an email specialized for the Engineering Notebook, in the subject line would be "#ENGINEERINGNOTEBOOK," or "#TEAM," for all team members. But of course, we expect all members to go through all email, regardless of if the email is of help to them. We want all our team members to be update and know what is happening.



Project Management
Good project management is crucial to the success of our FIRST team. We assign sub-group leaders and expect them to report their progress on a weekly basis, which are done during Saturday meetings. We also hold meetings mandatory for sub-team leaders to check in what they have done since a certain point prior. Our team is always informed of the progress of all our sub-teams and members, and help is always given when needed.



69. Sustainability

69.1 Future Plan

Being a part of STEM4Girls, we aspire to be able to spark an interest and increase the participation of STEM, particularly in girls. Our mission is to promote Science, Technology, Engineering and Math in girls everywhere and inspire them to become a part of the FIRST experience so that together we can show that girls are fully capable of participating and enjoying robotics! We continue to do this throughout the non-FTC season.

69.2 Expectations

With fun comes rules and our main rules revolve around member behavior and safety. We expect all members to arrive on time to large events, competitions, matches, and major meetings. Of course there are exceptions, but we encourage our members to try their best to attend as many meetings as possible. We always encourage members with schedule conflicts to join us through phone calls, Skype, FaceTime,Any Meeting etc.

It is also beneficial that subgroups have regular meetings and communications with each other. Regular updates on progress are expected. We assign leaders to each sub-group and expect them to conduct their sub-team orderly and intelligently.

Grades are not a large concern for us, as we are only an FTC team and all of out members are middle schoolers.Every member of the Nano Ninjas are hardworking and intelligent students- we really do not have to worry about their school activities. We are considering however, if and when we become an FRC team, we will have the requirement that each and every member must have at least C's in all of his or her classes.

Participation is key in this team and practically all other teams. The definition of a team is a group of individuals working together to create something bigger than what a mere member is. If team memeber are not coming to meeting or putting any effort, we will have a shot talk with them.

Core Values and Gracious Professionalism are also the backbone of our team. Consistent winners of the Core Values award, we live by our title. As Woodie Flower puts it, "never do anything you wouldn't want your grandmother to see." We reprimand negative and unsafe behavior and always take action in making sure the member does not repeat the same mistake.

Lastly, the aspect of safety is of upmost importance. We require members to wear safety goggle whenever handling the robot, using dangerous tools, and in the pit at competitions.

69.3 Training

We make sure that EVERY team member gets a feel for everything.That way when older member graduate out they won't have trouble filling in for other roles. We are also considering setting up off-season camps and workshops for new members so they can get an introductory taste of FTC.

69.4 Member Recruitment

For us, anyone, either a girl or a boy, with the drive and interest in STEM is all we need. New team members do not really need to know everything about FIRST, after all this is a learning experience.

69.5 Mentor Recruitment

We are here to learn as much as we can. Any mentor that has experience has can teach us well we do. We are always on the lookout for new mentor during outreaches and fundraising. We are very open to them.

69.6 Future Financial Plan

We plan that with our upcoming years of FIRST, we shall carry forth whatever money is left over. That s what we have been doing for the past four years. We also order new parts after the previous season is over in preparation of the next season. Our registration system is also to complete it as soon as possible. We are usually the first teams to finish registration. The only reason why we were later this year is because it took us a longer time than anticipated in finding members. As the Nano Ninjas, we are always prepared for whatever is to come our way.

69.7 Overleaf Template for FTC

What is Overleaf?
Overleaf is an online platform for professional writing. The programming language is Latex and is free to an extent of one gigabyte of data.

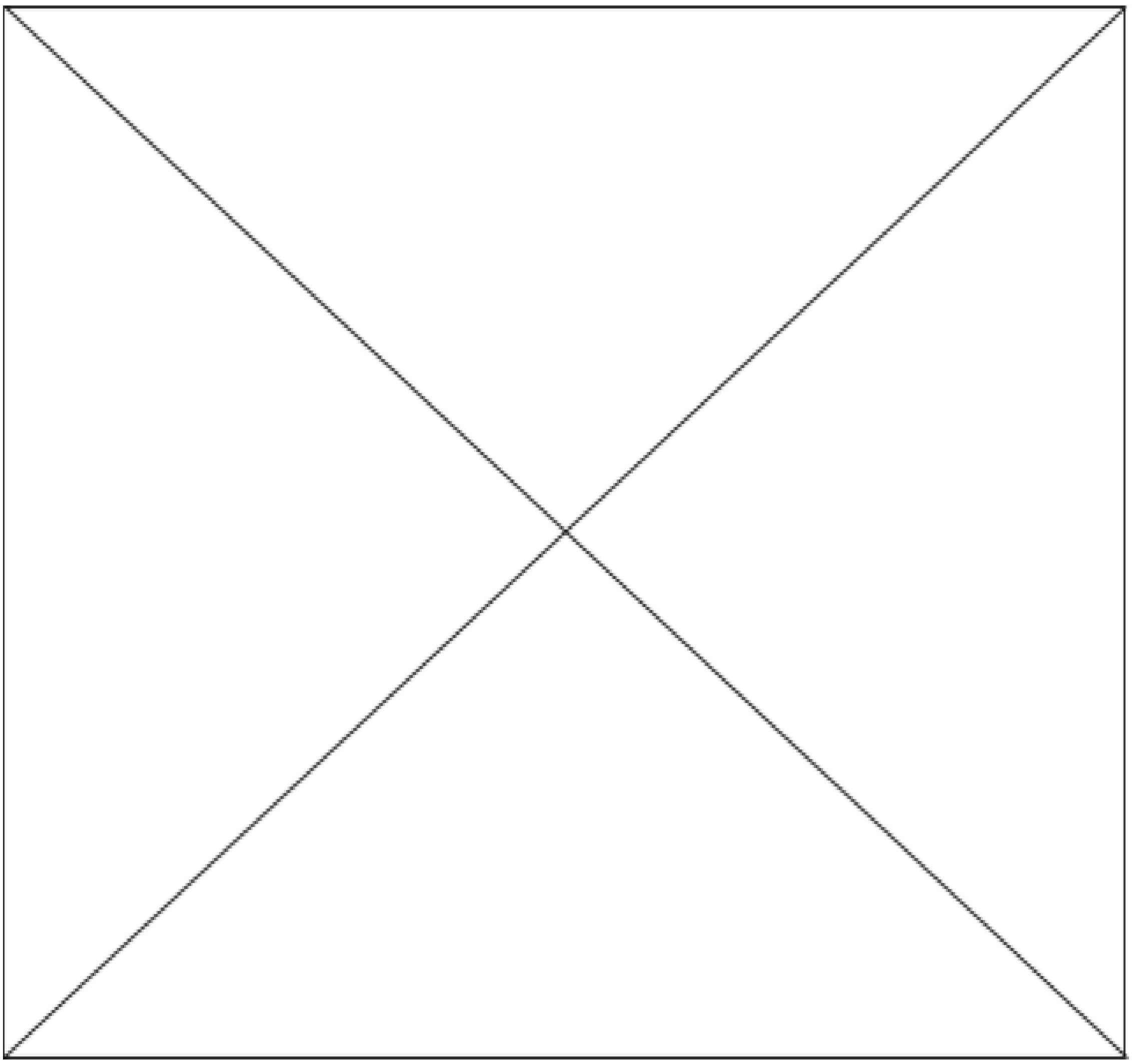
Features

- Features include real-time collaborative in one's browser and does not require any downloads
  One can see the final project as he writes
- Also, effortless sharing can be done by using a secret link
  Overleaf synchronizes changes from all authors transparently, so everyone always has the latest version
- Fast error detection is also a defining feature of the Overleaf platform
  They have clear explanations of syntax errors so on does not have to look through the Latex log.
- Protected projects also can be enabled for added security
  One can add and remove collaborators at any time, and only authorized users will have access
- Version history is also included so it is easy to see all the changes recorded for every project
  History includes details of which user made the changes and if something goes wrong, one can trace back to the latest error-free version

Why are We Using Overleaf?
Overleaf is easy to learn and use. Just taking thirty minutes get the programming and layout of Overleaf take can one far. Also, it takes the Engineering Notebook a level further. Overleaf is a professional writing platform and it makes the Engineering Notebook look professional as well. This is a software that published authors use, and it is also a good way to get familiar with this for future opportunities. One can use Overleaf for college submissions and even after college. Documents created by Overleaf have a nice finish and we believe this should be the future of FIRST.

Why Should FIRST Implement Overleaf?
One of our goals for the future and upcoming FIRST seasons is to establish the Overleaf document software as the standard Engineering Notebook platform. We believe will bring many opportunities. FIRST students will be able to get the practice of using professional document software and as discusses above, can use it in many applications. Overleaf is used in universities worldwide. Harvard University, University of Cambridge, Caltech, University of Oxford, Massachusetts Institute of Technology, Darmouth, Cornell University, Freie Universität Berlin, and École Polytechnique Fédérale de Lausanne are to name some. Overleaf is easy to adapt to and use and will bring much success to FIRST and the Engineering Notebook.

Figure 69.1: A diagram of the Overleaf interface.



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