Relic Recovery

2017-2018

Engineering Notebook

Summary Page

- This season, the Blu Cru is made up of 13 members (see Meet the Cru on pages 8 - 10) from all across Montgomery County, Maryland. We have worked extensively on designing, building, programming, and reaching out to the community to spread the spirit of FIRST during the 2017-2018 FTC Season. Some of the outreach activities in which we participated in that we particularly enjoyed this season were the Robert Frost Middle School STEM Night, Johns Hopkins Frontiers in Science, Summer Robotics camps, and the USA Science and Engineering Festival (documented on pages 34 - 61). We thoroughly enjoyed connecting with the kids, parents, and other teams in the community with our robot, which allowed us to experience first-hand the community-focused philosophy upon which FIRST was founded. The feedback we received allowed us to grow as a team, both technically and personally, throughout the season.

Our engineering design process began immediately following the release of the FTC challenge this year. We spent, and are continuing to spend, a large majority of time planning, drawing, and CAD-ing our designs out this season (see our brainstorming session on page 64). This year we have decided to construct two frames for the ability to both beta test new designs and see how the new rev kits and mecanum wheels work compared to old systems. We had many different approaches to achieving a high score this year. For the glyph facet this year we constructed three systems. These were a triple jointed mechanical arm (68), a vertical linear slider system (74), and a rolling system to deliver blocks to their correct location in the glyph boxes. All of these designs had merit and were explored but finally the linear slider system won out. It was faster,easier to maintain, and had a lower chance of mechanical breakage to the other designs. It especially won out on the last category as the arms' weight and torque would break motors; the rolling system would often fail in the service department as wheels and servos had to be replaced. The linear slider system as it requires much fewer parts than the other systems as it consists of a mono extrusion, two servos, string, and bars it was the obvious answer. It works through a pulley system in which a motor tightens and releases a string to slide the rail into a proper height and position to insert a glyph at different level in the cryptobox. It grabs glyphs through a servo system that lets us pick up to two blocks at once, hopefully giving us an edge on the field. Additionally, we came up with a relic recovery system which consists of an extrusion system with a small grabber/claw at the end to pick up the relic (107)This system was established after the alternative, another robotic arm system was found to be unfeasible and unstable through our testing cycle. Along with our mechanical endeavours, we spent extensive time on the calculations and the code behind our robot function (See Science and Mathematics Section 154, and Coding Section 160).

At the competitions in which we participate, we hope to exercise the fruits of our labors this season, and continue to have a good experience competing. We hope to continuously improve our robot and ourselves, and to be a positive influence to all the people with whom we interact. We are aiming to make it to Super Regionals, and eventually Worlds. This season we have won 1st motivate, 1st Design and finished as finalists in the control award after narrowly losing our semifinal matches at Walt Whitman and Bullis.We are hoping to continue a successful competition season, to improve on our accomplishments from last year,and strengthen our team both for current members and future members in the years to come.

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Team Mission Statement

By involving the community in our efforts to succeed in FTC, we will inspire our peers, friends, families, and communities this season with our passion and dedication to FTC. Along the way, we will embody and exhibit the FIRST spirit of gracious professionalism. Together, we will face our fears, build our bot, and hopefully conquer the competition. All we have to do is try.

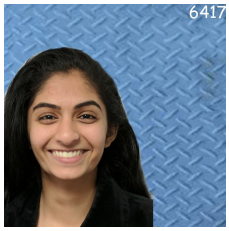
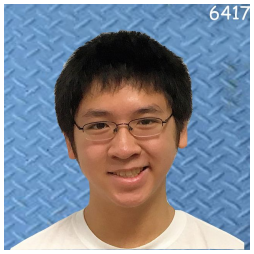
THANK YOU FIRST !

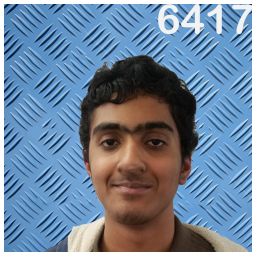
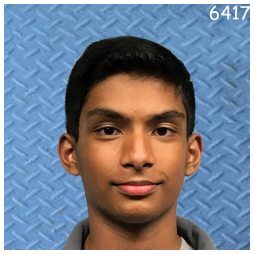
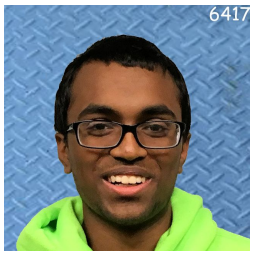
Dear FIRST,

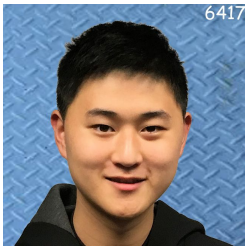
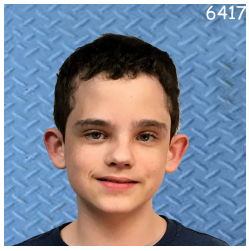
We'd like to thank you for creating and organizing the FIRST Tech Challenge. Those who say that robotics isn't a sport obviously have not seen a FTC competition in action. We love FTC because of the way it makes us think, and the way it makes us feel. FTC combines our love for robotics with the excitement of competition. For most of us, this program is our creative outlet, and an escape from the demanding school environment. During the season we are able to channel our passion for innovation, and push the limits of design. The Cru may start off the season as just teammates, but by the end we are family (robot included). FIRST makes all of this possible for us. WE LOVE FIRST & FTC!!!

Sincerely,
The Blu Cru 6417

Meet The Cru

Members : 13	About
Ragini Balachandran 	**School:** Thomas S. Wootton High School **Age:** 16 **Interests**: Robotics, Soccer, Drones **Joined FTC:** I wanted to use my building skills to work on a team project in my community. Chair of FTC team
Gunvir Lubana 	**School:** Richard Montgomery High School **Age:**15 **Interests:** Basketball, Swimming, Reading, Video games, Engineering, and Robotics **Joined FTC:** I had an interest in engineering that I wanted to pursue and to increase my experience.
Ben Ganelin 	**School:** Thomas S. Wootton High School **Age:** 15 **Interests:** Robotics, Fencing, Video games, Engineering **Joined FTC:** To gain experience in robotics and hopefully be able to expand interest of robotics throughout the local community.
Connor Gregory 	**School:** Richard Montgomery High School **Age:** 16 **Interests:** Video Games, Mechanical Engineering **Joined FTC:** I wanted to find a more friendly FTC team.
Austin Long 	**School:** Thomas S. Wootton High School **Age:** 17 **Interests:** Coding, Video Games **Joined FTC:** I wanted to apply my coding skills to a real-life challenge that needed to be solved.

Rohit Harapanhalli 	**School:** Montgomery Blair High School **Age:** 16 **Interests:** Video Games, Engineering, Coding **Joined FTC:** I joined FTC because I wanted to apply various engineering skills and robotics skills, as well as learn more about robots.
Vinamr Pemmaraju 	**School:** Richard Montgomery High School **Age:** 14 **Interests:** Basketball, Video Games, Robotics, **Joined FTC:** I joined FTC to learn engineering skills, and expand my knowledge of STEM
Bhavesh Kemburu 	**School:** Richard Montgomery High School **Age:** 16 **Interests:** Rocketry, Watching Football & Basketball, Journalism, Robotics **Joined FTC:** I joined FTC to apply skills as an engineer and collaborate with a wide variety of different people on engaging projects.
Thomas 	**School:** Richard Montgomery High School **Age:** 15 **Interests:** Video games, Puns, Science, Reading **Joined FTC:** I joined FTC to gain a new understanding on the construction of robots.

Sebastian 	**School:** Richard Montgomery High School **Age:** 15 **Interests:** Soccer, Coding, Game Design **Joined FTC:** I joined FTC to make new friends and expand my knowledge of Computer Programming and Engineering.
Priya Kalra 	**School:** Poolesville High School **Age:** 14 **Interests:** Coding, Fleld Hockey, Taekwondo, Track and field **Joined FTC:** I joined FTC because I wanted to improve my knowledge of STEM and work with people with the same interests as me in order to solve real life problems.
Daniel Wang 	**School:** The Heights **Age:** 16 **Interests:** Coding, Building, and Designing **Joined FTC:** I joined FTC because I wanted to improve my knowledge of STEM, and have access to new STEM opportunities.
Zac Bilyeu 	**School:** Northwest High School **Age:** 14 **Interests:** Physical engineering, how things work **Joined FTC:** Wanted to find people with similar interests as me.

Meet the Mentor: Bob Ekman

This page is dedicated to our mentor Robert (Bob) Ekman, without whose support we would not be here.

When a team member asked,"Why do you do all of this?"
Bob responded, "Because someone has to inspire the next generation of engineers."

Not only does our mentor go out of his way to support us with the comical gear we request him to wear, but he also makes a lot of sacrifices for us and for the community. Along with running our organization, the Explorer Post 1010 (which consists of 5 robotics teams, 1 UAS4STEM team and 3 rocketry teams), he spends a great deal of time inspiring the youth of our community through science and technology through his presidency of the Rockville Science Center. He does all this altruistically without seeking any reward. However, the true reward comes from those who benefit from his efforts: He sees and inspires the future engineers and scientists at work.

Unlike other mentors, Bob has an approach that facilitates greater growth of the team members; rather than directly telling the team what to do, he takes a step back and advises us, allowing us to design using our own collaborative methods. He advises us not only when we ask him, but whenever he finds it necessary, which is one of the things we most appreciate about him. The approach facilitates active thinking and independence, which work to develop critical skills essential for life. We feel, as a result of this approach, that we have both been able to grow as a team, as well as make the most of this experience. We can apply these invaluable skills later on as we pursue other engineering projects throughout our schooling and our careers.

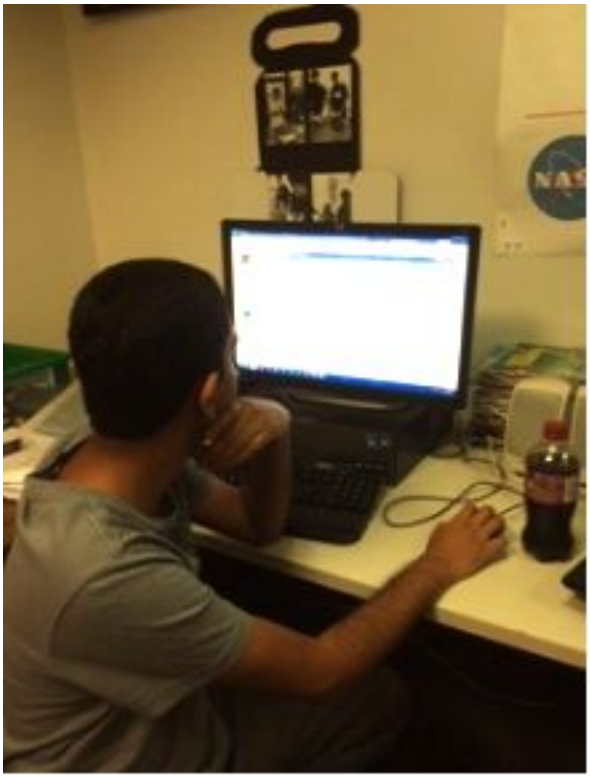
Meet the Mentor: Silvia Vidaurre

Our mentor, Silvia, an FRC alum, has played a Crucial role in our team by assisting us greatly as we build and develop our robot. She has constantly ensured that we are productive at every meeting, and makes sure that we are moving in the right direction. Silvia takes time out of her busy day so that she can teach and support our team as we work through the task of developing our robot. She has spent lots of time developing our team, furthering our knowledge in electrical and mechanical engineering, and preparing us for competition and for life. Silvia is currently an employee of Lockheed Martin.

Whenever we reach an obstacle, Silvia is there to help us. Whenever we are confused about which course to take to overcome a challenge, Silvia facilitates discussion as we share our opinions and helps us make the best decisions for our team. She always helps our team expand our critical thinking abilities, facilitating our growth by allowing us to solve our own problems rather than simply giving us the answer.

Silvia always provides her invaluable input when our team is working, which ensures that we effectively complete our tasks on a daily basis. Her perspicacious teaching has instilled a hard work ethic and has promoted active thinking in all of us, both of which have helped in the productivity of our team. Each and every team member will be able to effectively apply all the knowledge she taught us during this project to various engineering and even non-engineering projects in the future. Her mentorship and teaching have served a pivotal role in the development of our robot, and has strengthened the relationships between all our team members.

Business & Sustainability Section



Section Overview

1.0 Introduction 2

1.1 Who are we?

We are FTC (FIRST Tech Challenge) Team 6417 : The Blu Cru. The prominent Blue featured in the Explorer Post 1010 & Johns Hopkins Logos is a large reason for our team name. The color we wear honors and represents the organizations that extend their support to us. The Cru exhibits our team spirit through our capes, color coordinated outfits (tutus included), and our commanding chants.

We, as a FIRST team, strongly value the core principles set by the organization. Because of this, we make an effort to exemplify gracious professionalism at all events and meetings. We want to make a positive, lasting impact not only on FIRST, but on the community as a whole.

Our FTC team was started by the Explorer Post 1010 organization. Explorer Post 1010 has an exciting program of technical and fun activities for high school students interested in engineering. The Post is engaged in several engineering and research projects, such as the Team America Rocketry Challenge, FIRST Tech Challenge, Botball Educational Robotics Competition, and the UAS4STEM Drone Competition. The members get opportunities to develop both leadership and teamwork skills. The Post enrolls about 30 teens every fall and runs the program through the next summer, with most members being involved for three or four years. Since 1997, when our Post was founded, over 350 teens have participated, with some coming back after college to be mentors.

- The Blu Cru made its debut in FTC in the 2012 -13 season
- The Cru advanced to states in almost all of its past seasons
- Last season, when our alliance won, we qualified for states at States
- At states we made it to division finals, but just missed a chance at Super Regionals

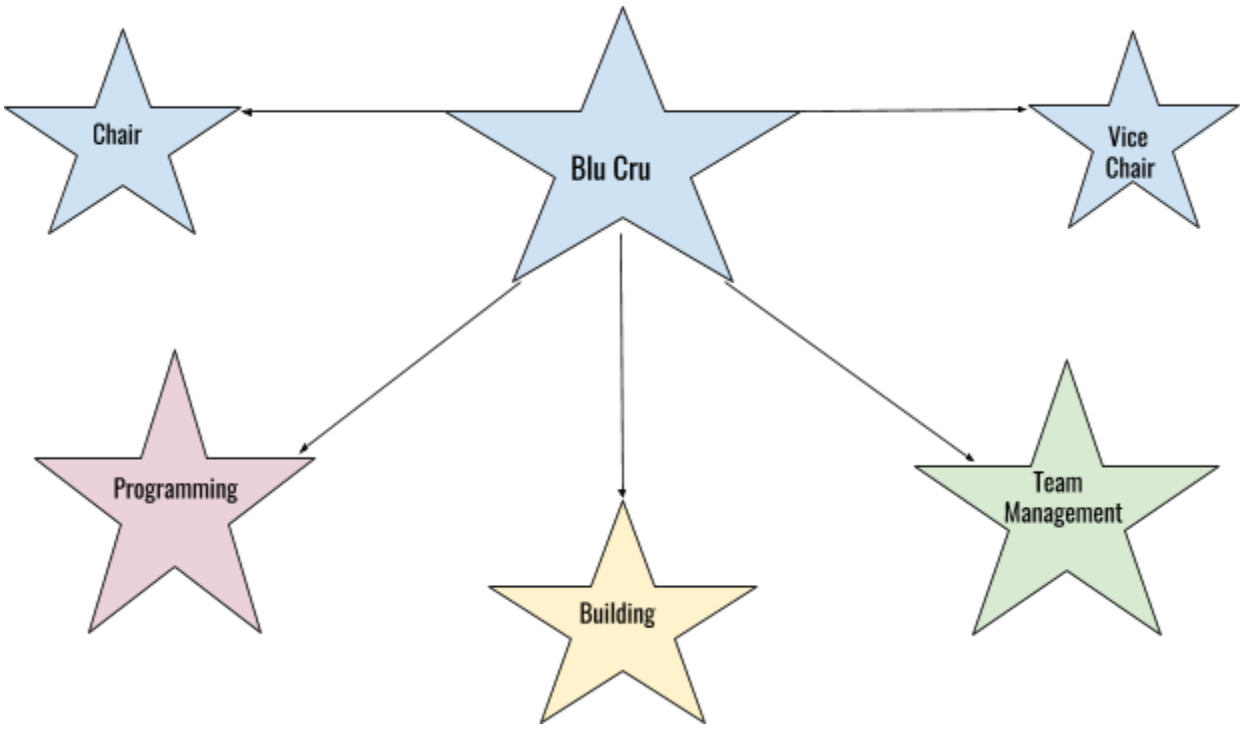
Each of our team members has experience in other STEM related competitions, such as Science Olympiad, Mathletes, FLL, USA4STEM, Science Bowl, and Botball. Our passion for FTC originates from our heavy involvement in the STEM community in our schools.

2.0 Team Organization

2.1 Leadership & Structure

To keep our team running efficiently every season, we elect a chair, vice chair,and communications officer among the Cru to oversee all sub crews, activities, and events. The jobs require a large amount of dedication and organization, so our mentors nominate the candidates to ensure that the team goes into the season with good leadership. Members of the Cru then vote on the members to fill the positions. The election of the of chairs takes place two weeks after the FTC kickoff.

During the season we divide into sub crews to increase efficiency. Our main sub groups are each focused on programming, building, and team management. The builders effectively design & build the robot. The programmer's program the robot's teleop & autonomous modes. Team management is responsible for deciding which competitions to attend, how to manage finances, and how to communicate with the community. However, we also come together as a team to make important, group-scale decisions, like when we decide on autonomous strategy and group objectives. This season we've also decided that documentation should be done by the whole team not just individuals, because we believe that if everyone is involved, it will keep everyone informed of group activities and achievements. Google Docs is an invaluable tool we use, with its collaborative features.



2.2 Business Meetings

Every month the Cru has a meeting to discuss our business agenda for the season. This meeting is led by the team management sub crew, and is attended by all team members and mentors. During the meetings, we update team finance spreadsheets, and approve big purchases like team shirts and accessories. We also discuss our fundraising opportunities and our sponsors. These meetings will teach our members to not only be technically skilled in robotics, but to also learn how to be business savvy. Throughout the season we will update our business section to include the results and decisions from the meetings.

3.0 Goals

3.1 General

- Be gracious and professional at all competitions and events
- Spread the spirit of FIRST to everyone in the community
- Inspire the next generation of FIRST
- Improve time management skills
- Be cooperative

3.2 Outreach

- Look for more ways to get involved in the immediate community
- Use social media effectively
- Attend at least one national level outreach event
- Get more team members to attend events
- Attend over sixteen outreach events this season

3.3 Technical

- Use CAD software (SketchUp/Autodesk CAD 360)
- Improve structure of robots
- Create robust designs
- Incorporate more sensors
- Improve autonomous programming
- Document the design process and its details extensively in notebook

3.4 Competition

- Score consistently
- Compete fiercely, but assist others when we can
- Improve presentation skills
- Create a competition checklist
- Efficient scouting spreadsheets
- Work our way up to competing at a national FIRST championship
- NEVER GIVE UP

4.0 Team Relationships

4.1 Community

Members of the Blu Cru come from a variety of schools in Montgomery County, and because of this our team has strong ties to elementary, middle, and high schools in our area. Our outreach is primarily focused on reaching out to the youth in the community because we want to inspire the next generation of FIRST, and future STEM workers and leaders. Over the seasons, we have also become heavily involved with the local libraries. At the libraries, we host different events, including robot demonstrations and NXT robotics tutorials for elementary and middle schoolers.

During our season we received a lot of support from the parents, teachers, and students in the community. The Cru appreciates the community's continued support so we decided to focus most of our outreach efforts on the immediate community. We want to give back to the same people who have given so much to us.

4.2 FIRST Teams

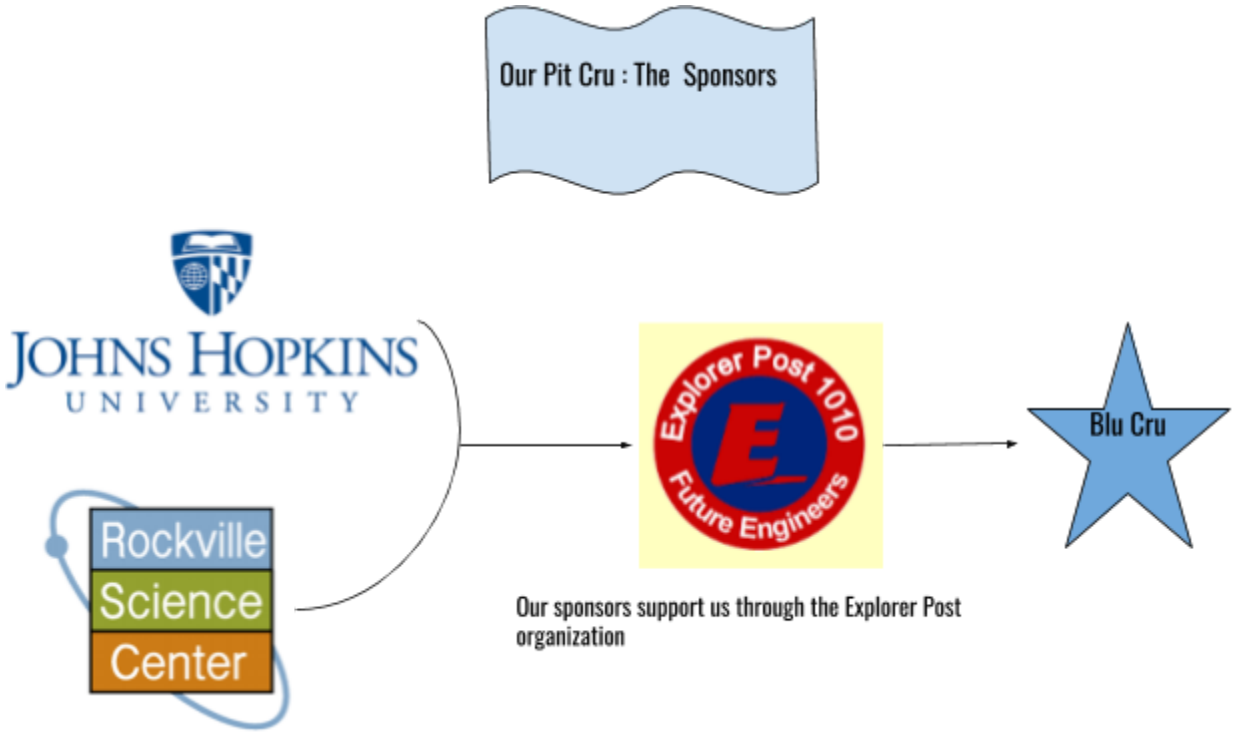
The Cru communicates frequently with other teams throughout the season. During the season we set up numerous scrimmages with teams such as Mechanical Paradox, Watkins Mill HS Robotics, Gaithersburg HS Robotics, and RMaggedon. Occasionally, we even visit the USRA Stem Action Center to catch up with other teams. The Cru has numerous social networking accounts, including Facebook and Twitter, to catch up with other teams. This past season we helped start a local FTC team with all middle schoolers in Potomac, Maryland the Flamingos; we also started another FLL team in the area.

Additionally the Cru volunteers at FLL competitions, and assists local teams. This season, we hope to attend and volunteer at multiple FLL competitions and kickoffs. We also will be assisting a few local FLL teams through our mentor, Bob Ekman. The Cru really focuses on providing a good foundation in educational robotics for all FLL participants in our area. We hope that they will all follow our footsteps and take the next step into FTC or FRC in the future.

4.3 Our Pit Cru: Sponsors

We recently lost our space in Lockheed Martin. Lockheed used to provide the team with a rent-free workspace, but recently their offices in the area moved to a new location. Luckily, with help from our mentors, parents, and community we were able to get through it.

This season we are happy to announce that we are now being sponsored financially by the Rockville Science Center and by local donors/alumni. Moreover, Johns Hopkins University is sponsoring us with space in their Shady Grove campus. Lockheed Martin even provided us with a 1000 dollar grant this season !! We are hoping to acCrue more sponsors and donations as the season progresses, and we wear their logos and brands proudly on our shirts. We represent our sponsors at their outreach events during the year, such as the Rockville Science Center at Rockville Science Day by wearing the center's uniform while we help put on the event. We will have several JHU events to attend later in the season, too.



We are expecting to receive a generous grants from ViaSat & IBM at the beginning of the season.

5.0 Sustainability Plans

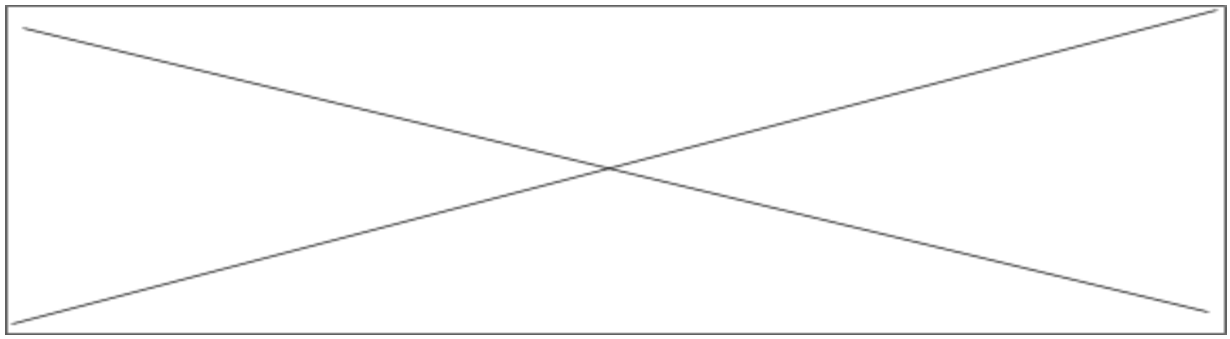
This section outlines our team's efforts to ensure the growth & stability during all FTC seasons. The Cru's members work collectively to execute each of these outlined steps.

This is Blu Cru's fourth season since its inception. We are under the parent umbrella of Explorer Post 1010 . Our team raises all funds through volunteer grants, direct sponsors, fundraising events and team dues. Every season we save parts of incoming funds for the next season. The amount of money saved for the next season is determined by our expenses, and team goals.

Our team is dedicated to building long term relationships with our sponsors by actively engaging them through the season. We will attend multiple outreach events hosted by sponsors to showcase our progress. We attract students from various schools in the MCPS area. The team usually has 2-4 new students every year to ensure that we can extend our legacy over the seasons. Our senior members usually transfer their knowledge and tips to the new members in training sessions. In addition, our team mentors are a mix of alumni and community volunteers. This allows us to ensure continuity from year to year.

5.1 Alumni Involvement

The Alumni of the Explorer Post 1010 program are vital to our team program because they make sure that everyone on the team has the proper knowledge required to participate in FTC. Before each season the alumni offer training sessions to new and current members on the team. They also advise the team on how to improve their competition and game strategies. During the competitions they also act as an additional layer of support and spirit for the Cru.



5.2 Team Risk & Opportunity Analysis

We have outlined the following concerns that might impact our current goals and strategies:

Opportunity 1- Advancing to Super Regionals and eventually a national championship

Factors that may hinder our goal:

- Technical errors in code (controllable)
- Other teams and robots (uncontrollable)
- Issues with static (Somewhat controllable)
- Robot's features like servos and motors having issues (controllable)

How we can address this :

- Create more checks for issues-(procedural checks)
- Use more static prevention techniques
- Increase teamwork and communication skills

Risk 2- Only One FTC team this season instead of usual 2 (old 9406)

Factors That may play into this risk

- May be harder to advance this season with only one team representing Explorer Post 1010

How will we address this

- Focus more resources on this one team
- More technical and individual training

Our Team has identified the following opportunities that we plan to take full advantage of:

Opportunity 1 - New workshop space

Benefits

- This will allow us to build in safer/organized environment
- Give us new technology to build and assemble parts

Opportunity 2 -More mentors

Benefits

- More training insight and help for the Cru
- More individual attention for members

Opportunity 3- More outreach opportunities with JHU & Rockville Science Center

Benefits

- Expands our platform to represent FIRST in the community
- Show sponsors & community our progress
- Reach our goal of 17 outreach events

5.3 Plans of action

Preseason Plan of Action to ensure growth & stability **Plans will be modified and added as seasons go on** (established 7/10/17)

Task	Actions taken	Responsibility	Planned completion
ReCruit & Train New members	1. Host 2 Open Houses a. 1st on 9/7/17 b. 2nd on 9/10/17 2. Have multiple coding, building, and designing workshops	Mentors & Seniors on the team	October 2017
Raise Team Funds for team registration costs, parts, and travel fees.	1. Send thank you notes to sponsors 2. Apply for more financial grants 3. Actively seek sponsors at outreach events 4. Host fundraiser events a. Laser tag in December b. Post 1010 picnic c. Car Washes	All team members participate Supervised by Mentors and alumni	Mid January 2018
Develop team leadership and more specialized roles	1. Hold Co-Captain elections 2. Identify strengths of each individual 3. Find methods of training for each individual to develop skills	Lead by senior members of team	November 2017
More OUTREACH	1. Use social media to communicate with community 2. Attend local and national events	EVERYBODY	Ongoing

6.0 Finances

The Cru is very fiscally responsible with the funds we are presented with. All donated funds are placed into a bank account managed by our mentor Bob Ekman. Although we don't have direct access to the funds, we do make a large majority of financial decisions as a group.

6.1 Income

Projected income ---------- Established (8/1/17)

Source	Amount
Member dues	$1100
Fundraisers/Community Donations	$100-500
Sponsors	$1500
Grants	$500
Total	**Approximate Goal:** $ 3000

Fundraiser Opportunities * Actual Fundraiser dates, and details will be added as season progresses*

Fundraiser Breakdown	Projected income from each	Notes
Laser tag all nighter	$200	If Package deal is bought
Post 1010 picnic/ field day	$50- 100	For Alumni and community
Car washes/bake sales	$70	Produce products with our own resources

Fundraisers for the team in the past have yielded mixed results, because of factors like weather, time, and surrounding people. We will not know for sure how well we will do, but our projected budget may vary from estimates in that department.

Travel
In the previous seasons we have not advanced past states, so our travel expenses have been covered by our team parents. The Cru tends to carpool to every competition and event, because of this travel expense remain relatively low.

6.2 Expenses

Projected Expenses (Rough Budget)
(actual budget/ amount of money spent will be updated as season progresses)

Category	Amount	Notes
Registration	$600	*required to compete
Building Expenses	$1000 (includes new field kit)	We are trying to reuse majority of parts and tools to save
Team wear	$200	If this exceeds budget amount we will individually pay the remainder to keep ON budget.
Competition expenses	$200	Addresses printing/posters/banners/ candy
Outreach/ activities	$100	We usually do not pay for spaces , but this is added just in case we need to buy something for these events
Total	$2100	Most likely will increase

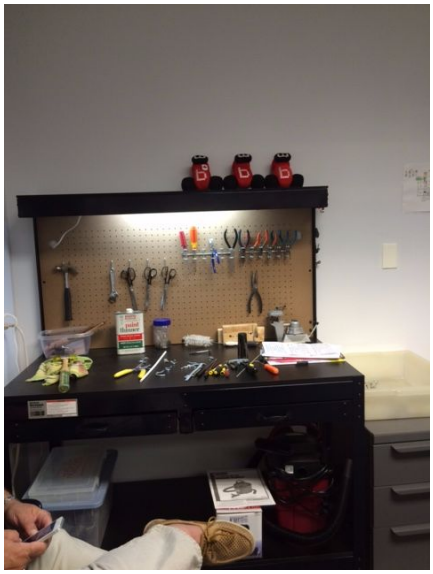
Staying on Budget

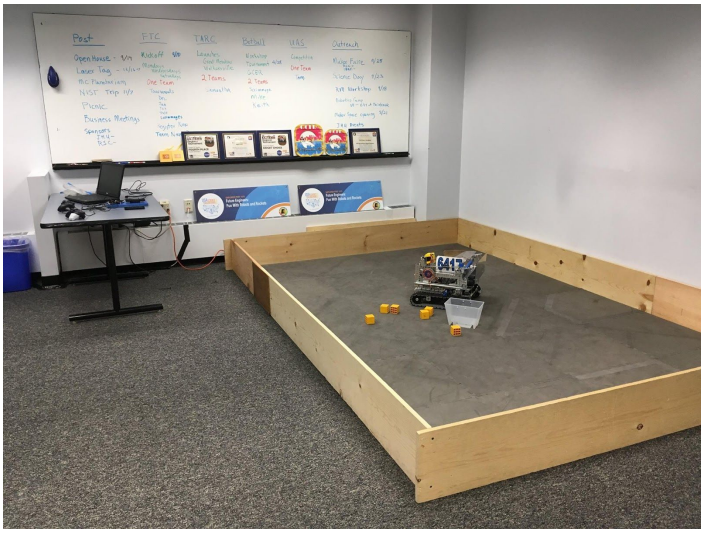
The Cru's main priority this season is to ensure that we have enough funds to build a good robot, while saving enough for future seasons and emergency expenses; it is for this reason that it is important to stay within our budget. Our business meetings, excel spreadsheets, and economic awareness will allow us to stay within our budget. Moreover, we will reuse the majority of parts from last season to stay on budget. However, if our income is greater than expected, then we may increase our budget accordingly.

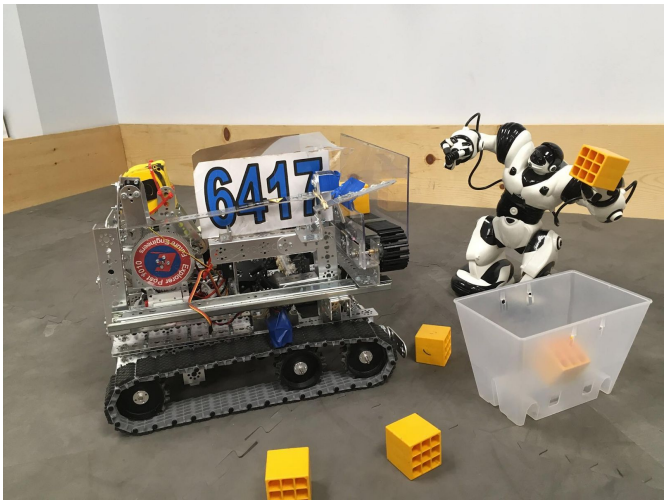
Workspace

We are extremely grateful for Johns Hopkins, which has offered its facilities to us rent **free**; their support saves our team a large amount of funds for this season.

Preseason Tour of our Workspace







Top Row : The Cru's workbench equipped with all our tools

Middle Row: Our programming and driving stations

Bottom Row: Our outreach bot has a little fun

7.0 Team Resources & Contact Info

7.1 FIRST links

FIRST resource library

http://www.firstinspires.org/resource-library/ftc/team-management-resources

FIRST Maryland

https://firstinmaryland.org/

7.2 Software/Sites Used

CAD

http://www.sketchup.com/

http://www.ptc.com/cad

http://www.autodesk.com/products/inventor/overview

Google Docs/Drive

https://www.google.com/docs/about/

Excel

https://office.live.com/start/Excel.aspx

Finance Tips

http://managementhelp.org/businessfinance/

7.3 Team Links

Twitter

https://twitter.com/post1010

Team site

http://www.post1010.org/

Facebook

https://www.facebook.com/pages/Explorer-Post-1010/118262374919489

7.4 Contact Us @

Team Email

explorerpost1010@gmail.com

Mentor Bob Ekman Email

bob.ekman@att.net

8.0 Business Meetings/Developments

Business Meeting #1

Date : August 3, 2017 (preseason)
Attendance: Austin, Ragini , Rohit, Ben, Gunvir, Connor (Returning Members)
Goals: Outline direction we want team to take, and how we will address budget and new members

Tasks	Reflection
Discuss Fundraising	We decided that we will stick with Laser Tag and the Picnic as our main fundraising opportunities . We will also have several minor fundraising opportunities with bake sales.
Come up with a team agreement (contract)	We've had many members in the past who show up at the beginning, and then disappear later in the season. To make sure we have a dedicated team for the season we want an agreement. We outlined several things we had issues with, such as attendance, active participation, competitions, and outreach. We then asked Ragini to write the contract because she appeared to have a good understanding of what the team wants for the team. Structure may actually push us to be better during the season. We may be able to focus more time on the important things now.
Set a date for open the open house / discuss agenda for first real season meeting	Most likely the date will be **September 9th.** We have proposed this date because it will give everyone time to prepare for the season, and adjust to the school life. At this meeting we plan to introduce team history, and the competition to the new team members.

Recorded By: Austin Long

The page below shows the final team agreement for the season

FTC 2017-18 Season Agreement

OVERVIEW

FTC is a competitive robotics program, which encourages innovative thinking in high school students. Our team, Blu Cru #6417, is entering its 4th season of competition. The season lasts from September to March; this may be shortened or extended based on how well we do. This is agreement outlines the team expectations and requirements for the season.

MEETINGS

1. We have meetings 2-3 times a week (Mondays(Sometimes), Wednesdays, Saturdays)
2. Members are required to attend at least 1 meeting per week, and must actively participate
3. There is one required business meeting for the team each month
4. There will be 4 excused absences during the entire season

COMPETITIONS

1. Competitions are required events (dates/info will be sent out during season)
2. Members must pay Team dues and register to be on team before competitions
3. If you cannot attend certain events and competitions notify mentors & team

OUTREACH & ENGINEERING NOTEBOOK

1. The team members must attend at least 2 outreach event during the season
2. All team members must contribute to engineering notebook

Explorer Post 1010 Open House

Date : September 9th, 2017

Duration: 6-9 PM

Cru Attendance: All members

Goals: To reCruit new members, ensure the future of the team, and show the community how we are doing this season.

Tasks	Reflection
Deliver FTC presentation	The Cru compiled powerpoint presentations and explained the processes and commitment involved in FTC. At the end of the presentation we played the game video, and encouraged the students to try and brainstorm ideas for the game. Parents and students seemed to positively respond to the presentation.
Hand out team interest sheets and registration forms	To ensure that we have accurately accounted for the students interested in the team, we ask that they fill out Explorer Post 1010 forms so we can get to know them , and contact them as needed.
Talk to the parents and students individually	Most of the parents and students seemed to have questions about the team and the organization, so we assigned one team member to talk to each family. This opportunity allowed to get to know possible reCruits and explain FTC in more detail. Many parents were worried about the time FTC demands, but we reassured them the schedule we've provided would not be too strenuous; since many past team members had been able to handle it.

Recorded by	Ragini Balachandran

Explorer Post 1010 Business Meeting 2:

Date: September 20, 2017

Duration: 6-9 PM

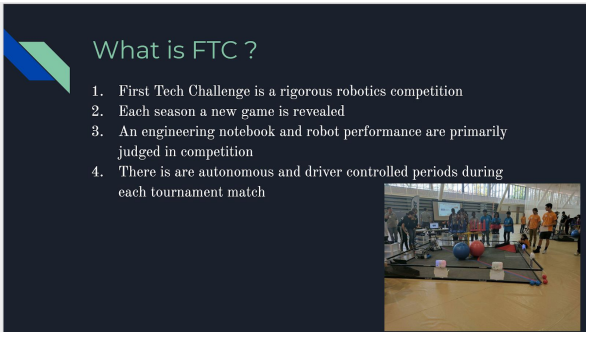
Cru Attendance: All members

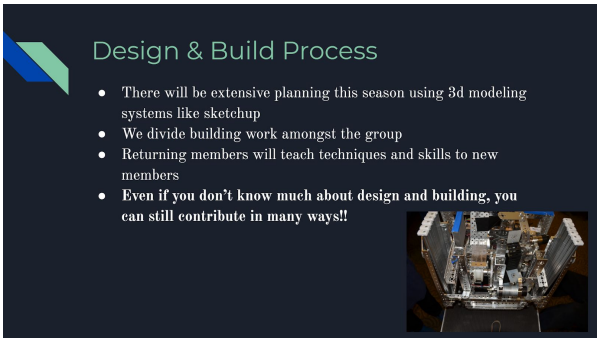
Goals- To introduce new members to the Post

Tasks	Reflection
Introduce new members and general intro of the Post to new members	We introduced all our members, mentors, and alumni to each other and went over general rules and information about the Post. We also showcased each of our projects (Robotics, Rocketry, and Drones) and allowed members to choose which one they wanted to work on.
Present FTC powerpoint to parents and new members	Powerpoint went well, and was meant to show our team's progress. We had a couple new members sign up to be on FTC and we introduced them onto the team and discussed the game and our strategy.

Recorded By: Austin Long

Powerpoint Snippets





Explorer Post 1010 Business Meeting 3:

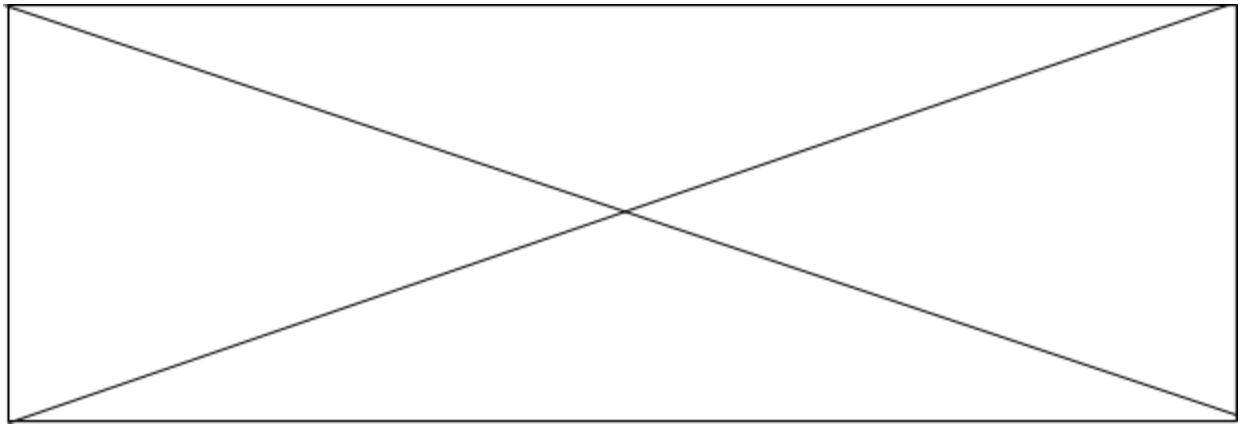
Date: October 12th, 2017

Duration: 6-9 PM

Attendance: All members

Goals : Discuss Attendance, Qualifiers, and Active Participation

Tasks	Reflection
Review Group Attendance/ Active Participation	Over the last few meetings we have had some issues with attendance and participation in the last few meetings and we made it clear that in order to win we would need to put in more effort. This message was well received by our team.
Qualifier Overview	We updated our team on the qualifiers we had gotten this year: ● Whitman December 17th ● Bullis Day 2 Jan 14 th
Good News : **GRANT !!!!**	We received a $1000 grant from Lockheed Martin. We will use this money to purchase additional parts and supplies.
Recorded By :	Ragini Balachandran



Explorer Post 1010 Business Meeting 4:

Date: November 16, 2017

Duration: 6-9 PM

Attendance: All members

Goals : Discuss Qualifiers, and go over priorities list

tasks	reflection

Informed group of incoming events	• We have an incoming scrimmage and build session with RM and poolesville FTC teams on NOV 26th
	• We have our first qualifiers nearing as well
	• We made sure teammates knew how they could contribute and what they should do in advance
	  ○ Register for stims
	  ○ Focus on learning team rules more extensively
	  ○ Turn in T Shirt sizes

Went our team priorities and what needs to get done before competitions	• We need to finalize which method of Relic recovery we will be going with
	  ○ Extrusion and grabber
	  ○ Servo Arm and grabber
	• Autonomous will also become a priority in the next few days
	• Ordering t shirts will also be done ASAP
	• We decided that designs for the ball capturing system will be a latter priority
	  ○ Our new logo may be too difficult to print

Recorded by	Austin Long

BLU CRU COMMUNITY OUTREACH SECTION

Why is outreach important to us ?

The Blu Cru has always emphasized the importance of community outreach. We feel that by reaching out and giving people the opportunity to see robotics in action, we'll be able to inspire more people to pursue STEM-related activities, including FTC and FLL. Furthermore, we believe that with good outreach, we'll garner additional interest for the development of new technology as a whole. Through outreach we have gained the support of the community, as well as the addition of new members to the Blu Cru. Many of our team members were inspired to join our team because of past outreach events, so we feel it is in the spirit of

FIRST to give back, the same way our alumni graciously did. As such, community outreach has become a central aspect of what we do.

OVERVIEW OF OUR EVENTS & PROJECTS

1. Robert Frost Stem Night
2. USA Science & Engineering Festival (2 days)2017
3. Rockville Science Day
4. FLL Parent and Student Information
5. College & Career Preparation Expo
6. MCPS TV Interview
7. Cub Scouts
8. Gibbs Elementary School Stem Night
9. Hometown Holidays (2 days)
10. Summer Robotics Camps (8/8/17-8/19/17)
11. First Lego League Qualifiers (2 days)
12. Johns Hopkins Breadmaking Event
13. Johns Hopkins Frontiers in Science
14. Scrimmage with RM and Watkins Mill
15. NIST visit
16. Rockville Science Day Proclamation
17. Senior Center Presentation
18. FLL Expo
19. Kidfest
20. Makerspace Opening
21. International Outreach
22. Our Biggest Platform : Social Media
23. FLL Outreach
24. USA Science and Engineering 2018
25. Rockville Science day 2018

USA Science & Engineering Festival 2016

Location: Washington D.C.

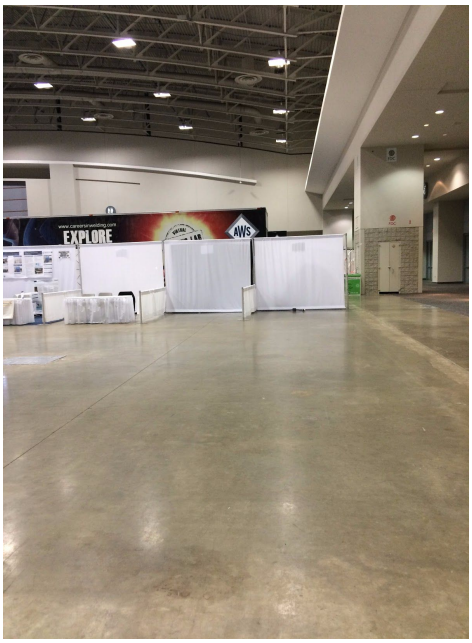
Duration of Event: 16 hours over two days

Thousands of people attended this huge event

The Explorer Post 1010 organization has been attending the event since its inception in 2010.

The Science and Engineering Festival hosted hundreds of exhibits, including our own. Our booth was located on the first floor near the stage, and the Nasa exhibit. We also had members assisting the Gaithersburg HS booth on the second floor. On both days of the event we drove our bot for hundreds of people, and allowed some of them to drive as well. The Cru set up our booth with information about FTC, Rockville Science Center, and our team as a whole. We also played our competition feed on a laptop, to give a sense of what a competition is like. Our team also brought 3D printers and drones for people to observe along with our robot. At the event, we attempted to circulate between both floors to give everyone a view of our robot. Our robot made it down the escalator safely multiple times, thanks to our skilled drivers. The Cru thoroughly enjoyed seeing other exhibits,and learning about new experiments and companies out there. We hope our audiences enjoyed the event just as much as we did.

Above a picture of our event space, and demonstration for a group of people at the event.



Robert Frost Stem Night

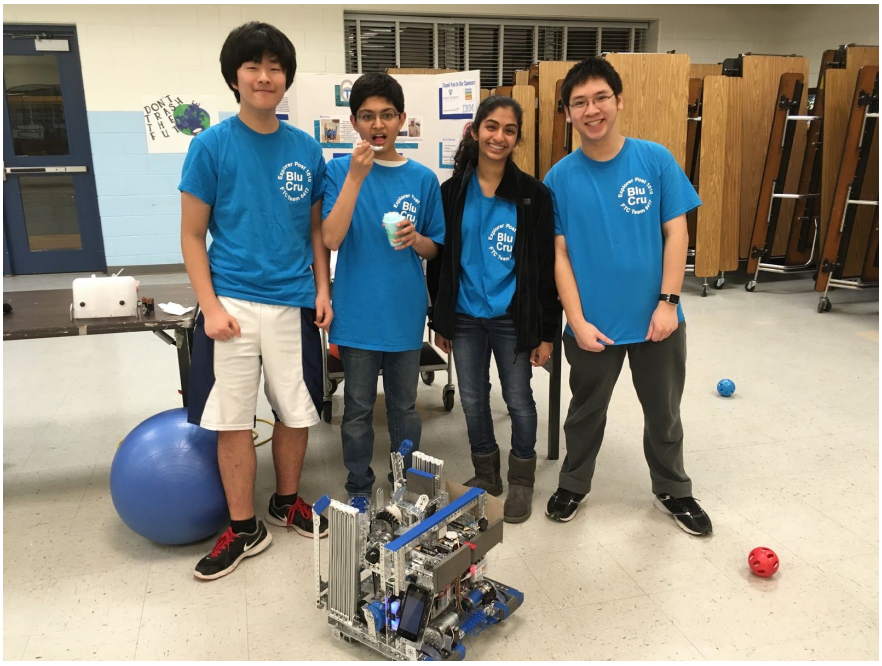
Location : Robert Frost Middle School, Rockville MD

Duration of Event : 3 hours

March 1st, 2017

For the past three years, our team has been attending the annual stem night to raise awareness for robotics in the community, and demonstrate our progress during the season. Throughout the night we allowed students to drive, and test our robot's functions. We received a lot of positive feedback from the parents, students, and teachers ! The Cru also gave out information regarding summer robotics programs, future outreach events, and science programs in the Rockville Science Center.

One of the reasons we prioritize school events so much is to connect with the next generation of FTC programmers, and builders. Middle and elementary schoolers are not only the future FIRST participants, but future engineers, doctors, and astronauts. We hope with our demonstrations we are inspiring them just enough to start them on this journey.



College & Career Preparation Expo

Location : Bioscience Education Center at Montgomery College's Germantown Campus
Duration of Event: 5 Hrs
The event had over 1,000 attendees
March 20,2017

At this event the Cru demonstrated our robot for a large number of spectators, while distributing information about what we do as an FTC team. We also allowed the spectators at this event to drive our robot, and see potentially how many points they could score in a real competition as a driver. Many people at the event were made aware of opportunities out there for them in FTC, and STEM competitions. We felt like we accomplished our goal of raising awareness, and entertaining our audience.

MCPS TV Interview

Blu Cru member, Ragini Balachandran was interviewed by David Frey from Montgomery County Public School TV.
MCPS TV is broadcasted for the thousands of students in the county.

During the interview Ragini answered questions about how kids could get involved in Robotics through their schools and community resources. She also advocated for more girl involvement in STEM programs,like FTC. Following her interview she showcased our robot's talents for the camera and the people at the event.

Later that week, we saw our Cru member and bot make a cameo in a MCPS TV episode! We all agree that our robot is definitely the star of our team.

Below are a few pictures from the interview

Rockville Science Day Proclamation

Location: City Hall Rockville

Duration: 4 hours

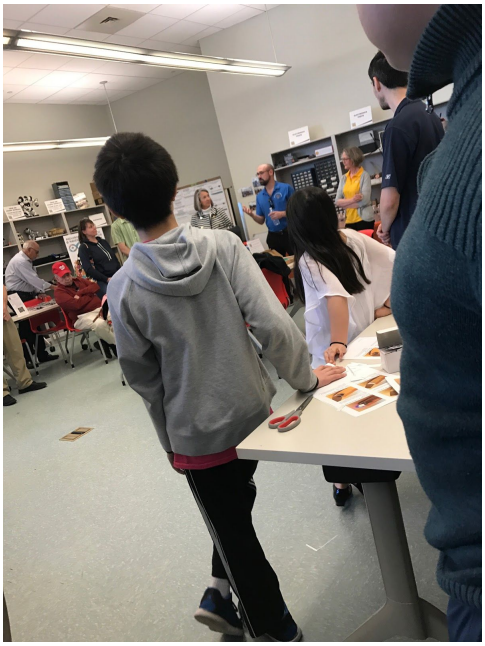
March 27th, 2017

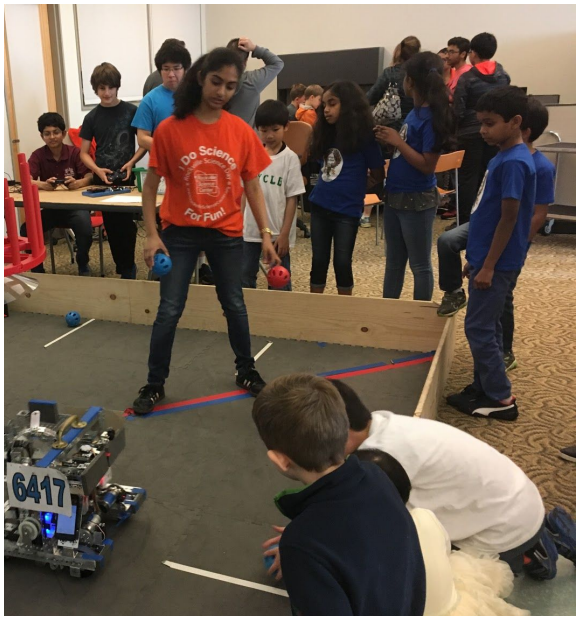
Our mentor, Bob Ekman, was honored with a Rockville Science Day proclamation to memorialize the famous event ,and to bring more community recognition to it. At the event, we drove our robot around for the city council members and the mayor; we also spoke to reporters and community members about the FTC and our sponsor the Rockville Science Center. When the mayor presented the proclamation to Bob Ekman, our robot shot a ball out for him to catch. In addition, we held posters with information on Rockville Science Day that were broadcasted and sent out amongst the community. Overall, we feel the event was extremely successful as we were able to get publicity for both Rockville Science day, and for robotics.

Makerspace Opening

Location: Rockville Library
Duration: 5 hours
April 9th, 2017

With our sponsor, the Rockville Science, we attended the Makerspace Opening on the second floor of the Rockville Library. We have previously used this space to practice with our robot, and work with other FTC teams. At the event, we showcased our robot and spoke with parents and students about the FTC competition. We also let the kids there drive and interact with our robot to allow them to get some perspective on the competition. As a team, a huge goal is spurring more community involvement in robotics. Moreover, we got to talk to county executives and the mayor of Rockville about our robot. It was really interesting to get new perspectives on our robot, and receive encouragement from the community.

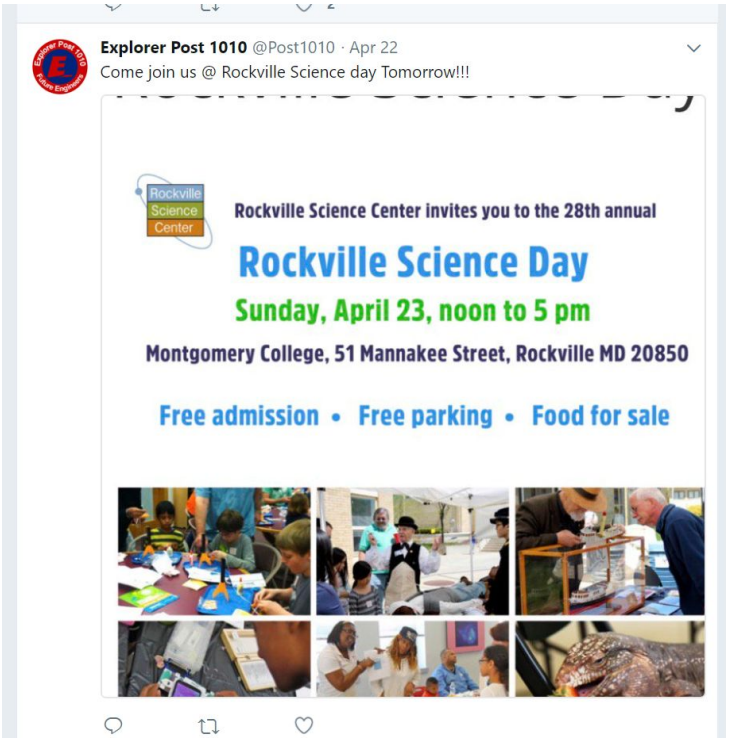




Rockville Science Day

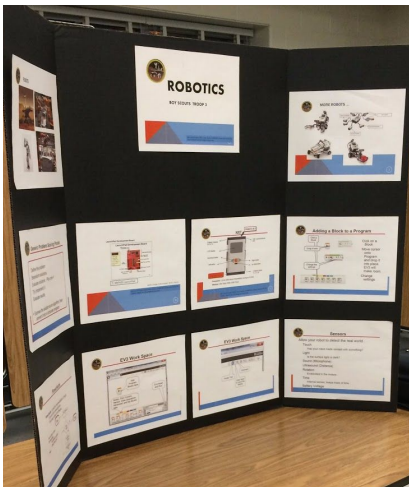
Location: Montgomery College, 51 Mannakee St, Rockville, MD 20850
Duration of Event: 5 Hours
April 23rd, 2017

The Rockville Science Day has been a tradition for our FTC team, because our involvement with Rockville Science Center. Our Cru drove our robot around the event, and raised awareness for robotics in the community. We met with a lot of kids and parents in the community, explained the functions of our robot, and how what we've learned can be applied later in the future. The Cru also set mini courses for people to try to get through with our robot. In addition, we decided to set up logo stations for the kids to experiment and play with NXT kits. We enjoyed watching the kids and their parents have fun with the different types of robots we brought to the event. Overall, the team had a lot of fun with entertaining the attendees, and connecting with kids at the event. This year was the biggest Science Day to date, and was largely successful because of the efforts of our mentor Bob Ekman.



Above a picture of the event and a tweet we sent out about the event.

Cub Scouts



Total Hours Spent at meetings : 16 (as of 11/30/17)
Meetings Attended : 4

We periodically brought our robots to local Cub Scout meetings and allowed the children to drive the robots. It was our intent for the kids to learn more and become more passionate about robotics, and they had a lot of fun driving our bots around and seeing how they worked. At some of these meetings we helped teach boy scouts the basics of NXT and mindstorms building. Together we created posters that diagramed the processes we went through to get our mindstorms working. We plan to continue attending meetings throughout the season.

Gibbs Elementary School Stem Night

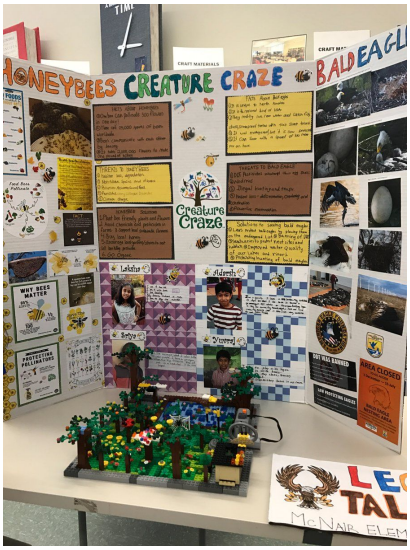
Location: Gibbs Elementary School 12615 Royal Crown Drive, Germantown, MD, 2087
Duration of event: 3 hours
March 15th, 2017

The Cru arrived at the STEM night early to help the teachers set up the event. When the event started, we drove the robot around for the kids. Our robot was initially confused for an “alien ship”, but after the kids began to see it in action they really started to understand and enjoy the purpose of it. In addition to our demonstration, we also set up a lego play area for the kids to build their own FTC mini bot. We also handed out information to the parents about the different levels of FIRST robotics, and we are hoping that these elementary schoolers start as soon as they can.

FLL Jr Expo

Location: Rockville Library Makerspace
Duration: 10 hours
May 6th, 2017

Our team and the Rockville Science Center decided to pair up to host an FLL jr Expo. We hosted 8 teams at the expo. Our team members were responsible for judging, organizing, handing out snacks, and entertaining the participants and their parents. During the judging portion of the Expo, two of our senior members and our mentor, Bob Ekman, got the chance to interact with the presenting groups and their amazing projects. The participants were eager to share details about the leggos animals, and thoughtfully answered the questions we asked them. After judging, other team members entertained the kids with a paper rocket station and with a robot demonstration. At the end of the day we presented each kid with a small medal, their team award, and some fruit snacks. Overall, we feel the event was a huge success and we are proud of both our team and the competitors for making such a big event possible. The Cru looks forward to possibly hosting a few more FLL Jr expos, and FLL competitions. We feel like these expos are a great way to get involved with our FIRST community, and ultimately we believe that these events are great segways into other robotics programs and competitions for both the parents and students involved.



Johns Hopkins's Science of Bread Making Event

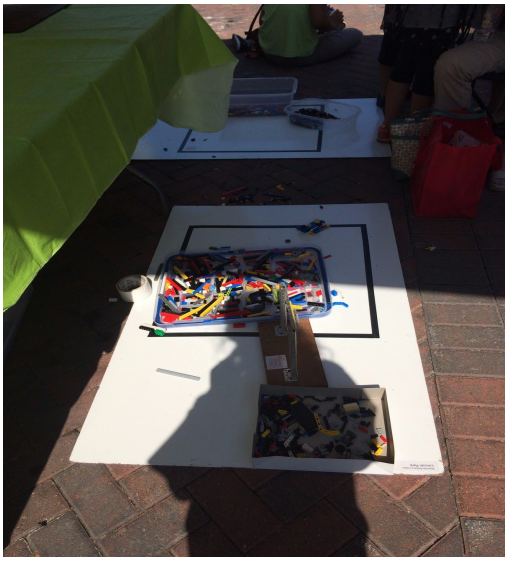
Location: Johns Hopkins University
Duration: 5 hours
May 13, 2017

During this event, Approximately 200 fourth-graders from three Montgomery County elementary schools visited Johns Hopkins University Montgomery County Campus to learn the art and science of bread baking. The students, from Candlewood, Mill Creek Towne and Rosemont elementary schools, participated in the King Arthur Flour Bake for Good Kids program. The Cru helped the kids understand that bread making was more than just mixing ingredients together. It was about science and math as well. The Cru was there to mentor these kids, and also display the robot. The kids were extremely fascinated by the all of the STEM activities that JHU had to offer. Additionally, the robot was a massive hit. The kids drove the robot, and both the parents and kids were interested in getting involved. We interacted with them and helped them try to grasp the idea of building a robot. Overall, this event was a great way to expose young children to the world of STEM, and the Cru was glad to be part of it.

Hometown Holidays

Location: Rockville Town Center
Duration: 10 Hours over two days
May 27th and 28th 2017

Our Team spent two days at Hometown Holidays exhibiting our Robot along with Rockville Science Center in their tent. We set up the foam flooring of an FTC field across from our tent, and created a mini course for our drivers to entertain bystanders with. The Cru also let some of the children at the event drive the robot around. Moreover, we set up lego stations for the kids to play with. The parents and kids at the event really enjoyed our stations because it was a great opportunity for them to get out of the heat that weekend. Our team also met with local reporters to discuss our involvement in both robotics and the community. The Cru met with members of the RM FTC teams to discuss FTC opportunities and possible scrimmages in the future. One of our goals as a team is to make sure the experience is as interactive, and informative as possible. Overall the event was successful because of how well we worked together as a team to get everyone involved in our event.



Left : Our lego stations set up underneath our tents. The stations helped the kids get out of the sun, and take a break for a couple minutes.	Right: Our Cru's headquarters for the the two days we were at the event.

One Billion Literates Foundation in India

Location: Bangalore, India

Duration: 18 Hours over 3 Days

July 4th to 6th 2017

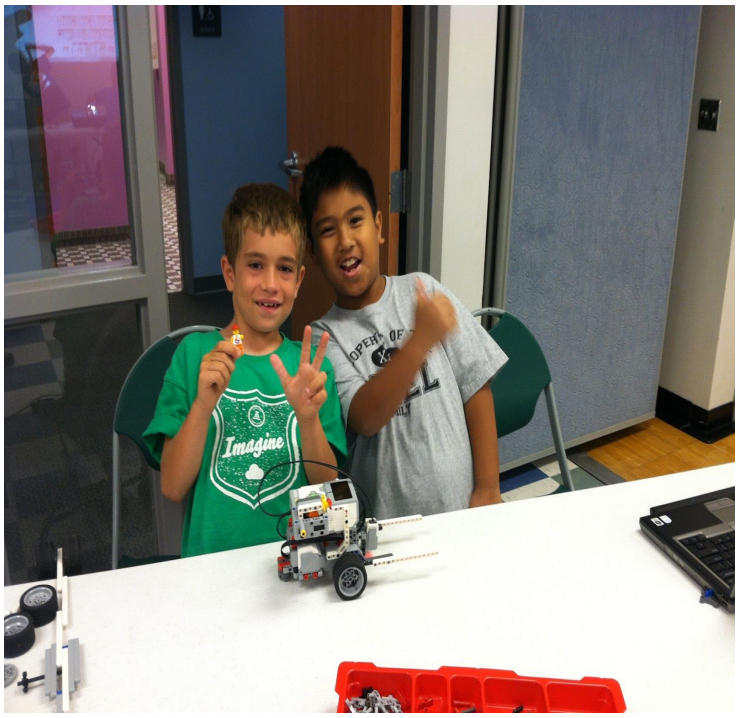
As a team, we made plans at the end of last season to take our outreach international. Many of us felt like that while we may be doing a lot in our own communities, we could be doing more internationally. We decided to reach out to One Billion Literates, an organization dedicated to expanding educational opportunities for kids in India. Our primary reason for wanting to work with them was the fact that they teach both computer science and English, so that these kids are able to get jobs after high school. We decided to send our team captain, Ragini, to help out on our behalf. Over her 3 days, there she trained the teachers and students to use new laptops and tablets. In addition, she taught lessons on grammar to the students there. At the end of her trip she worked with the staff in the school to come up with a solid curriculum for the teaching of computer science. Ragini really enjoyed the event, and we hope to send more members to schools next year in India.

Summer Robotics Camps (8/8/17 - 8/19/17)

Location : Twinbrook Community center
Duration : Days between August 8th and 19th 1-4PM

During the summer months our team hosts and visits various summer camps to teach middle and elementary schoolers the basics of the NXT and EV3 systems. We also mentored during numerous STEM camp sessions with our mentor, Bob Ekman. Our team sent at least five members to each session, to ensure that we could give the kids at the camps as much individual attention and instruction as possible. The goal for us at these camps is to try and pique interest of every kid there in hopes that they will possibly end up in programs like FLL, FTC, and FRC in the future. Overall this summer's campers and the Cru really enjoyed the experience. This Spring Break we hope to host a mini camp for more kids in the community.

Robotics Camp!!!



Gaithersburg High School Robotics & Watkins Mill Robotics

Our Blu Cru alumni helped found the Gaithersburg HS FTC robotics team. Over the years we have helped them find sponsors, create documentation, and learn how to build and program FTC robots. In addition to this we've hosted small scrimmages for Gaithersburg, where we shared tips and guidelines regarding the competition. Members of the Blu Cru were featured in the Gaithersburg Gazette after the outreach. Our Alumni even set up a demo with Mayor Jud Ashman to raise awareness for robotics. The article and the meeting with the Mayor provided a lot of exposure for our team, and the Gaithersburg team. The Gaithersburg team initially started with 10 people, and currently they have over 60 members. We are hoping that we can still help them expand, and improve with future scrimmages. The Blu Cru alumni also maintain active roles mentoring, and assisting the team along with us.

We also meet and share ideas with FTC Team 4452 Watkins Mill. We often mentor Team 4452 and exchange ideas on how to improve their coding and building. We've also set up numerous scrimmages with them, and work sessions at the Gaithersburg Library. In addition to this, both of our teams share a mentor, Bob Ekman. Bob helps regulate, and aid our team scrimmages.

Top left: A work session with both Watkins Mill and Gaithersburg at the library.
Top Right: Mayor Jud Ashman watches our demo at GHS.
Bottom Right: We help mentor, and guide a GHS robotics meeting.

FLL Parent and Student Information Session

Location: Johns Hopkins Rockville Campus
Duration: 4 hours
September 16 ,2017

Before the beginning of the FLL season, we met with parents and coaches from our community to talk them about what they will need to do to great prepared for the competition. In addition, we provided NXT kits (instructions included) and leggos for the coaches and parents in charge of the teams. These kits will be used by these teams to build their competition robots. While our mentor, team alumni, and senior mentors spoke to the parents, our other members entertained the kids with our lego collection. We also showed them some our leggo prototypes from our FTC season. We subsequently taught the kids how to plan out and build similar designs. At the end of the sessions we made plans to meet with these teams at later dates in the season to help them set up scrimmages and practice presentation.

Kidfest

Location: Silver Spring Veterans Plaza

Duration: 4 hours

September 24th, 2017

During this outreach event the Cru showcased 3D printers along with smaller autonomous robots with our Explorer Post 1010 counterparts in both rocketry, and botball. The Cru talked with parents and kids about the opportunities available in STEM for kids with Rockville Science Center and in the community. Throughout the day we also took requests (mostly pokemon) on what the kids would like printed by the 3D printer, and handed out the creations. Even though we were unable to bring our FTC robot because it was being remodeled for this season's challenge, we had a great time showcasing our other projects in the STEM field. We also took questions about this season's FTC game, and the ways to start a team. Hopefully in the near future we are able to help start more teams like Gaithersburg. We were also glad to connect with the other FTC teams gathered at the event. The Blu Cru really felt that kids and parents who saw our exhibit enjoyed, and as a team that is our first priority at outreach events.

Johns Hopkins University's Frontiers in Science

Duration : 6 hours

Location : 9601 Medical Center Drive (Johns Hopkins Montgomery Campus)

Over 400 middle schoolers Attended this event

October 27th, 2017

We were invited by our sponsors Johns Hopkins University to attend the Frontiers in Science Event.The goal of the JHU Frontiers in Science was to bring excitement to young kids about science and technology in today's world. For the entire day, we demonstrated our robot for this season, and performed a usability test. Over 400 middle schoolers played with a the basic frame of a robot, and experimented with the controls to get a feel for how robots are maneuvered with controllers. We brought old beacons, blocks, and balls to give kids perspective on what the competition feild looks like. This experience was very important for them, the kids were able to understand and experience the tele-op part of the robotics game in FTC, as well as get excited about participating in FTC in the future. Moreover, the kids' interest in science and technology competitions and activities increased greatly, and many of the kids showed interest in participating in FTC once they are eligible to do so.

The kids at the event pictured at our two robot stations: one with an FTC robot and another with smaller autonomous bots much like the ones found in the First Lego League Competitions. The students took turns picking up blocks and placing them into the crypto boxes.

Cub Scout Rocket Launch

Location: Hanson's Farm
Duration: 4 hours
November 6th, 2017

During this outreach event, Explorer Post 1010 went to Hanson's farm to interact with elementary school kids, and help them launch rockets and rock climb. We made sure to set up a rocket launch area, and a spectator area to ensure safety for everyone. The Cru and the cub scouts' Rocketry Team helped harness kids and and instruct them through the process of rock climbing. We also helped kids launch little rockets made out paper and plastic, which was a great way for kids to get into a STEM related activity. This was a good opportunity to meet with younger kids and help them do things that they enjoy greatly, which they may pursue in the future.

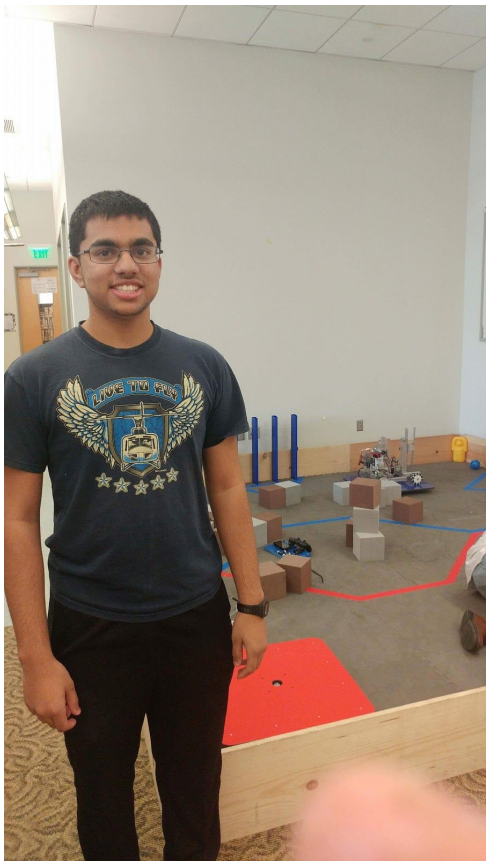
Scrimmage and Build Session At Rockville Library with RM and Watkins Mill

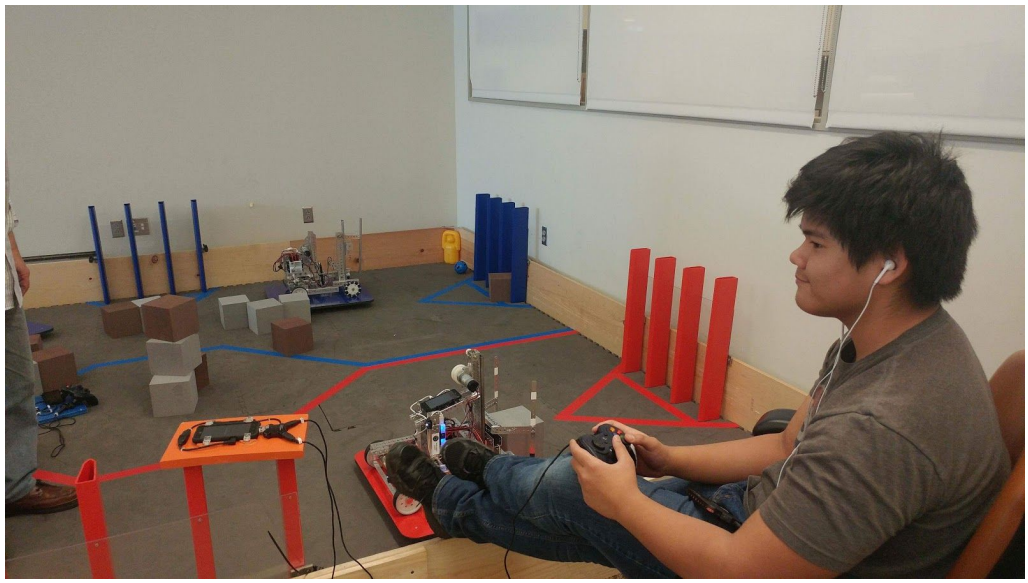
Duration : 5 hours

Location : Rockville Memorial Library

December 2nd, 2017

We decided to hold a scrimmage and build session with other teams competing in the qualifiers. During this session, we had three major goals: to work on the autonomous code, to determine the best method for stinging the extrusions, and practice driving our robot .We also used this session to do more outreach towards other FTC teams and FLL teams. We began the meeting by working on the autonomous code for our robot. We worked on coding the robot, as well as testing the code to see how well it runs. Through our time in the library, we were able to show the other teams how we made our robot, a very important skill in FTC and in engineering. Moreover after testing our stringing for our extrusions, we were able to show the other teams how important it is to have different ideas to accomplish a goal, as well as to pursue both ideas and test them out in practicality. This also helped teach the other teams how important designing systems are in the real world.





On the left a member from RM robotics and on the right a member of Watkins Mill robotics practices with us. We worked closely with the teams, and exchanged lots of ideas on construction .

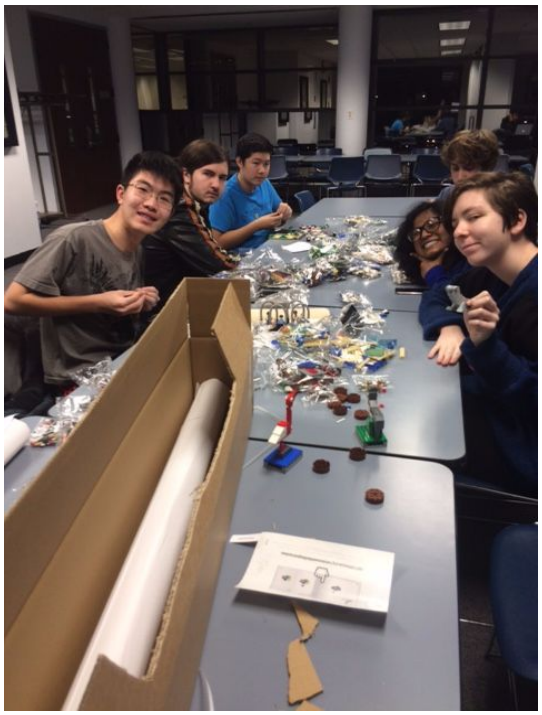
First Lego League Build Session

Duration: 3 hours

Location : Johns Hopkins Shady Grove Campus

December 7th, 2017

We invited some FLL teams to come join us at Johns Hopkins for a build session. Together we assembled the new game board and parts for the competition. The board we assembled will be used by multiple FLL teams in the area who use Rockville Science Center facilities.We had a lot of fun building with the teams, and we encouraged them to come visit us in the future. Later, this month we will be attending more FLL qualifiers to assist teams, parents, and FIRST staff. Since the members of FLL are the future of FTC and FRC we feel it is our duty to get them interested in STEM and make sure they all have a strong base to build upon in their upcoming years. We plan on visiting other FLL teams as well during the FLL season. The Cru is excited about all the upcoming opportunities to get involved with the future of FIRST.



First Lego League Scrimmage Assistance

Duration: 3 hours

Location : Rockville Memorial Library

December 8th, 2017

We visited an FLL scrimmage between a couple First Lego League teams that were in our area at the Rockville Memorial Library so we could aid the teams during their scrimmage. Some of the members from the Blu Cru helped the First Lego League teams primarily with their scorekeeping and timekeeping as the scrimmage took place. We really enjoyed the opportunity to help out the teams, parents and FIRST staff. Since people interested in FLL will likely join FTC/FRC in the future, we feel very inclined to inspire them and get them more involved in STEM so that they understand the fundamentals of engineering. We will continue to visit FLL teams' scrimmages so we can continue to inspire the future generation of FTC teams.

FLL team Fantastic pictured along with Cru member Rohit

Robotics Presentation at Rockville Senior Center

Location :1150 Carnation Dr, Rockville, MD 20850
Duration : 3 hours

Mentor Bob Ekman and the Cru demonstrated the autonomous capabilities of both our robot and some smaller lego robots at the Senior Center. We detailed our journey as a team and showcased video footage of our robot in the presentation. Our mentor Bob Ekman also helped us detail the opportunities still out there to get involved with FIRST and robotics in the community for the seniors at the center. Moreover, the responses we got from the people at the center were very positive and it seemed like everyone involved enjoyed the experience thoroughly. It was interesting to hear different perspectives on how we could improve and our robot's unique design features like the conveyor belt and flickr launcher system. We will definitely be visiting again soon.

To the Left our mentor Bob addresses some questions on autonomous robotics

Mentor Session with Watkins Mill Robotics

Location : Rockville Memorial Library

Duration : 3 hours

Date: December 16th, 2017

We helped out a fellow FTC team from Watkins Mill with preparing for the FTC qualifier. During this session, we helped them with driving their robot on the field. In particular, we focused on wiring optimization, coding, and their arm design. We explained to the team various design principles and methods, such as brainstorming as a team, allowing appropriate disagreement between ideas, and the combination of ideas that create a unique idea that accomplishes as much as possible. Moreover, we worked with Watkins Mill on their presentation through timing and questioning. We then gave feedback on their presentation such as speaking times, getting straight to the point, and answering questions concisely and without taking too many tangents. Finally, we helped them on their driving skills, such as how to coordinate between drivers to effectively score points in the least amount of time.

Here our team member, Ragini, teaches Watkins mill about the competition structure and driving under pressure.

FLL Scrimmage

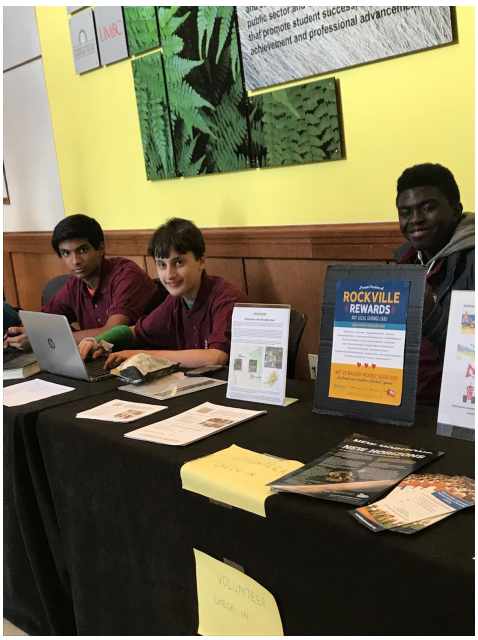
Location : Makerspace in the Rockville Memorial Library
Duration : 6 hours each day
Date: December 16th, 2017 & December 23rd, 2017

During the scrimmage, several FLL teams came in to practice for their upcoming competitions. We set up a field where they could practice setting up their robots and going through the different tasks. They were able to experience how the actual competition would go, as they had to deal with the time and many of the same rules as during the competition. However, during the scrimmage, they were able to practice interacting as a team, and offering words of encouragement even when they had to face problems. Also, practicing on the field gave them the opportunity to identify any issues in their code and make adjustments. Besides competing with the robot, the FLL teams also brought in presentation boards and practiced presenting their projects as well as core values activities. They greatly benefitted from the practice because after their presentations we asked them questions that they would receive during the actual judging process that they had to answer to the best of their ability. Through this process we helped them understand the importance of being knowledgeable about their project and be confident in front of the judges.

FLL Qualifier

Location : Universities at Shady Grove
Duration : 12 hours
Date: January 5th, 2018 & January 13th, 2018

Every year, we host a FLL qualifiers with our mentor Bob Ekman and Rockville Science Center. As a team, we believe that the younger generation is of utmost importance to stimulate interest in the STEM opportunities available. FLL competitions provided our team with the opportunity to spread FTC robotics and STEM interest in the community. Before these competitions, we mentored local teams, teaching them the fundamentals of engineering design and construction. In addition we gave tutorials on the basic functions of NXT programming. At the competitions, we demonstrated our robot for crowds of interested middle and elementary schoolers. Our team also helped manage the match scheduling and organization, as well as setup and clean ups at the competition. Moreover, numerous members of our team participated in judging and scoring. We were able to share our enthusiasm of robotics with the kids, and they learned a lot about competing in FLL and some of the important values of robotics, such as collaboration, persistence, and spirit. We feel our efforts during these competitions had a positive lasting impact because of the positive feedback and interest we received from both parents and competitors. But more importantly, we had fun!



Mentoring an FLL team

Location: The team members' homes and the Rockville Memorial Library
Duration: 22 meetings
September 2017 to Present

We mentored an FLL team, Taka Tech for three months on how to use the lego robotics kit and program the robot. The FLL team was started in 2016 and had little to no prior experience on how to build the robot, program and manage the team. We worked with the team for three months meeting at least twice every week, and are helping the team prepare for the competition by explaining how to speak about the engineering cycle. In addition to the technical lessons we've provided for the team, we came up with team building activities meant to help teach the team about core values. Taka Tech, now after three months of training they all have a basic engineering background, can now come up their own codes and designs using the engineering design process. At their competition in late January, we plan on cheering them on as they compete for their spot in the Maryland State Championship.

Transporting & Organizing FLL supplies

Location: Universities at Shady Grove, Rockville Civic Mansion

Duration: 1 day

January 26th, 2018

After hosting the FLL qualifiers and scrimmages , we helped the Rockville Science to transport supplies from the Universities at Shady Grove to the Rockville City Civic Mansion. We transported tables, chairs, and other supplies that we needed at the FLL qualifier. When we arrived at the mansion, we unloaded the vans and took the supplies inside. Once inside the building, we organized the materials in the basement into categories, so that in the future teams, organizations, and individuals are able to the access things more easily.

Our Biggest Platform : Social Media

What Social Media sites do we use?

Our team utilizes social media platforms like Facebook ,Twitter, Snapchat and our team website to communicate with a larger audience and expand our network in the community.

How do we use our social media?

- Through these sites we were able to advertise and raise awareness about our local fundraisers, competitions, and educational events to members of the community.
- We also use these sites to chat among the team and keep members informed at all times.
- With access to social media, we're also able to communicate with other teams and share our ideas using facebook, twitter, and even Reddit.
- Set up scrimmages with other teams

As a team we feel that it is our responsibility to help those in need, social media allows us to extend our outreach further across the continent. Together we are able to communicate faster, and more efficiency to produce results for the community, other FTC teams, and ourselves.

Our twitter page advertises our outreach events, and accomplishments throughout the year.

Our website allows alumni and members of the community to keep up with all our events.

Twitter @Post1010

- Joined April 2015
- 300 followers
- 40 Posts
- Following over 40 FTC teams
- Outreach/fundraisers advertised

Facebook @Explorer Post 1010
@ Post 1010 FTC

- Over 180 members collectively
- Over hundreds of Posts & comments
- 5 FTC group chats over Messenger
- Parents, alumni, and community involved

Team website @http://www.post1010.org/

- News & Events updated weekly
- Gives community insight into team
- Provides contact direct info for other teams
- Showcases sponsors

Gmail @ explorerpost1010@gmail.com

- 2 emails sent to members and alumni a week
- 150 Google Docs created
- Over 40 Google Spreadsheets created
- 50 Google slideshows created
- Hundreds of FTC related questions answered
- Monthly updates provided for our sponsors
- Includes pictures of competitions

Reddit & The Cru

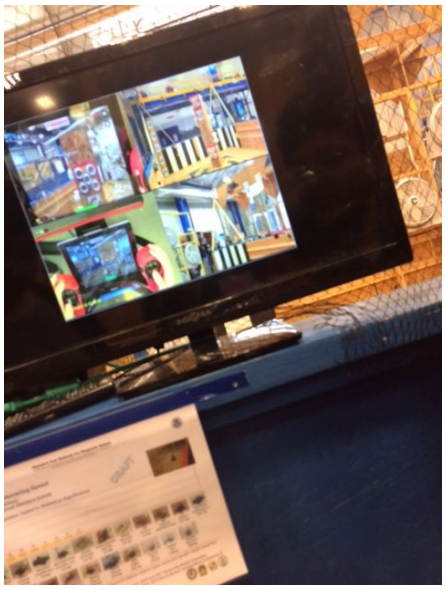
- We use Reddit forums to ask and answer questions for other FTC teams
- We also use Reddit to inform others of our progress
- Cru members enjoy sharing their competition stories and experiences with other members of the FIRST community

NIST Visit

Duration : 3 hours

Location: National Institute of Standards and Technology Gaithersburg Campus

The National Institute of Standards and Technology is the country's leading organization in setting the standards for various measurement systems, as well as in developing and testing new robots to accomplish arduous tasks facing humanity daily. The entire Post took a tour of the NIST Gaithersburg Campus, where we learned about how NIST sets the standards for everyday measurements, how NIST constructs and tests robots for use in natural disaster situations, and how NIST experiments and develops methods-- such as augmented reality-- to improve human interaction with robots and machines. Moreover, we learned about how NIST develops new and improved ways to deal with everyday issues and current disasters affecting our world. This visit was very useful for all of us because we were able to get a first-hand experience on how robotics and computer science are relevant in our rapidly changing world, and how robots have a real-life purpose and serve our society by helping us deal with human or natural disasters. We now understand the various career opportunities in robotics and computer science that are available to us once we graduate from college.



USA Science & Engineering Festival 2018

Location: Washington D.C.

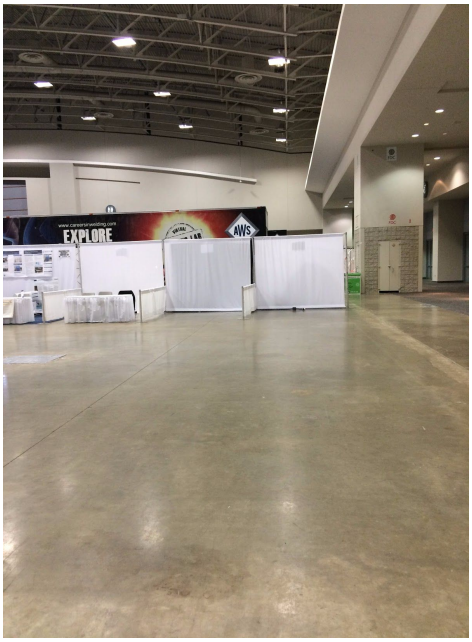
Duration of Event: 16 hours over two days

Thousands of people attended this huge event

The Explorer Post 1010 organization has been attending the event since its inception in 2010.

The Science and Engineering Festival hosted hundreds of exhibits, including our own. Our booth was located on the first floor near the stage, and the Nasa exhibit. We also had members assisting the Gaithersburg HS booth on the second floor. On both days of the event we drove our bot for hundreds of people, and allowed some of them to drive as well. The Cru set up our booth with information about FTC, Rockville Science Center, and our team as a whole. We also played our competition feed on a laptop, to give a sense of what a competition is like. Our team also brought 3D printers and drones for people to observe along with our robot. At the event, we attempted to circulate between both floors to give everyone a view of our robot. Our robot made it down the escalator safely multiple times, thanks to our skilled drivers. The Cru thoroughly enjoyed seeing other exhibits,and learning about new experiments and companies out there. We hope our audiences enjoyed the event just as much as we did. We go to this event annually and teach a multitude of kids and give them exposure to stem.

Above a picture of our event space, and demonstration for a group of people at the event.



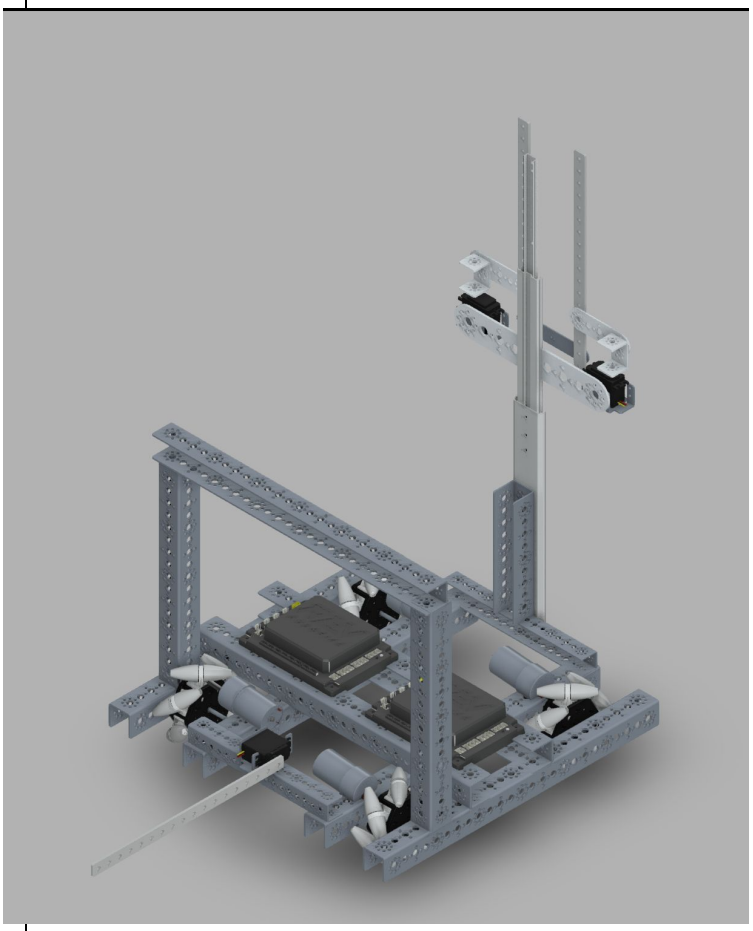
Rockville Science Day 2018

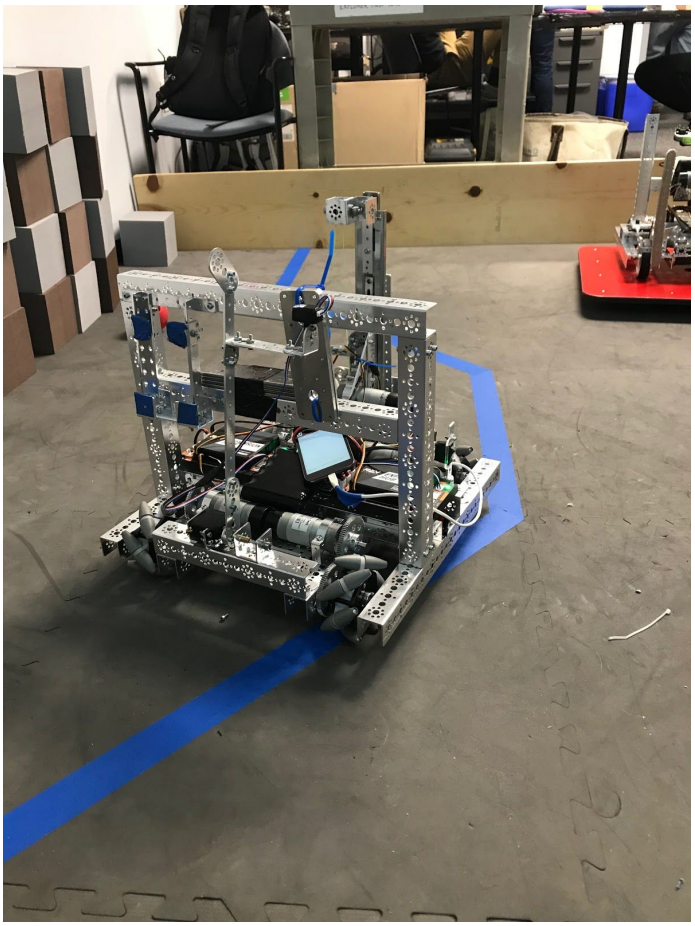
Location: Montgomery College, 51 Mannakee St, Rockville, MD 20850
Duration of Event: 5 Hours
April 22nd, 2018

The Rockville Science Day has been a tradition for our FTC team, because our involvement with Rockville Science Center. Our Cru drove our robot around the event, and raised awareness for robotics in the community. We met with a lot of kids and parents in the community, explained the functions of our robot, and how what we've learned can be applied later in the future. The Cru also set mini courses for people to try to get through with our robot. In addition, we decided to set up logo stations for the kids to experiment and play with NXT kits. We enjoyed watching the kids and their parents have fun with the different types of robots we brought to the event. Overall, the team had a lot of fun with entertaining the attendees, and connecting with kids at the event. This year was the biggest Science Day to date, and was largely successful because of the efforts of our mentor Bob Ekman.

Engineering Section

Master Engineering Plan for the 2017 -2018 FIRST Tech Challenge





Objective: Before the season began we decided to outline our approach to this season's game to ensure that we would be successful in our competitions and in giving every member a chance to learn about the steps involved in the engineering design process. Below is our plan and how each part of our plan correlates to the steps of the design process.

Step 1: Identifying the Problem (In this Case the Cru's Challenge)

- ➢ Viewing and interacting with the Relic Recovery game
  - We plan on sending one team captain to the FTC Kickoff to get a hands on experience with the game elements, and having the rest of the team watch the game on youtube together on the same day.
  - Following the game reveal, we plan on deciding which parts of the game we would like to address and take on as our challenge.
  - We have decided to address our challenge in parts, so we do not overwhelm ourselves at the start.

Step 2: Background Research

- ➢ Our Research Process
  - Research will occur both individually and as team to maximize our results.
  - We plan on looking to past FIRST Games and how our alumni has tackled those problems to see if it will helps us advance our designs.
  - Researching the tools and designs used by real world professionals will also serve as a developmental stimulant for us.
    - Research Sources include: NASA, DoD, SpaceX, Etc.

Step 3: Identify Our Constraints

- ➢ Reading the Rules
  - We will read the rules and check the sizing constraints along with any other new changes which may cause our design considerations to change.
  - In addition, we will review new parts available for this competition, such as the Rev Robotics electronics kit.

Step 4: Brainstorm, Evaluate, and Choose Solutions/Ideas to Pursue

- ➢ Our Brainstorming Process
  - As a group we've decided to brainstorm our ideas and look at which ones will be the most feasible to develop .
  - If we have issues with ideas we will work together to see how they can be modified or merged to be successful.
- ➢ CADing Our Designs

- This year we've chosen to use Autodesk 360 as our platform for computerized designs.
- We want to CAD all of our designs our so that we have a framework for prototyping, and construction.

➢ Evaluating and Choosing Solutions

- We will evaluate designs based on complexity and whether we have the means to pursue the ideas intiall.
- We would like to explore as many possibilities as possible.

Step 5: Develop & Prototype Solutions

➢ Prototyping Process

- We decided that season we will be building and prototyping on two seperate robots that way when can try and test new ideas on one, while building on another.
- We have decided that if our idea is rather complex (based on the CAD) , we prototype in legos then in metal.
- Following the construction of a prototype we will conduct extensive testing.

Step 6: Test Solutions

➢ Different Testing strategies

- By hand Testing: If a design is rather difficult to integrate into the system, we will simulate the power of servos and motors by using our hands
- Direct Battery Connection: IF it is safe to provide power to a motor,we test the functionality of it using quick bursts of power which may clarify whether it is weak points in a design
- Full integration: Usually after conducting the previous two tests, we may end up deciding to implement the design on one of the two robots to give an opportunity to see how the design works with the other aspects of our robot plan.
- Usability Tests: At outreach, we let others drive and use our robots along with our prototypes. Based on feedback and the difficulty individuals have with our robot we decide that a solution may need a modification.

Step 7: Discerning whether a “solution” is actually a solution or a problem

- ➢ Decision + Payoff Matrices
  - We will evaluate our designs based on the complexity, effectiveness, accuracy , precision, and cost of implementation
  - Based off our testing results we make our decision to improve a design or discontinue it to focus on another solution.

Step 8:Communicating Our Results

- ➢ Engineering Notebook
  - While the notebook will be written at the same time as our development, we believe that a successful notebook communicates both the full pathway to a solution and the solution itself.
- ➢ Business Meetings
  - In these important meetings with our mentors and team we discuss ways to improve ourselves and designs to continue our success in the engineering process.
- ➢ Outreach
  - Communicating our results with our outside community during events or open houses allows us to gauge public opinion and gives an opportunity to simultaneously spread the spirit of FIRST.

Meeting #1

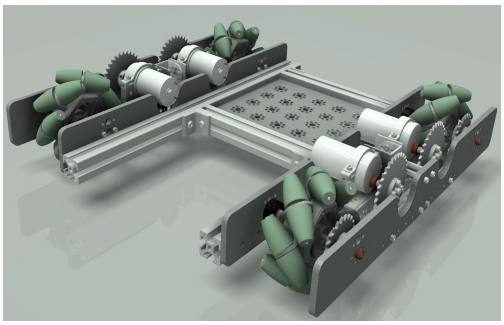
September 13th , 2017
Attendance : Austin, Ragini, Thomas, Ben, Gunvir, Connor
Duration of meeting :6-9 PM
Goals: Explore possibilities of game and design

Task: Research & Brainstorm Session	Robot Design Considerations
Decide Scoring Goals Strategy after Rewatching Game video	1. **Autonomous** a. Balance robot b. Read cipher c. Place one glyph in correct column 2. **Driver Period** a. Glyphs in Cryptobox (filled box with pattern) b. Score Relic in third section of the scoring zone
Drivetrain Ideas	Objectives of train: High mobility ● Turn efficiently ● Balance ● Power Possible options: 1. Using two omni wheel sets and a regular wheel on each side, geared accordingly and supported by metal panels 2. Use four wheel drive and all stealth wheels or all mecanum
Formulate plan for lifting and placing Glyphs	We decided that a **robotic arm** would most likely be the best method of picking up and placing the Glyphs and relics. Points of Consideration for Robotic Arm: 1. Rotating or only front facing 2. Motor allocation and integration 3. Reliability Vs Complexity However, as a team are also coming up with alternative options in case we are not able to successfully implement the arm.

Wheel and Base Design Ideas Continuation From Research

1) This is one possible base/wheel setup idea that has interested us so far. We want to try to create support for our axles like this model does. We will most likely accomplish this using aluminium on the sides of our wheels that will also act as a wheel guard.
2) The mecanum wheels or stealth wheels we want to use will help us turn more effectively than omni wheels we have used in the past .
3) Gearing : We are not sure about the gear ratio at the moment, but we will test different combinations after finalizing the design. We still need to consider the amount of power and speed we need for our robot.
4) Four wheel Drive : We are interested in the increased speed and power four wheel drive would give us. In addition, it would lessen the strain on each motor.

Figure 1.1: A picture of a possible design we could use (not necessarily with the same wheels)



Brainstorm Progress for Robotic Arm

Figure 1.2 :A possible design for our robotic arm
That the team came up with together on the whiteboard

1) We think we would like the arm in the center with multiple stages that can provide us the height and maneuverability to place it.
2) We are considering using some sort of claw or grasper that we can use to grab and hold objects

Team Pictures From Brainstorm Session (Photos Taken By Ragini)

Successes and Setbacks: • We were successful in collaborating, researching, designs from past FRC and FTC games	**Reflections:** • We need to spend more time considering options • While, we may start prototyping next meeting, as a team are going to continue research and brainstorming
Recorded by : Ragini Balachandran	Reviewed by Austin Long

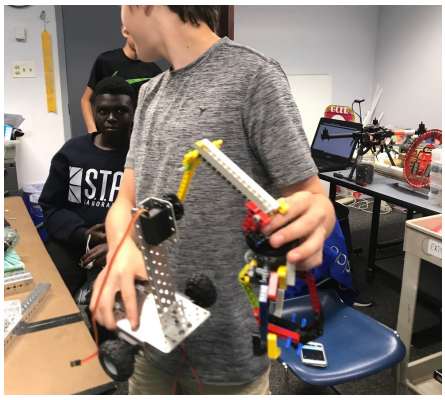
Meeting #2

Date: September 16th, 2017
Attendance: Ragini, Ben, Gunvir, Sebastian, Thomas, Rohit, Connor, Austin
Duration : 11am-2pm
Goals: Further design brainstorming/prototyping engineering process, and compile orders list

IN PROGRESS: Robot Arm And Chassis Design

Tasks	Design Considerations and Results
Start prototyping the Robotic arm	Before constructing the arm on a larger scale, we decided wanted to prototype an arm using Legos and small servos. We felt that the arm was reliable, and could be help us place objects precisely to execute patterns.
Experiment with grabbing designs for the arm	Along with the normal claw design (reference **figure 2.1**), we decided to come up with another way to secure the cube just in case the claw may not be possible to construct out of metal. **The Scissor Grabber:** The design we came up with is two metal bars crossed over each other and attached. When a cube is in between the bars' opening, pressure can be applied from the other side to press the bars against the cube (glyph) and keep it in place with a friction fit.
Start Chassis construction	1. As a team, we began to construct our chassis using the remaining parts from last season. We decided on four wheel drive. 2. After quickly building our chassis, we began to CAD it so that we will be able to how components of our design may come together virtually. 3. This season our team has enough resources to construct two chassis for testing and building purposes.
Take inventory and prepare order	During the meeting, we decided to take note of some purchases we may want to make this year. 1. New electronic systems 2. Neverest Orbital 20 motors 3. Mecanum Wheels

Figures 2.1 and 2.2 : Robot Arm Leggo Prototype and Scissor Grabber Prototype



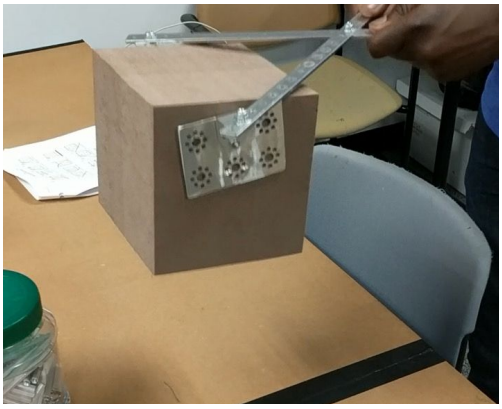
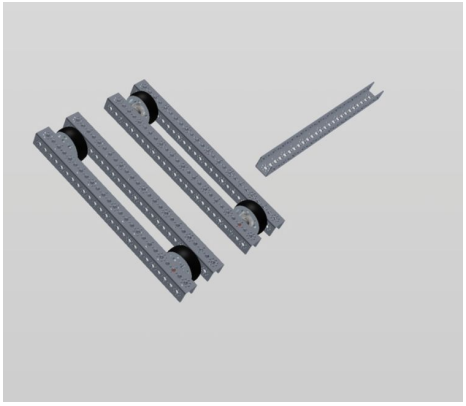
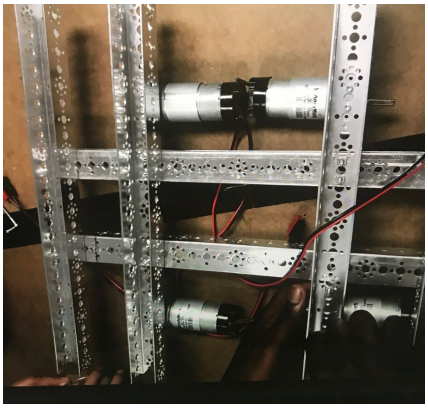
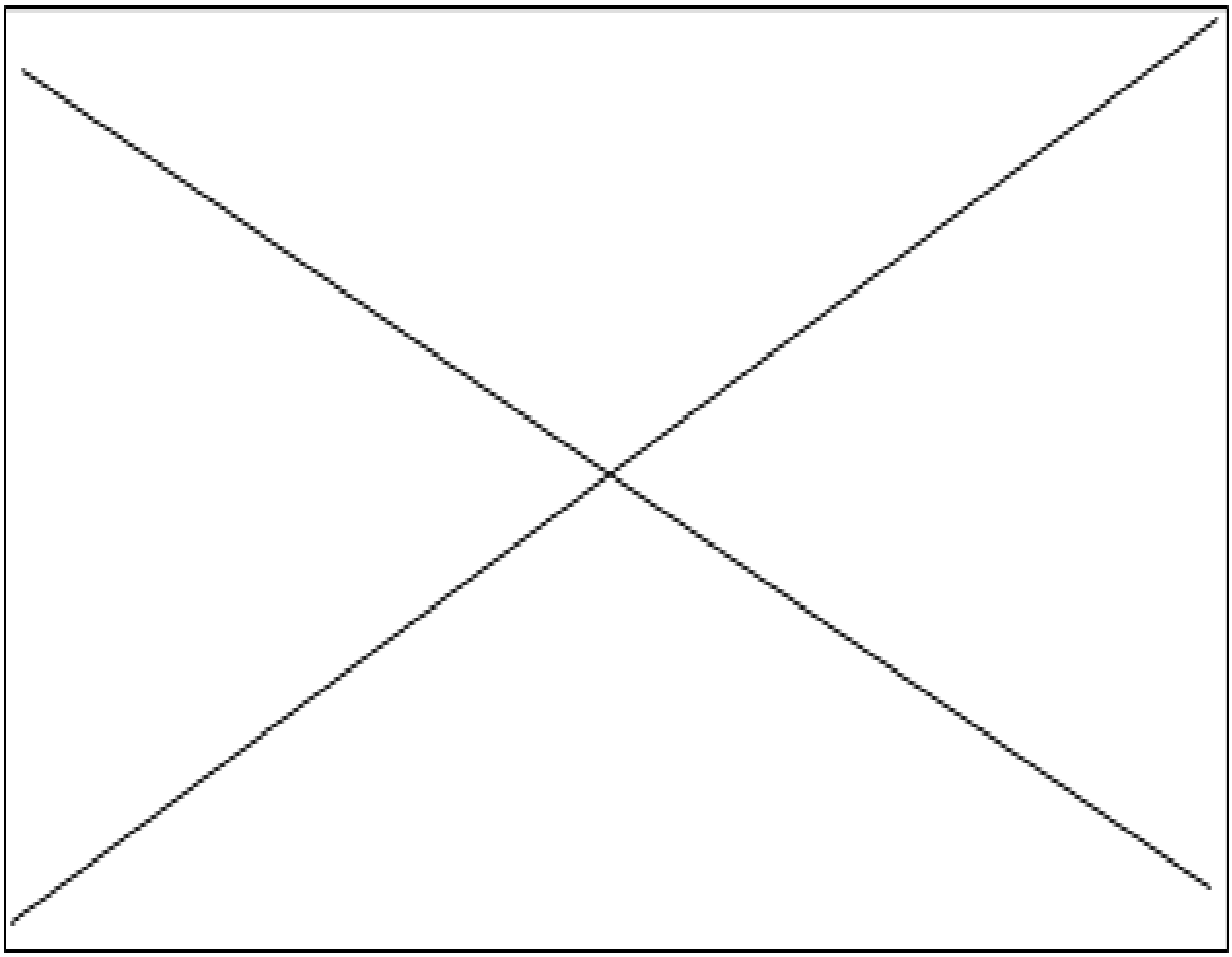


Figure 2.3 and 2.4 :Chassis Pictures (CAD and Build)





Successes and Setbacks: • We were successful in collaborating, researching, designs from past FRC and FTC games	**Reflections:** • We need to spend more time considering options • While, we may start prototyping next meeting, as a team are going to continue research and brainstorming
Recorded by : Gunvir Labana	Reviewed by Austin Long



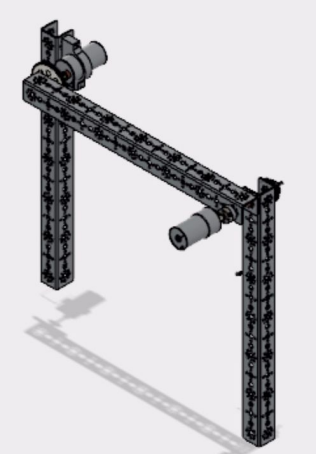
Meeting #3

Date: September 19th , 2017
Attendance : Ragini, Ben, Sebastian, Thomas, Gunvir, Connor, Rohit
Duration : 6-9PM
Goals: Begin Field Set Up, Consolidate construction plans with CAD

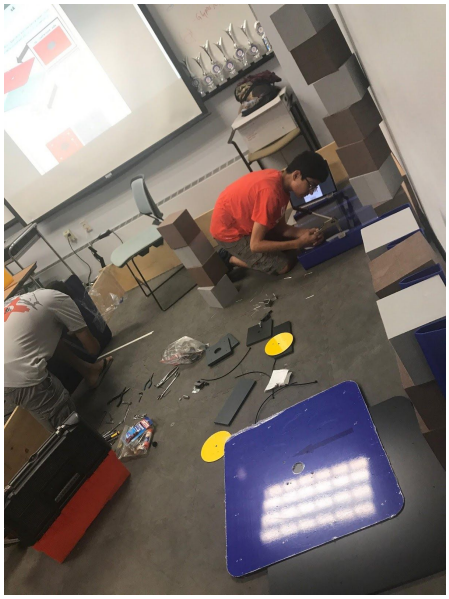
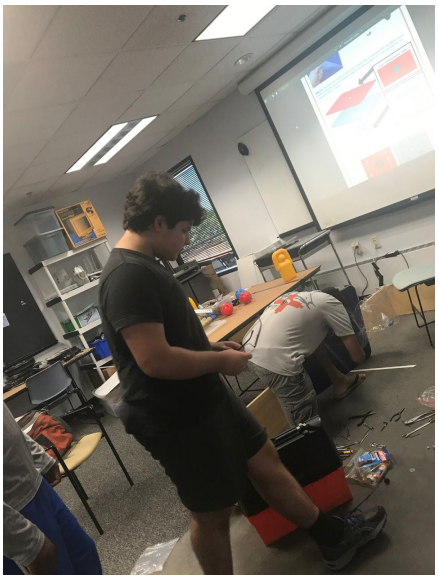
IN PROGRESS: Robotic Arm for Glyphs and Field Construction

Tasks	Design Considerations and Results
Field Construction	Our field kit arrived today, and the team decided to split up into small subgroups in order to assemble the field in one meeting. It was imperative for us to finish our field to begin our autonomous and driver controlled period testing. The field also provides us with more perspective on how parts should be constructed in order to complete tasks.
CAD for Robotic Arm	We decided to come up with a preliminary CAD design for the robotic arm, to provide some perspective for the following meeting's prototyping session. In past years we have built, without Cadding our designs out which caused us to encounter many unforeseen problems with construction and structural design.

Figures 3.1 : CAD design for preliminary arm design



1) The Robotic Arm was designed with multiple stages in order to stay within the height restraints and be able to reach to top portion of the cryptobox.
2) It is powered by two motors that allow each of the two additional stages to extend upward.
3) At the base of the 3rd stage (the rightmost vertical piece shown) there will be some sort of claw attached to get the glyphs and place them in the cryptobox.

Figure 3.2 and 3.3: Field Construction
 

Completed: Field Construction and Prototype CAD

Successes and Setbacks: • We were able to successfully design a robotic arm using Autodesk 360 • We were able to finish the field	**Reflections:** • In the future we may need to add or fix elements on the field • We feel it was good for us to CAD our designs out for us to build.
Recorded by : Ragini Balachandran	Reviewed by : Priya

Meeting #4

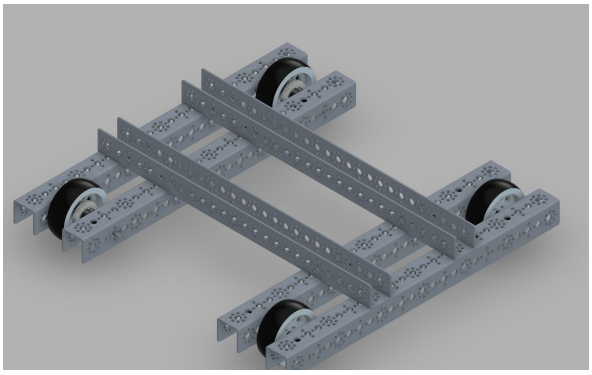
Date : September 23th , 2017
Attendance : Ragini, Gunvir, Thomas, Bhavesh, Connor, Sebastian, Rohit, Ben, Zac, Adam, Daniel, Vinamr, Austin
Duration: 10 am - 2pm
Goals: Further design brainstorming/prototyping engineering process

IN PROGRESS: Robot Arm And Chassis Design

Tasks	Design Considerations and Results
Work on Claw/ Robot Arm	1) The new constructed prototype of the robotic arm is made of of metal. The arm consists of three metal sections, two that can extend outwards, and two motors. 2) The second claw prototype utilizes a gear box like system too open and close two metal bars around the glyphs.
Make More Balancing Stones for Field	A third balancing stone was constructed similar in fashion to the other two made. The third balancing stone will be rooted onto the field., and was added to the field to aid our autonomous programming later on in the season.
Start the assembly of our second chassis for robot.	1) As a team we worked further on the construction of the second chassis. We decided after finishing the first drivetrain we wanted to test a different gear ratio, motors, and wheels on a second chassis 2) Some of the chassis dimensions had to be adjusted in order to account for differences in four motors and wiring. 3) We plan for the chassis to be almost a duplicate of the first with some changes in parts such as different wheels (mecanum). However, this second chassis will give us the opportunity to test and practice more.

Figures 4.1 and 4.2: Robot Arm and Claw Pictures

Figures 4.3 and 4.4: Chassis Pictures (Full CAD and Fully wired First chassis)



Completed: Drivetrain cad and basic drive train construction and wiring

Successes and Setbacks:	**Reflections:**
• Successful construction of a robot arm. • Worked on a CAD design for robot • Added motors to second robot chassis	• We need to consider better organization of materials, perhaps by size, since we had trouble finding appropriate gears and screws.
Recorded By: Bhavesh Kemburu	Reviewed by: Vinamr

Meeting #5

Date : September
Attendance : Ragini, Gunvir, Thomas, Bhavesh, Connor, Sebastian, Rohit, Ben, Zac, Adam, Daniel, Vinamr, Austin
Duration: 10 am - 2pm
Goals: Further design brainstorming/prototyping engineering process

IN PROGRESS: Redesign of the glyph retrieval systems and the construction of the second train

Tasks	Design Considerations and Results
Redesign of the glyph retrieval system	After thoughtful consideration about the ability of the glyph retrieval arm, we decided to abandon the design, and began to contemplate possible redesigns. Possible plans include a slider system, placed at anterior of the robot. Attached to the sliders would be grabbers controlled by servo motors, grasping the sides of the glyph. This will allow us to stack glyphs on top of each other and successfully execute the pattern.
Continue the construction of the second drivetrain	We continued the construction of the second drive train, which we intended to use to prototype different attachments for the robot. The additional gears were mounted on the drive train, and the plates for the electronics were installed.
Finish the construction of the jewel knocker	The jewel knocker, composed of a servo and metal attachment, was made in order to knock the jewel off on the field. In order to improve the success of knocker, it was positioned directly in the front-middle of the robot. This would make it easier to knock off jewels, because it would allow the robot to spin fewer degrees to achieve its goals, making it more productive.

Figure 5. 1 and Figure 5.2 (Old claw system; New claw system)

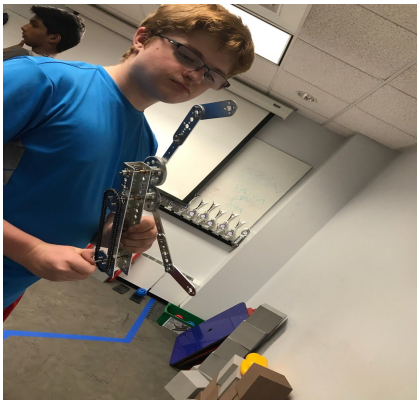
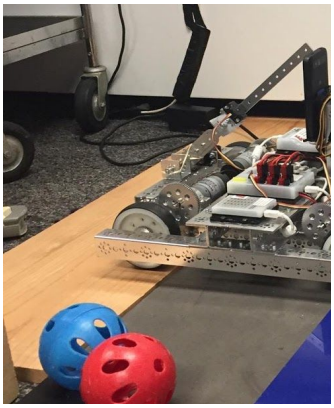
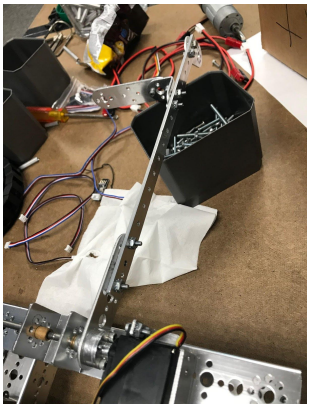



Figure 5.3 : Jewel Knocker

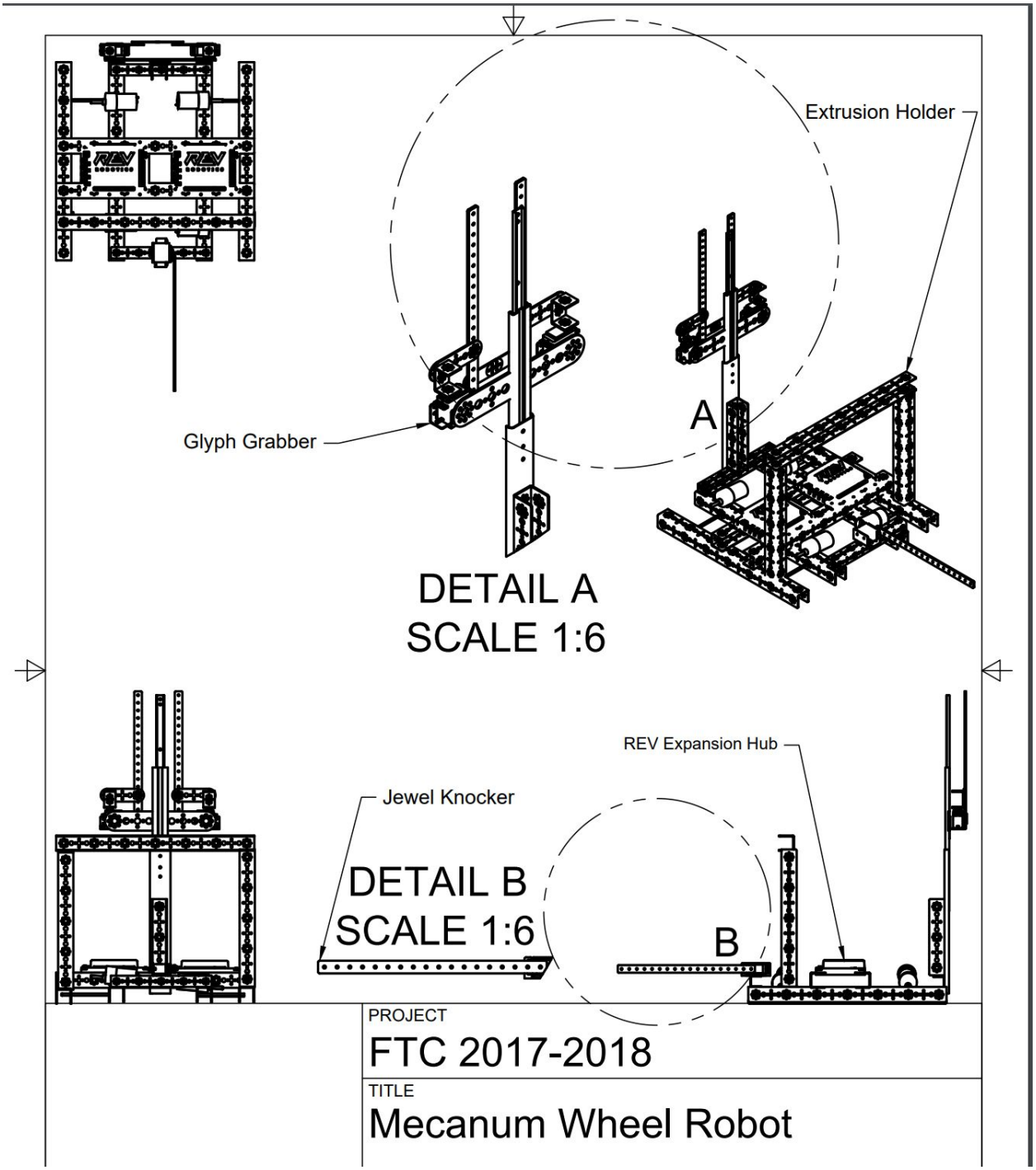



Completed: Jewel Knocker

Successes and Setbacks:	**Reflections:**
• The Jewel Knocker has been successfully modified and constructed • We were successful in collaborating and brainstorming new plans for the glyph retrieval system	• We may have to add additional sensors on the robot in order to knock off the correct color jewel. • More testing is needed for the jewel knocker so we can find possible problems sooner
Recorded By: Thomas Ajala	Reviewed by : Gunvir Lubana

FINALIZED TEAM DESIGN DRAWINGS + PLANS ESTABLISHED IN CAD MEETING (6) FOR OUR SECOND ROBOT

Our plans from the second robot came from our prototypes on our first robot, and what we as a team found successful.



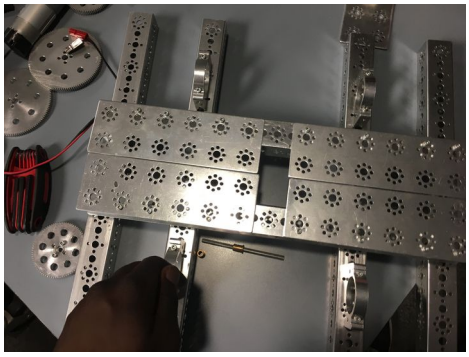
Meeting #7

Date : September 27th, 2017
Attendance : Ragini, Thomas, Connor, Rohit, Ben, Zac, Daniel, Vinamr,
Duration: 6 pm - 9pm
Goals: Further prototyping engineering process/design development

IN PROGRESS: Second drive train, Grabber for Glyphs,

Tasks	Design Considerations and Results
Attach grabber for glyphs and create lift system	We want to attach our grabber arm prototype to the robot in such a way such as to both fulfill our needs and keep it within the space limitations. We also plan to utilize a lifting system in order to raise the arm up and down. This is to allow us to control two cubes at once and complete the glyph more efficiently.
Continue Second Drive Train	The second drive train will have similar specs as the first one, except the wheels will be changed for mecha wheels. Moreover, we will use this train for testing our other cube collection system.
Design and prototyping of the Mini Relic Delivery Bot (MRDB) idea for Relic recovery and depositing.	The MRDB is our prototype system to drop off the relic in the 40 point zone. It will be connected to the robot via long cables, and will consist of a chassis and two wheels attached to motors. Our goal is to develop a bot and have it hold the relic and deliver it.

Figures 7.1 : Creation of Second Drivetrain /Chassis



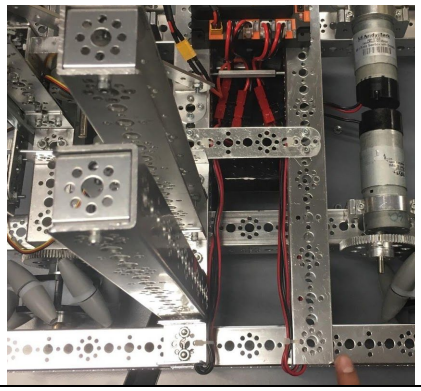
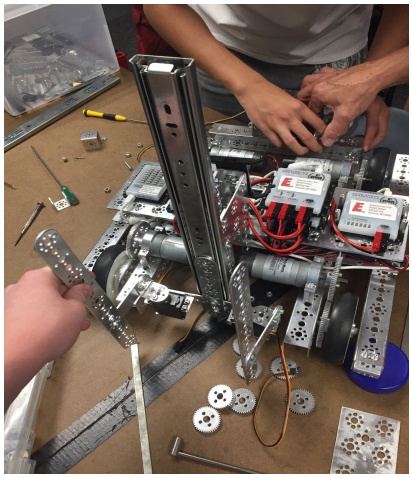
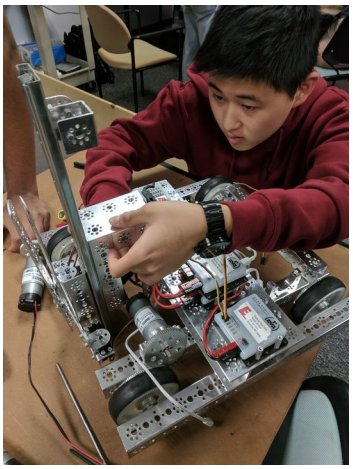


Figure 7.2 and 7.3 : Mounting of Glyph Grabber and deposit system
  • Here, Daniel is attaching the motor for our block grabbing system. • This motor is being attached for our proposed lifting mechanism in order to successfully complete a glyph pattern at the higher levels of the cryptobox.

Completed: Mounting of Glyph Grabber System

Successes and Setbacks:	**Reflections:**
1. We were able to attach our prototype arm on a slider system on the front of our robot. We were also able to make preparations to program this next meeting.	This was a productive work period for our team, as we were able to get our arm idea off the ground. In addition, we have made significant progress on the second drive train, and we hope to allot time for testing purposes. Finally, our MRDS bot idea is being developed, and we hope to innovate this year's challenge with this implementation.
Recorded by : Rohit Harapanahalli	Reviewed by: Zac Bilyue

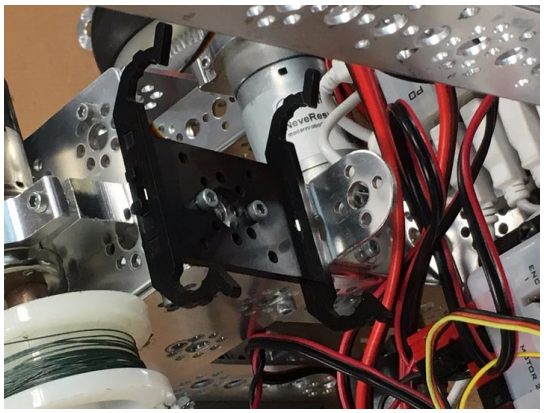
Meeting #8

Date : September 30, 2017
Attendance : Ragini, Gunvir, Thomas, Bhavesh, Connor, Sebastian, Rohit, Ben, Priya, Zac, Adam, Daniel, Vinamr, Austin
Duration: 10 am - 2pm
Goal: Further design development stage of engineering process

IN PROGRESS: 2nd drive train

Tasks	Design Considerations and Results
2nd drivetrain	We wanted the drivetrain to have the ability to swap for mecanum wheels. Also, we want this robot for testing and revising, so that our main robot can be function at its highest potential. We are in the process of building the second drive train with mecanum wheels. We will also use this drivetrain to test other grabbing systems.
Grabber system	We wanted to make improvements to the grabber arm. In addition, we attached it to a pulley system so that it had the ability to go up and down. We did this by stringing the system so that it can move when powered by a motor.
Prevent jewel knocker from hitting phone	We wanted to make sure the jewel knocker does not hit the phone without restricting its movement too much. We attached a channel vertically to prevent it. It should not be too big or long, or it might take up too much space, but we are considering building on top of it.

Figures 8.1 and 8.2: Phone Mount

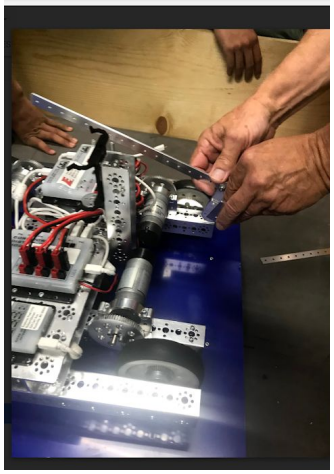


The phone mount was moved upward over the electronics. There were many additional benefits to moving the mount upwards these include:

A. Easier access for getting and placing phone on the robot. This will prove especially useful to use during the competition season

B. The height will allow us to utilize Vuforia if we would like to decode the pictures on the sides of the FTC Feild

Figure 8.3 : Jewel Knocker Explained



The Jewel Knocker is now positioned slightly off to one side of the robot so that nothing hits the new phone mount . However, the reason why the picture shows the system on the balancing stone is because while we were testing we wanted to ensure the knocker was placed in the middle of the two jewels. When we added a color sensor we wanted to ensure that we were able to properly detect the color of the ball we wanted to hit or keep on the platform. Moreover, keeping the jewel knocker in this placement will enable us to accurately determine the amount of force we should apply in particular direction in order to able successfully complete the task every time.

Successes and Setbacks:	**Reflections:**
We successfully made the pulley system for the grabber, we also completed the phone protection system.	Today was a successful work session, We made the pulley system of the grabber, we also completed the phone protection device.
Recorded By: Vinamr Pemmaraju	Reviewed by : Zachary Bilyeu

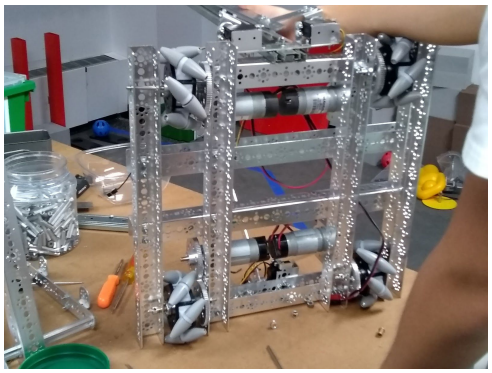
Meeting #9

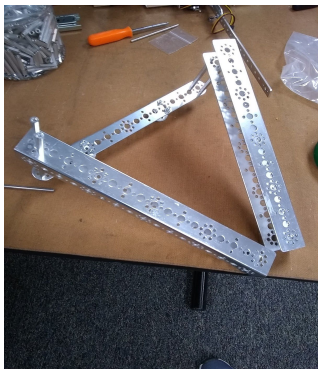
Date : October 7th
Attendance : Thomas, Austin, Bhavesh, Daniel, Zac, Connor, Priya
Duration: 10 am - 2 pm
Goals: Further design brainstorming/prototyping engineering process

IN PROGRESS: 2nd Drive Train

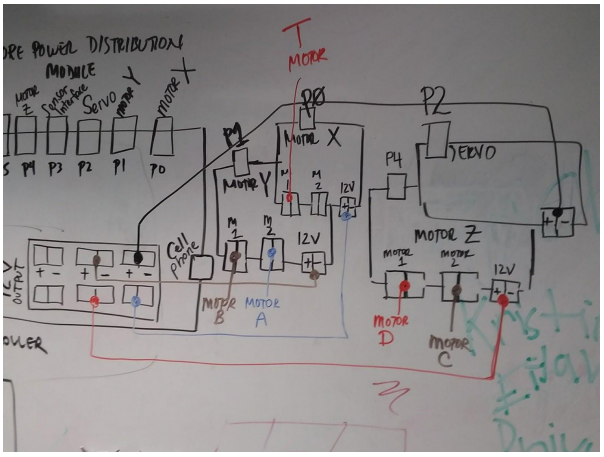
Tasks	Design Considerations and Results
Experiment and prototype a grabber system for the relic capture	We continued our design process with two different grabber systems, but ran into several problems. One design involved six corners and a set of gears and axles, but did not have enough space for the motors. Another design consisted of two large arms operated by servos, but it can not grip the relic tightly without the relic falling over, which would reduce the yield of points. We ultimately want a grabber arm that has enough space for a motor and can grip the relic tightly enough. The main arm was also attached.
Attach mecanum wheels	We received the mecanum wheels that we ordered and worked on attaching them to our robot. We had difficulty in figuring out which direction to attach the mecanum wheels, since the design was hard to interpret. We considered having the gears on the inside of the robot chassis, but we encountered difficulties and are still unsure of how the wheels will move.
Programming of First Robot	We worked on coding the first robot's electronics, specifically to check the orientation of the wheels(direction that the wheels are turning). Programing Priorities ● Jewel Knocker Code ○ Important for testing and improving design quality ○ This will determine autonomous strategy ● Drive ○ Four wheel vs Tank Drive ○ Help us determine drive team strategy at competition and allow us to begin practicing

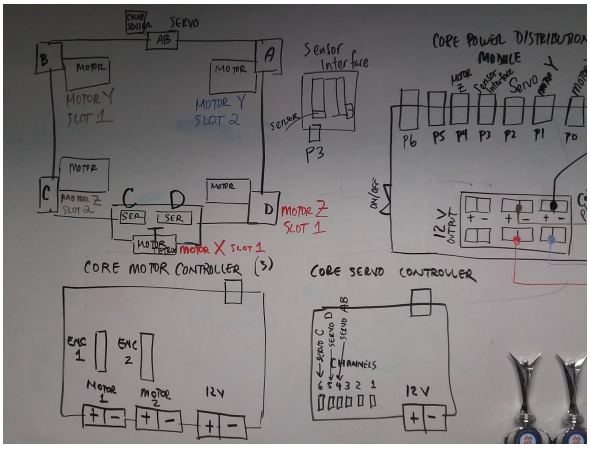
Figure 9.1 & 9.2: The mecanum wheels and one possible relic grabber prototype .





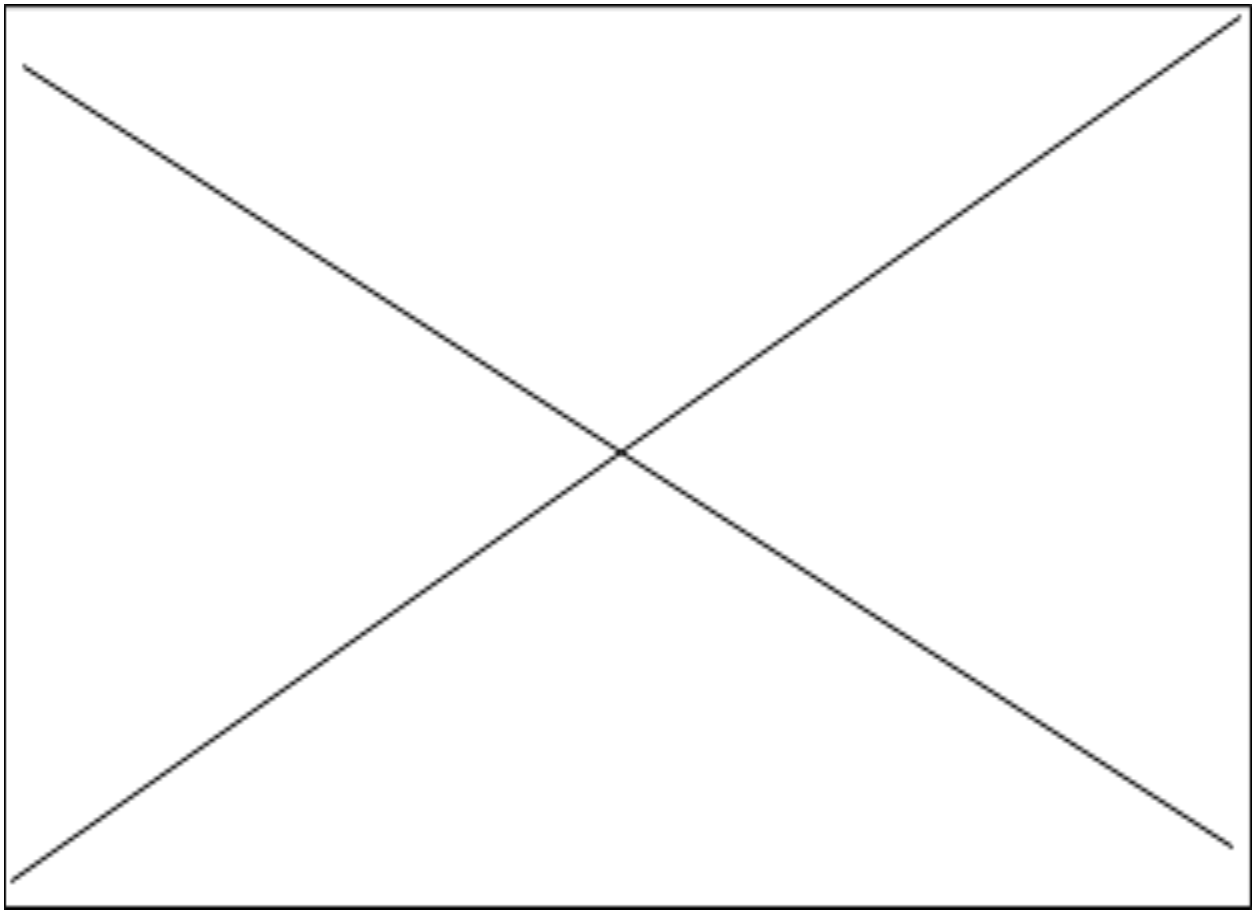
Figures 9.3-9.5: The wiring diagrams created by team member





Successes and Setbacks:	**Reflections:**
1. We were able to set up the mecanum wheels and add most of them to the robot. But, we had an issue with the last mecanum wheel. 2. We had two design proposals for the grabber arm for relic. However, each design has its own setbacks, such as	This meeting was definitely productive, as we created two prototype designs for the relic arm. We were also able to work on attaching our mecanum wheels. In future meetings, we could organize roles better and have even contributions for each part of the project.

not enough space for a motor as well as loose grip. 3. We created a draft of the wiring diagram for one of the robots. Following the wires was a challenge at times, but well worth documenting in case any changes or repairs need to be made.	The wiring looked very thoughtful. Most wires were out of the way of danger. There were a few wires that might need to be covered. Perhaps we can agree to naming identifying each module/component by a serial number printed on the module/component so that we know what the connections were made even is the robots is taken apart
Recorded By: Bhavesh Kemburu	Reviewed by : Connor Gregory



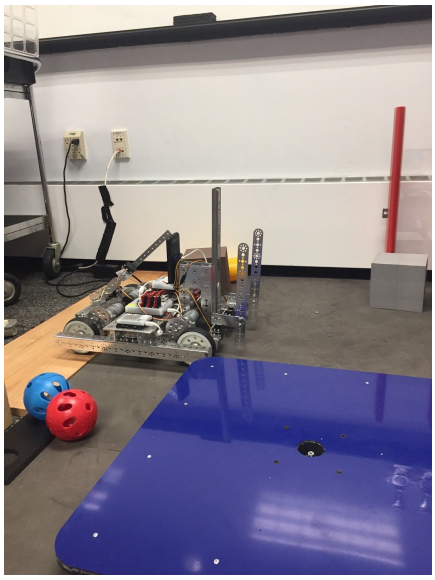
Meeting #10

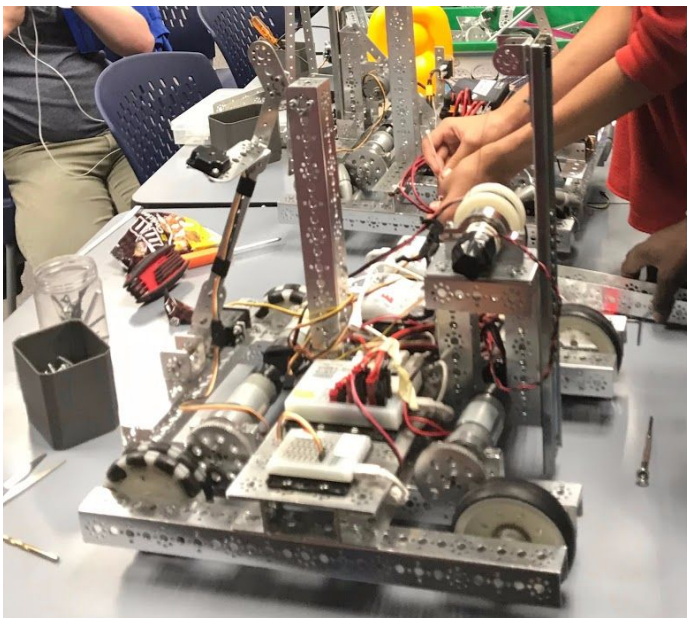
Date : October 14th
Attendance : Rohit, Ragini, Zac, Thomas, Priya, Connor
Duration: 9 am - 1 pm
Goals: Replace wheels on one chassis and continue developing second chassis

IN PROGRESS: Battery Mount, First Drivetrain Modifications

Tasks	Design Considerations and Results
Replace back wheels on first drive train with omni wheels.	While conducting a driving test last meeting,we noticed that while the robot is able to drive forwards and backwards efficiently, turning left and right proved to be a challenge due to the limitations of our wheel choice. Therefore, we decided to replace the back wheels with omnic wheels, which are suited for turning.
Add servo blocks.	During our testing session for the block grabber, the servos moved around constantly, reducing efficiency and increasing likelihood for error. Therefore, we decided to replace the servos with servo blocks, which would keep the servos stationary.
Construct the battery mount on our second drive train.	Continuing our construction of the second drivetrain, we have to build a battery mount in order to contain the battery. The reason for this is two-fold: 1. Keeping the battery secure will make the robot look better aesthetically while running it. 2. Securing the battery will prevent it from moving around during testing, and will eliminate the chance of disconnection.

Figure 10.1 and 10.2: **Before and After** System with new Omni wheels on the back with stabilized servo positioning





Performance Test Results following the addition of Omni Wheels
Problem with **Before** Replacement was that turning and speed was inhibited by the back wheels **After** we are now able to turn faster and easier, and get to the scoring objects in a much more efficient manner. This change, while it may seem minor, will have a major impact on our ability to compete with and against the best teams.

Completed: Battery Mount for second Drive train and Replacement of old wheels on first drive train for omni wheels

Successes and Setbacks:	**Reflections:**
We were successful in our testing of our new drive wheels, however we need to refine our wiring more. Another setback we encountered was the mounting of the battery holder, we were concerned it was not accessible enough but we were able to reposition it to have access.	As a team we need to pay more attention to the relic retrieval, and stay on task more during meetings to increase our efficiency and our progress before our upcoming competitions.
Recorded By: Rohit Harapanahalli	Reviewed by : Bhavesh Kemburu

Meeting #11

Date : October 18th,2017
Attendance : Thomas, Austin, Bhavesh, Daniel, Zac, Connor, Vinamr, Gunvir, Ben, Ragini
Duration: 6 pm - 9 pm
Goals: Further design brainstorming/prototyping engineering process

IN PROGRESS: Grabber Arm for Relic

Tasks	Design Considerations and Results
Make grabber prototypes for the relic and attach it to the Robot	Created prototype grabber arm consisting of two foam wheels attached to a shoulder system. This design was proposed in order to grab the relic by the body. We still have consider the following things : 1. Weight and size of grabber 2. Claw system or another type 3. Wiring and usage of servos 4. Angle of the system when it is mounted
Built slider system for second chassis to extend the relic arm	To extend the arm a further distance, we built a second slider system consisting of six sections, five expandable. We plan on possibly mounting the system on top of the robot of metal support columns. This will allow us to go extend over a wall and the reach the highest level.

Figure 11.1: and 11.2 Grabber prototypes for the relic

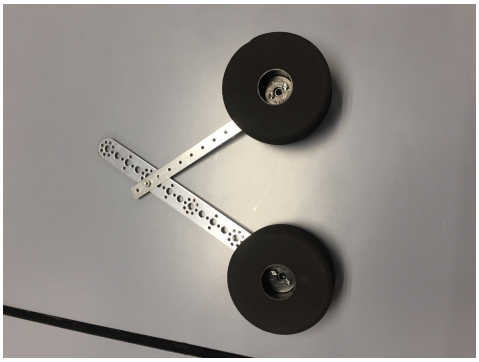


Figure 11.3 and 11.4 : Extrusions

We decided that using extrusions may help us to reach the outer levels on scoring in the relic depositing. The points would help us do well in competition. Extrusions also provide the following benefits:

1. They are light in comparison to other extension systems
2. We will be able to utilize our stringing knowledge about pulleys to get the system functioning
3. Extrusions can be mounted in a number of positions on our robot and we would be able to easily attach something to them in order to grab the relic.
4. We have the parts necessary for the system

In years past, we have utilized the extrusions to accomplish tasks and we feel our former experience may be of advantage in construction and maintenance.

Successes and Setbacks: 1. Were able to design a prototype arm system with foam "hands" that can grip the relic easily, as well as a slider system for the extension of the arm.	**Reflections:** At this time, we are still unsure of where and how to attach the arm system to the actual robot so that it fits within the size guidelines. The telescoping arm has the advantage of lifting an object really high, while occupying less space on the robot.
Recorded By: Ragini Balachandran	Reviewed by : Bhavesh Kemburu

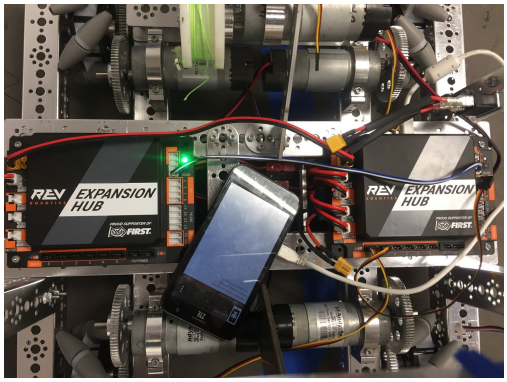
Meeting #12

Date : October 21st
Attendance : Thomas, Bhavesh, Daniel, Zac, Connor, Vinamr, Gunvir, Ben, Chase
Duration: 10- 2pm
Goals: Come up Cohesive design

IN PROGRESS: Grabber Arm for Relic

Tasks	Design Considerations and Results
Continue working on grabber arm for relic	We are advancing developments on the grabber arm to grab the relic. It will extend out from the top of the robot and drop the relic. We have to make sure that it doesn't cross the 18 inch box limit.
Add Rev system to robot	We began to attach the REV hub the robot and wired it up. Hopefully, this new system will be able to handle more, and we can add more motors. The robot should be able to do more tasks. The REV system also has more resistance against static, than our previous electronic system.
Practice Driving	We test drove the robot to see if there is anything we need to fix right off the bat. We found some problems with the robot. For example, some wheels were moving smoother than others. We had to fix it so that all the wheels moved evenly. Fixes like this should make the robot function better.

Figure 12.1 and Figure 12.2 : Rev Wiring



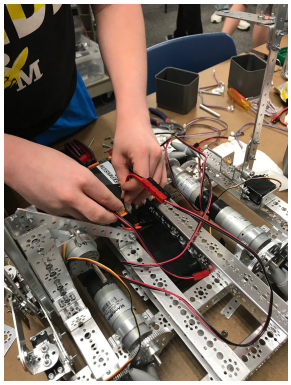
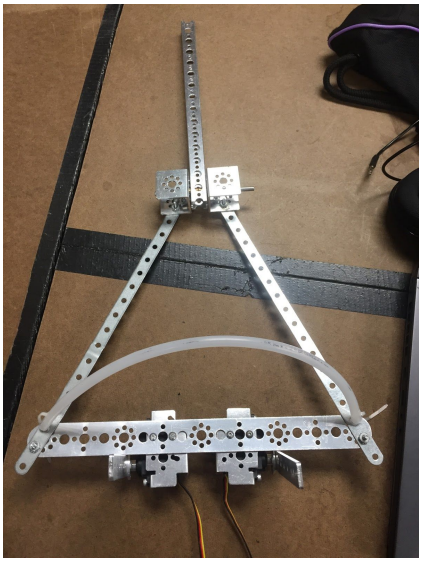
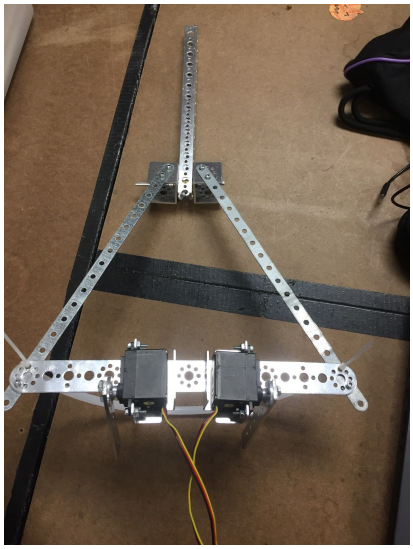


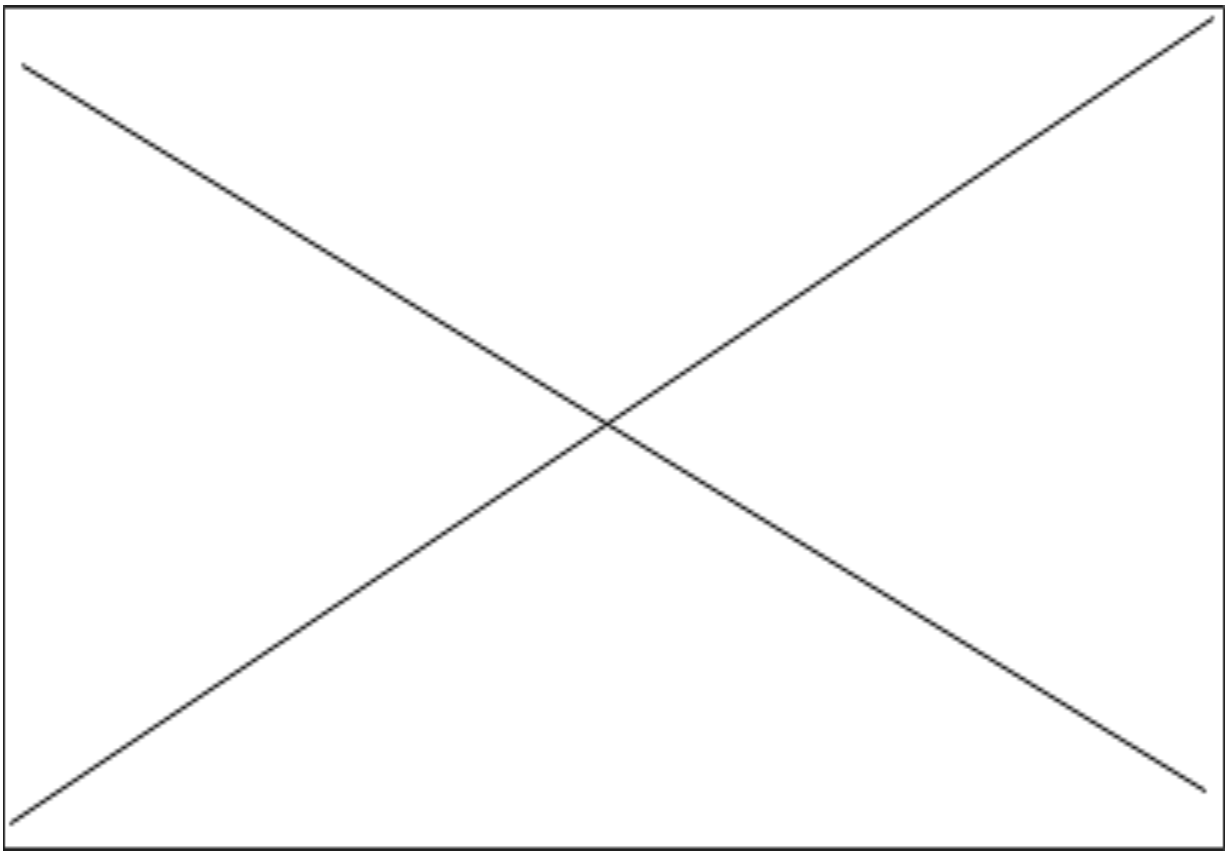
Figure 12.3 and 12.4: Front and back of the new Relic Grabber prototype





MINIBOT IDEA WAS STOPPED. THE IDEA WAS NOT FEASIBLE AND IS NOT ALLOWED UNDER FIRST RULES

Successes and Setbacks: Success: We successfully added the REV robotics system to the robot. This will allow for more tasks to be accomplished **Setback:** All of our Relic grabber ideas are not feasible, we haven't advanced very much in that area	**Reflections:** Our progress has been fairly good so far, and we have been making some small advancements. However, we have not addressed some big things that need to be done. We need to refocus our attention on refining the systems we have and adding a relic grabber and depositor on our robot as it is a huge scoring component this season.
Recorded By: Vinamr Pemmaraju	Reviewed by : Austin Long



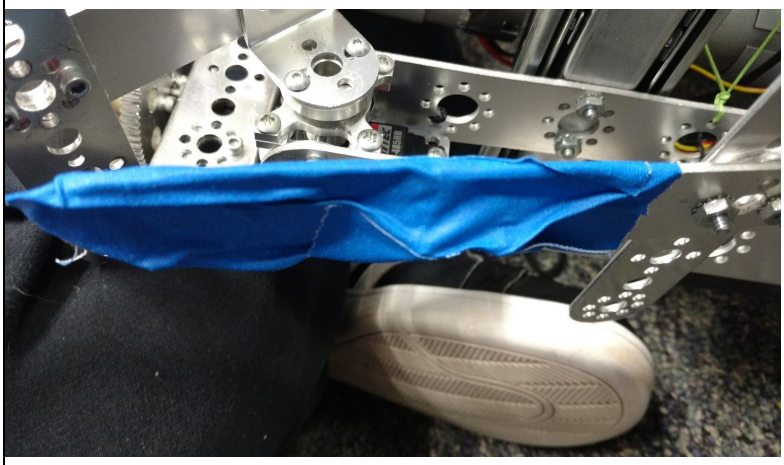
Meeting #13

Date : October 28th
Attendance : Thomas, Bhavesh, Daniel, Zac, Connor, Vinamr, Gunvir, Ben, Chase, Priya,Ragini
Duration: 10 am - 2 pm
Goals: Make improvements on our robots based on our testing data

IN PROGRESS: Grabber Arm for Glyphs and Relic Recovery

Tasks	Design Considerations and Results
Reinforced block grabber back	The back of the block grabber was bending under the strain, so we added another metal piece in front of the current backplate. This also aids the bot by making sure the blocks do not get stuck in the cavity previously formed between the backplate and arms.
Added gaffer tape to block grabber arms	In order to increase the friction between the block and grabbed, the ends of the block grabber arms
Replaced string for block extension	The string that allowed the block grabber to extend and retract has gotten caught in the mechanism, so it was ripped out and replaced.
Fixed “squeaking: noise caused by gears	The squeaking noise was fixed by changing the angle of the connection of the gears to the wheel, thus reducing friction and minimizing the the noise.
Changes copied over to second bot	However, the extension of the block grabber arms forced the bot to not fit in the allotted area, so it had to be changed.
Wired everything on secondary bot	The wheels and block grabber were connected physically to the controller.
Worked on Mecanum code	The code that allows the specific utility of the mecanum wheels was started, though it will need to be completed at a later date. We hope to be able to strafe (move horizontally) during the competition with this code.

Figure 13.1 and 13.2: Gaffer tape and Friction Pads



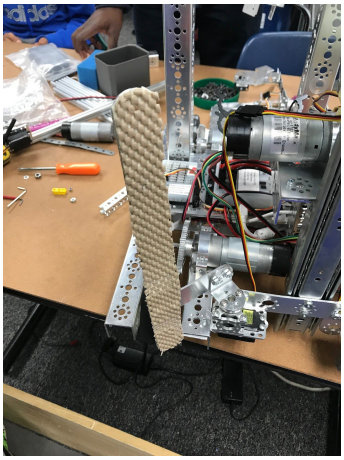


Figure 14.3: Relic Grabber Prototype

The Relic grabber utilizes a motor that powers two gears that help to open and close two metal pieces around the relic.

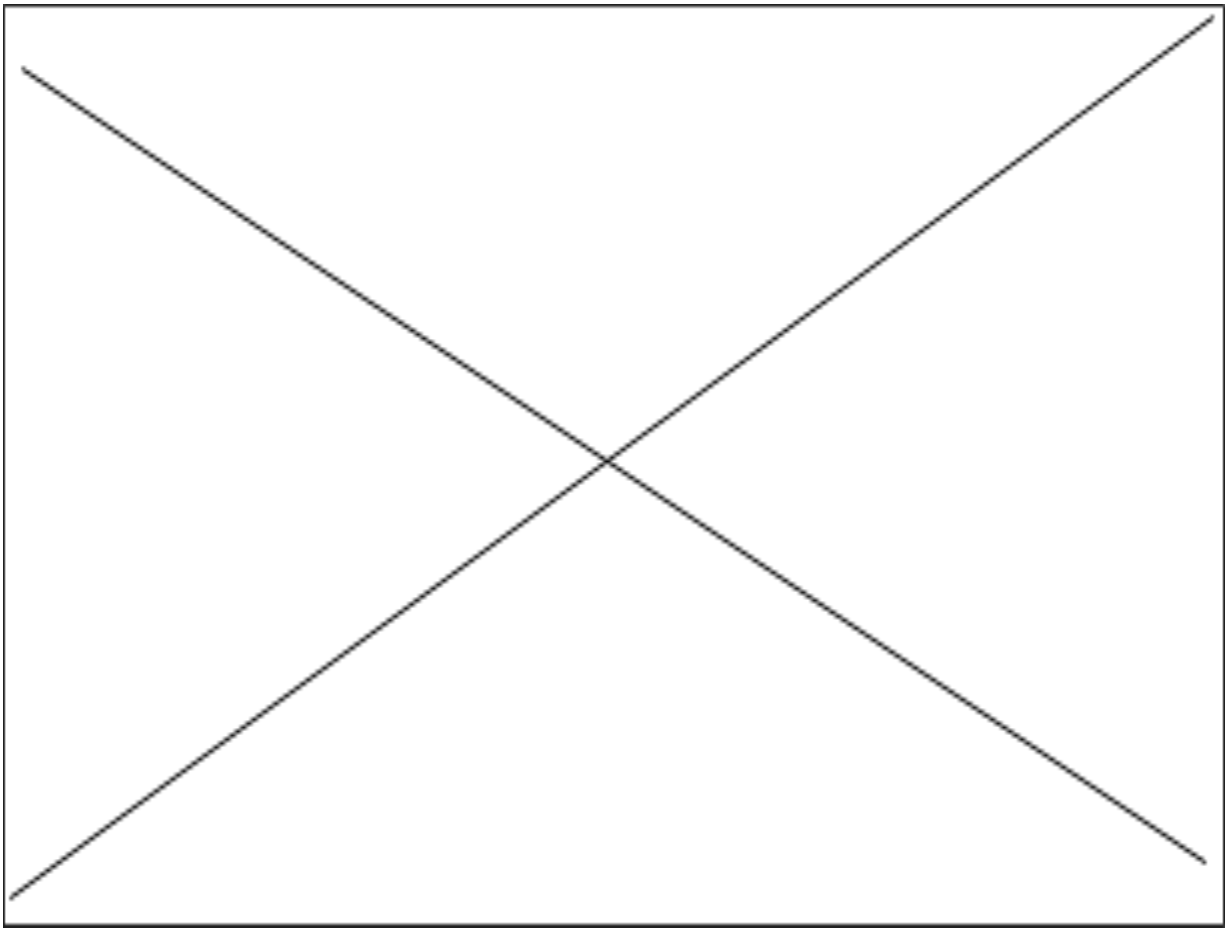
The benefits of the design include:

- Strength
  - It is able to hold the relic securely
- Reliability
  - Successful in 9/10 trials conducted

The design is good off the robot, but there are a few issues with it:

- Size
  - There Isn't enough room to mount this on our robot because
- Angle
  - We would have to obtain the relic at a very specific angle in order to get. This was easy to do in tests, because it was unmounted. Considering, the corner placement of the relics it may be infeasible to try to utilize this design.

Successes and Setbacks: 1. We were able to successfully model our designs, and make improvements on our robot to further our progress. 2. We are having trouble coming up with a cohesive design for our relic recovery system, and we need to go back and redesign to further our progress.	**Reflections:** 1. We need to modify the relic grabber design to make it with servos in a smaller scale. We will also need to make it compatible with either of a relic recovery systems (the slider system OR servo arm system)
Recorded By: Ragini Balachandran	Reviewed by : Daniel Wang



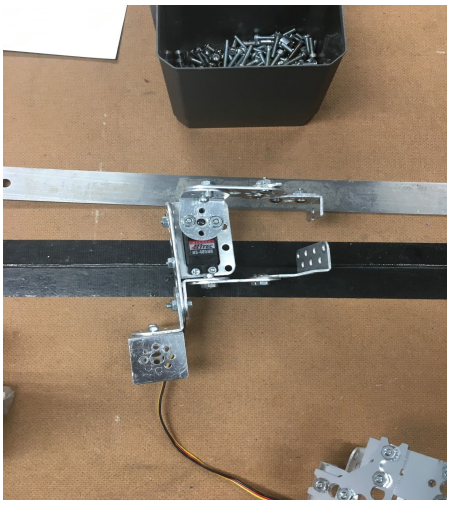
Meeting #14

Date : November 4th, 2017
Attendance : Zac, Thomas, Conner, Ben, Austin, Rohid, Vinum
Duration: 9 am - 12 pm
Goals: Adapt our robot design to fix problems with robot function

IN PROGRESS: Relic Recovery System

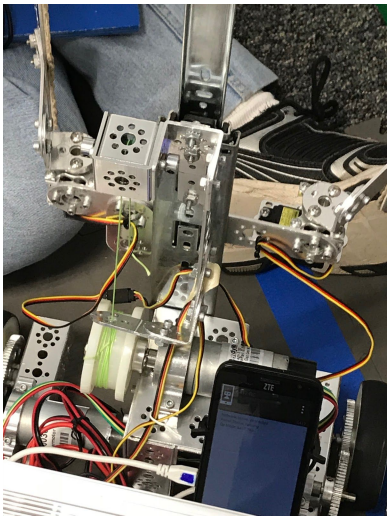
Tasks	Design Considerations and Results
Refine the Glyph Pulley system	The wire of the pulley system goes up and loses tension, this might come off so we added a top piece to prevent this event. Along with this we added a guiding piece for the string to go through. The guiding piece prevented the string from wrapping around the ael instead of the coiling wheel. In addition, we changed our thin fishing line string to a thicker nylon string to ensure less slippage.
Modify the Relic Grabber design from the last meeting	This system would pinch the relic from above, but will utilize servos instead of geared gripper powered by motors. The system can be integrated into either relic recovery system formerly discussed. We plan on using one servo to lower the actual grabber to ground from the extrusions or servo arms. Then another servo would open the claws to grab the relic.
Duplicating the cube grabber friction pads	The grip pads on the first cube grabber worked well, so it was decided to duplicate the grips to the other chassis's grabber.
Sand the pulley base	The pulleys had a lot of friction in the holder, so the pulleys were sanded down to minimize friction.
Added frame for relic arm	Needed for additional weight and to serve as placeholder for when the actual relic arm completed

Figure 14.1: Relic Grabber Idea



- This design utilizes a servo that opens and closes to scrap metal pieces from our old parts meant to press in the indentation between the relics head and arms.
- Although we think it will work in concept we may need to make more design changes to make sure it fits in with our extrusions.
- We have not had the chance to test due to some issues with servo wiring and getting the necessary servo screws
- We may try another system next meeting as well

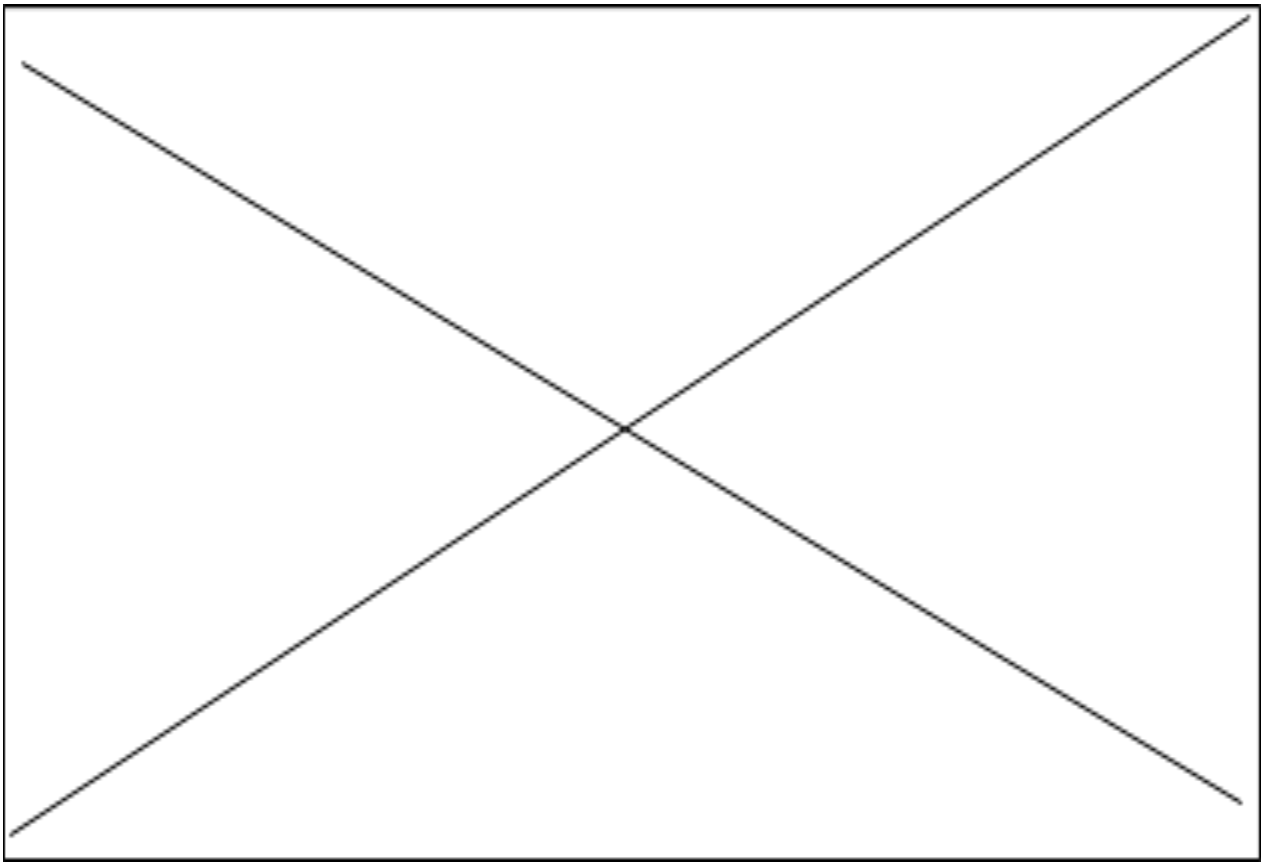
Figure 14.2: Pulley with newly attached friction pads



- The **friction pads** we added are actually small pieces of **drawer liner** we had leftover that are attached to double sided sticky tape
- The benefits of drawer liner are
  - Increased grip
  - Quick replacement time
  - Inexpensive purchase
- We also would like to make sure as much of our robot's metal surfaces are covered to prevent any sort disaster attributed with static shock
- We may use the liner on the tips of the relic grabber

Finished: Glyph Grabber & Friction system on the glyph grabber

Successes and Setbacks: Pulleys now have less friction and can now move freely, the block grabber can grip the blocks properly.	**Reflections:** Today was a very successful day, the pulleys were sanded down to prevent friction, the block grabber now has more grip, the pulley system for the block grabber was blocked to make the string stay in place
Recorded By: Zachary Bilyeu	Reviewed by : Austin Long



Meeting #15

Date : November 6th, 2017
Attendance : Zac, Connor, Ben, Bhavesh, Vinamr, Ragini, Daniel
Duration: 6 pm - 9 pm
Goals: Test Prototypes

IN PROGRESS: Relic grabber and refinement of stringing for glyph depositor system

Tasks	Design Considerations and Results
Attached extrusions system to robot chassis	One alternative way to attach the slider system on the chassis in order to extend the relic arm is to attach it horizontally as shown in Figure 1. We were able to attach the extrusions successfully to the robot chassis. However, we need to figure out how to mount the relic arm itself to within reasonable size restrictions.
Worked on guiding system for stringing on glyph slider system on both robots	Although the majority of the robot glyph is complete, we had issues with the stringing that allows the system to go up and down, because the stinging had been getting tangled around the axle of the motor powering it. We decided to a series metal pieces to guide the string and keep it from tangling outside of the system.
Conduct **sizing and performance tests**	Sizing Results Although the slider system has been attached, we need to find a method for attaching the relic arm that fits within the 18*18 restriction range for the robot. The current design does not fit in the box that can be carried into the competition. We need to create a design where we can fold the relic arm or fit it into the restricted size limits. The relic system is rather bulky and we may need to modify it or come up with something new entirely. Performance test results Daniel and Ragini tested our relic grabber by hand on the field. We noticed that during these tests that the relic fell out of the of our system, and we were unable to obtain it thereafter. Moreover, the gripping ability of the system was not very strong at times. Although, we tested by hand we believe that even with servos this the system has many flaws that could be exacerbated in

	times where the driving is imprecise. <u>Implications of testing</u> • Need to have practiced drivers • Need to modify or redesign the design

Figure 15.1 and 15.2: Mounted Extrusions and The Initial Performance test

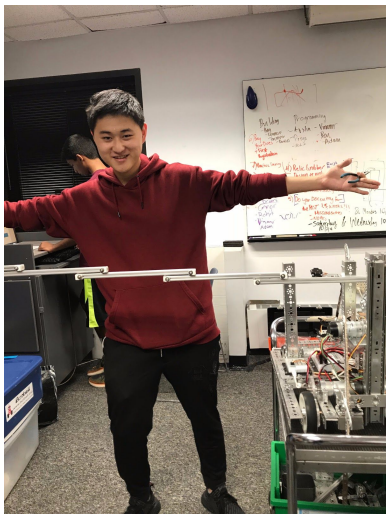
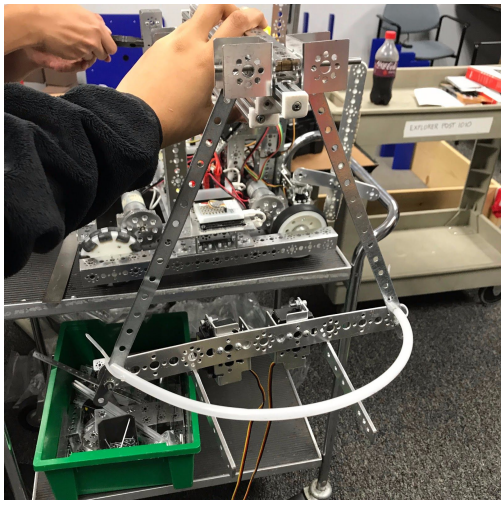


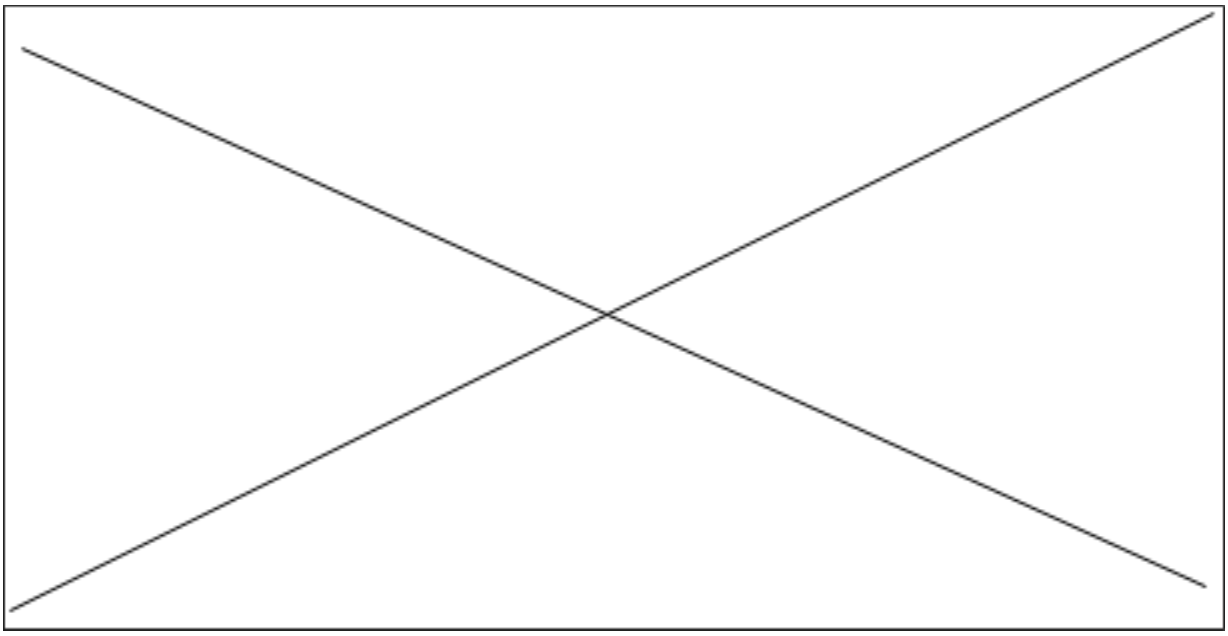
Figure 15.3 and 15.4: Mounting Possibility and Sizing Test



Current Relic Grabber Idea: The current (seen in the above figures) prototype has been temporarily placed on hold in development to allow us to pursue other ideas that may be more feasible

Finished: Guiding System for the String on the Glyph Grabber

Successes and Setbacks:	**Reflections:**
After weeks of going through relic arm designs with no success, we have finally been able to create a design that seems to work, and we have successfully attached the slider system horizontally for relic grabbing. However, we still have issues in fitting our system to the FTC requirements. We also have issues with the motion of our robot, as the back wheels are moving at a faster rate than the front wheels.	A lot was done today that has built off of the previous meetings. However, we still need to do a better job of organization and keeping track of our progress and how to improve each week. Even after weeks of time spent on designs for the relic arm, we are still facing issues because we did not consider all the requirements, including space. More organization will lead to greater efficiency and progress.
Recorded By: Bhavesh Kemburu	Reviewed by : Zachary Bilyeu



Meeting #16

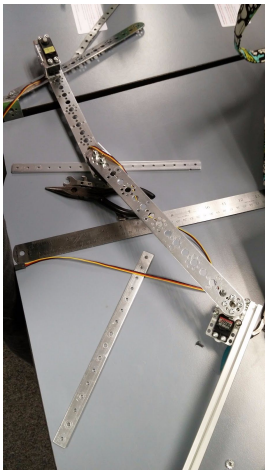
Date : November 8th
Attendance : Zac, Connor, Bhavesh, Thomas, Austin, Zac, Ragini, Gunvir, Ben,
Duration: 6 pm - 9 pm
Goals: Improve Claw and pulley system

IN PROGRESS: Relic grabber arm

Tasks	Design Considerations and Results
Create claw for the robot	Today we worked on two possible prototype designs for the claw to grab the relic. One design consisted of a lengthy section with four shoulders, two servos, and a clamping mechanism to grab and drop the relic (Figure 16.1). However, this design consists of a very large arm, so it will be difficult to determine where to attach it and meet the space requirements. The second prototype is a more simple claw that would implement the extrusion system that we already built, but it would still be difficult to meet the space requirements. The design (Figure 162) consists of the slider extrusion system, two arms, and two clamps to tightly hold the relic.
Finished Cable and Electronics Management	We had to make a few adjustments to the arrangement of the wires on the robot. We adjusted a few cables on the robot so that they were ina safer location. We also attached a panel on the bottom to hold the battery in place as well as some of the wires that were protruding from the bottom of the robot.
Adjusted pulley system	The pulley system was adjusted with new and stronger string that should be able to lift up and the arms for the glyphs with ease. We still need to conduct drive tests to make sure that the pulley system is durable and will be able to last throughout the competition.
Drive Testing	We made a significant step by testing the robot's ability to move around in the field and perform. While the tests that we conducted today were superficial and just initial impressions, we still ran into several problems that should be addressed: 1. Lift buttons should be reversed. 2. Lift speed should be much faster.

	3. There should be POV drive as opposed to tank drive(Both controls should not have the robot move in the same directions.) 4. Occasional stickiness in controls There were further problems with the parts that we used in creating the robot, such as the servos.

Figure 20.1 and 20.2: The two prototypes to try out on a respective robot we have built



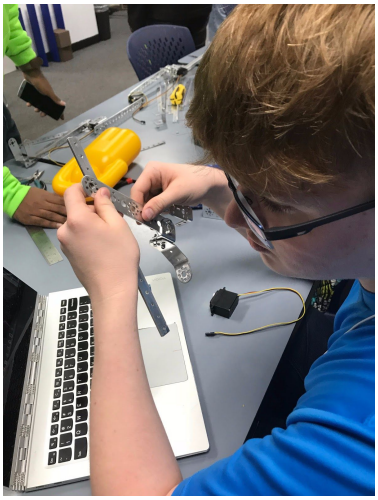
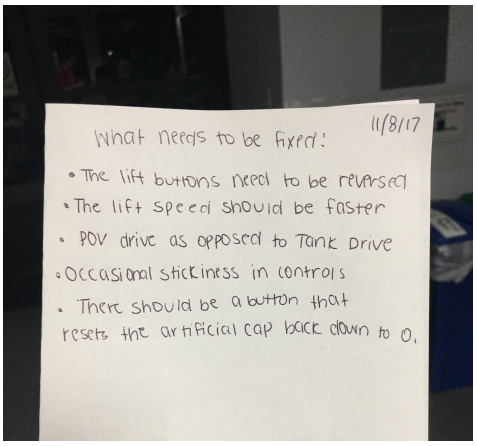
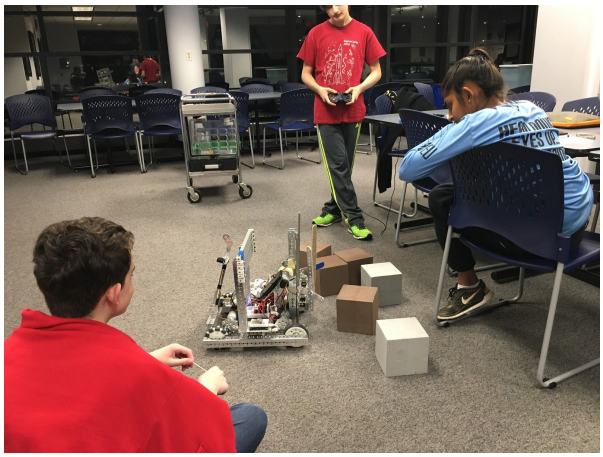
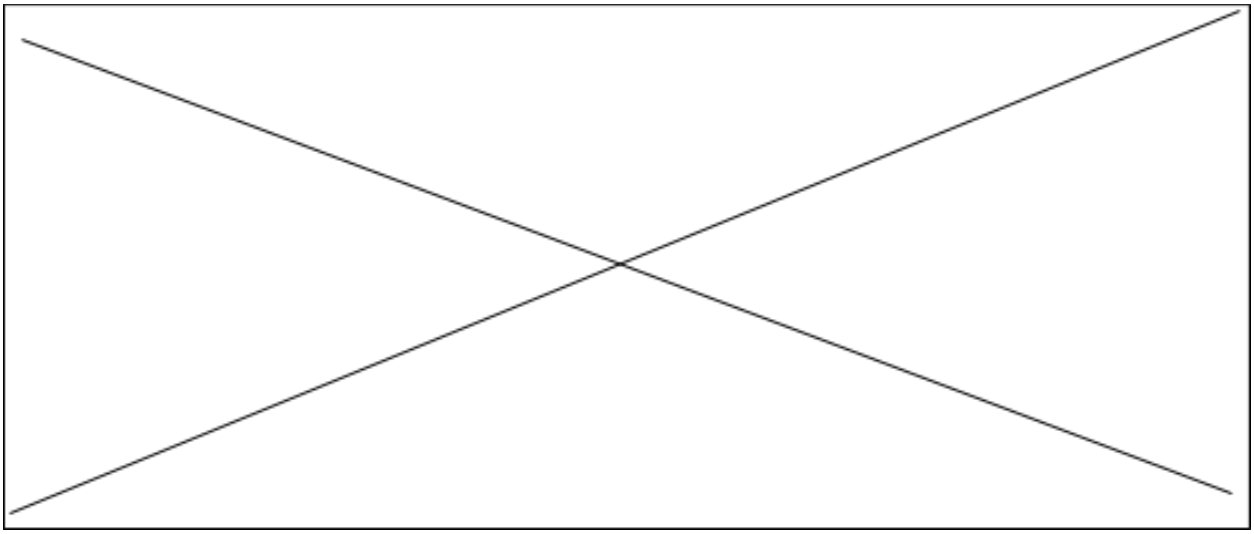


Figure 20.3 and 20.4: The list of improvements needed and the testing led by Ben and Priya





Successes and Setbacks:	**Reflections:**
We created two prototype designs for the claw, and they both have their merits and can be potentially used for the real competition. The designs were simple yet sufficient to lift the relic. We also finally started driving tests. With our qualifiers just a month away, it is important that we have members engage in the actual experience of the competition. We still encountered several problems that could or should have been addressed in the past weeks. One of these problems involved cable management. While we saw the need to organize the cables and fix the pulley system, it still took us time to organize the wiring, because we had to work on other parts of the robot.	Overall, we made successful progress today and we should continue to work at this rate. We worked on more prototype designs, which shows our critical thinking in the design process because prototyping is a very important step that requires a working system. Although we have found problems in many of the prototypes that we have built, we have still been able to analyze these problems and build off of them. Starting the drive tests was a big step in the right direction, but it also revealed some of the problems with the build of the robot and requires that we add some necessary components. The list of problems that we composed are only some of which that we will face in the coming weeks, and we have to be prepared to address problems that we find immediately after each drive test, rather than do multiple tests and repeatedly encounter the same problem.
Recorded By: Bhavesh Kemburu	Reviewed by : Ragini Balachandran



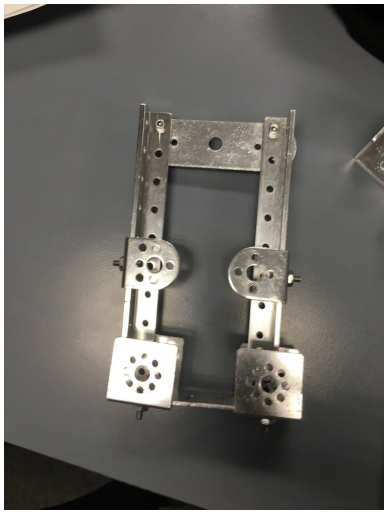
Meeting #17

Date : November 15th
Attendance : Zac, Connor, Bhavesh, Thomas, Austin, Zac, Ragini, Gunvir, Ben, Vinamr
Duration: 6 pm - 9 pm
Goals: Grab and move relic

IN PROGRESS: Relic grabber system (Both extrusions and servo arm system)

Tasks	Design Considerations and Results
Phone mount	We bought new phones, so we need to make mounts for them. These mounts have to be able to hold the phone securely, so that they don't fall out. These mounts will be constructed out of metal, and have tape in places where the phone makes contact to prevent any scratching. The mount itself will be attached higher up on the robot to allow us to utilize the camera functions if we use Vuforia in autonomous
Fix extrusions	The extrusions that were attached to the first robot were attached the wrong way, and it opened up the opposite way it's supposed to. We had to detach it and fix it so that it would move in a direction that would allow us to deposit the relic.
Fix construction of servo arm	On testing it was found out that the arm is not efficient. It was not efficient because the grabber was too wide and it was hitting the boundaries of the mat. We have to make it so the it could fit in between the gap of the relic and the edge, in order to get it to work.
Update New Phone software	We had to download the apps for the driver station phone and robot phone. The new phones were purchased because we were having issues with older phones crashing, and we were having issues updating the apps for competitions.

Figure 17.1: Possible Phone Mount



We had a previously had a plastic phone mount but with it there were numerous problems:

- It was not able to be mounted at higher point on the robot
- It was prone to breakage
- It was not large enough to keep the new phones secure

The benefits of this new mount include:

- The necessary space to hold new phones
- The frame is stable with a lot of movement
- The ability to be placed in many different locations

In the future we may need to:

- Add tape around the edges
- Try to prevent static shock

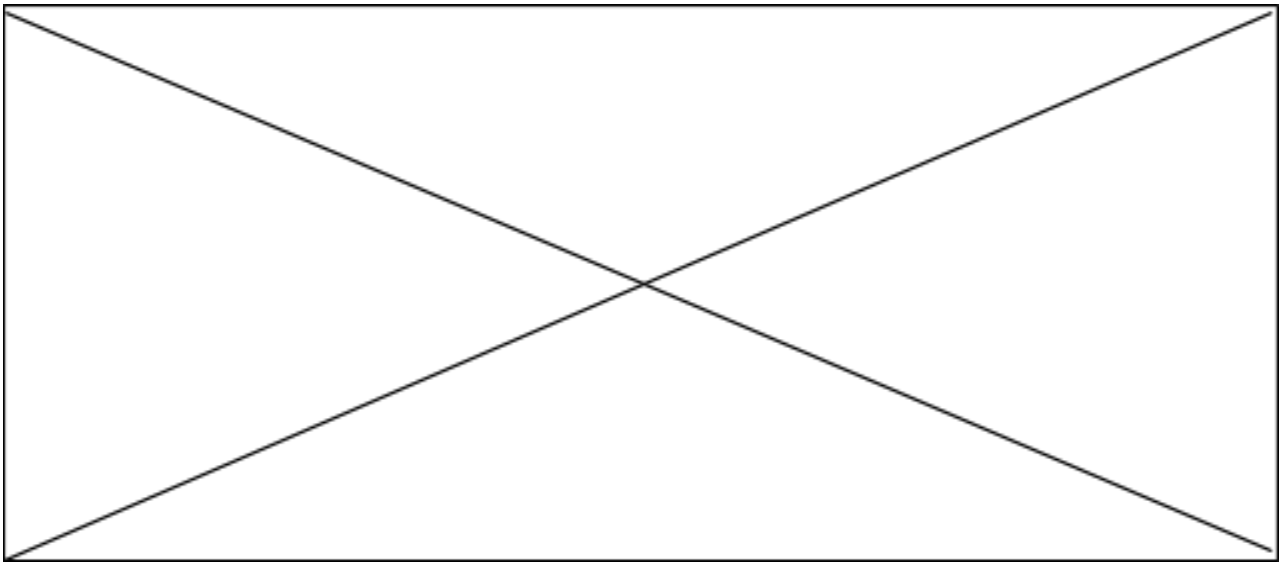
Figure 17.2: Servo Arm Test

We conducted a servo arm test to see if the arm would actually be able to rotate and bear the amount of weight necessary to deposit the relic.

The results from the test were that torque exerted on a single servo was too much for it to handle. In the process of this test on servo was damaged so much that we could not repair it. While the idea of a multistage servo arm is good in concept, we simply do not have the resources to build a design with this level of complexity.

STOPPED: SERVO ARM FOR RELIC RECOVERY WILL NOT BE DEVELOPED FURTHER

Successes and Setbacks:	**Reflections:**
We were able to create a prototype phone mount design that fits the dimension requirements of our phone. We were able to follow the model that we created to build a phone mount, but we will need to consider later on where to position the phone mount on the robot itself. We observed today that the relic arm is not an optimal design for our robot. We were able to figure out the main problem with our design, which were the dimensions and the strength of grip. We were able to update the hardware on the new phones purchased. The appropriate software is necessary to ensure that we can actually implement code for our robot.	We will need to return to the design phase of the process for the relic arm. The servo arm system will no longer be used for the relic arm, because of problems with some of the servos themselves as well as spacing issues. This means that we will need a completely new approach, and we will most likely have to come up with multiple prototype designs in the coming weeks until we find the ideal arm. The important thing is to make sure that we keep record of the design process so that we know for a fact what could work and what will not. We can continue coding without having to worry about software issues on the new phone. Although we will probably have to do some testing of the code and potential bugs might come up, the software should be up to date and suitable for the competition.
Recorded By: Zac Bilyeu	Reviewed by : Bhavesh Kemburu



Meeting #18

Date : November 18th
Attendance : Zac, Connor, Bhavesh, Thomas, Austin, Zac, Ragini, Gunvir, Ben, Vinamr
Duration: 6 pm - 9 pm
Goals: Grab and move relic successfully

IN PROGRESS: Relic grabber arm

Tasks	Design Considerations and Results
Worked on extrusions	A motor was attached to extend and retract the extrusion. A method for "stringing" the extrusion was devised and partially attached. It is not operational yet, but significant steps were made towards starting it.
Worked on fixing mecanum drivetrain	Formerly, we were unable to strafe because of the uneven weight distribution. To confirm our suspicions about about the problem.Weight was added to the bot, and the speed of the wheel was code-limited. This improved performance, though it was a temporary solution.
Rewired cables	We organized cables in order to make the bot look more presentable. This is an extension of the work that was continued since the first items were wired. This way, the wires will not interfere with the mobility of the robot.
Worked on design for logo header	The previous design was too square for places where vertical space is at a premium, such as headers, Designs were proposed and iterated that fulfill this requirement.

Figure 18.1 and 18.2 : Extrusions and the Stringing Plan (created by Daniel Wang)

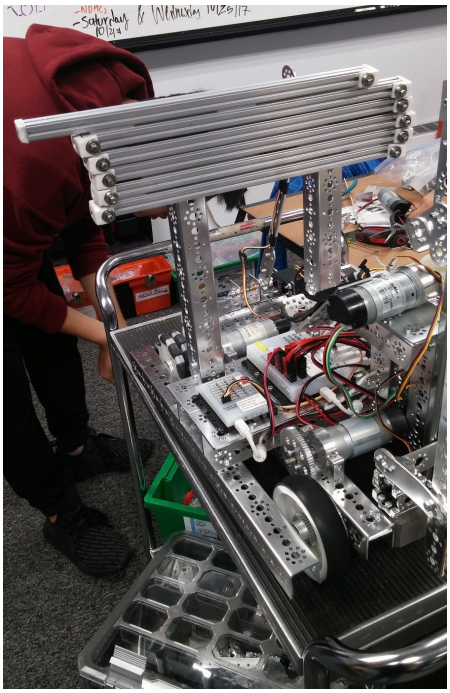
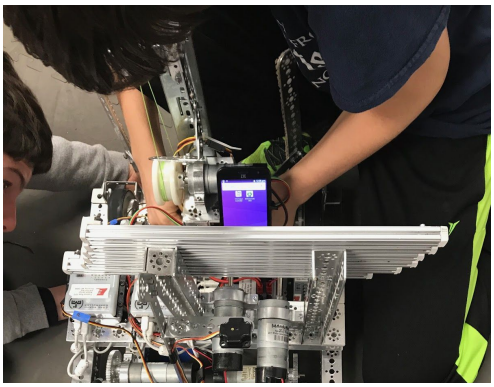
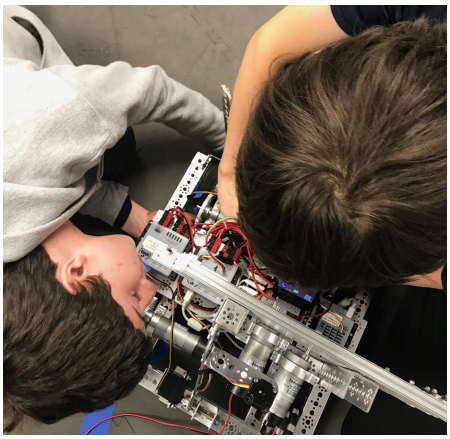
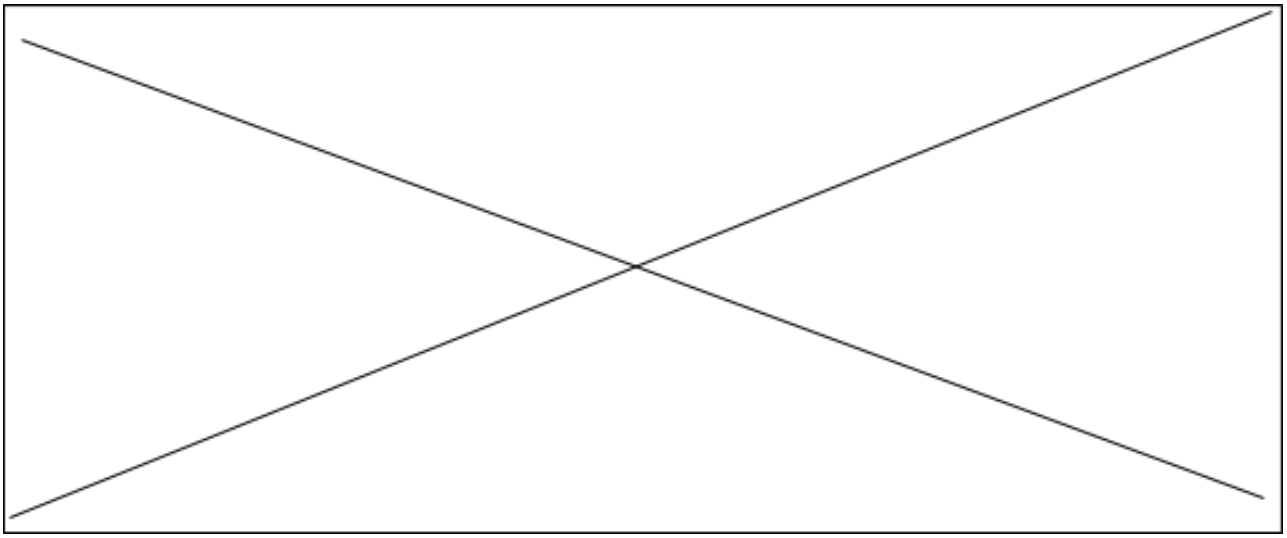


Figure 18.3 Cable management





Successes and Setbacks: 1. We found a temporary solution for the drive train problem, involving the addition of weight and modification of the code values.	**Reflections:** 1. In the future we may want to consider space limitations earlier in the building process, as that could save us time with our designs. 2. We may want to add a permanent weight in the back
Recorded By: Daniel Wang	Reviewed by : Austin Long



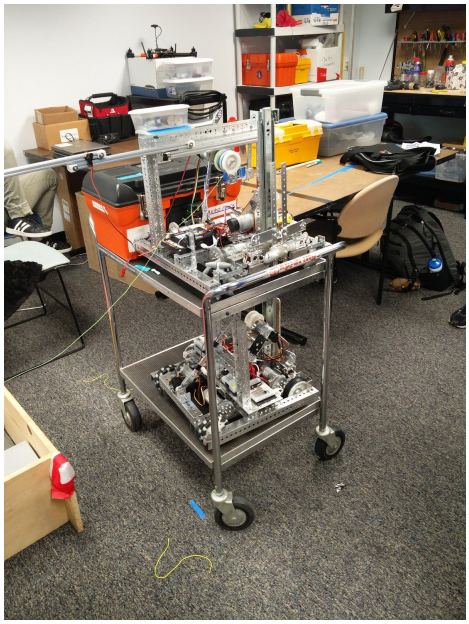
Meeting #19

Date : November 20th
Attendance : Zac, Connor, Bhavesh, Thomas, Austin, Zac, Ragini, Gunvir
Duration: 6 pm - 9 pm
Goals: Finish Extrusions system used to pick up and move the Relic

IN PROGRESS: Attaching Relic Grabber

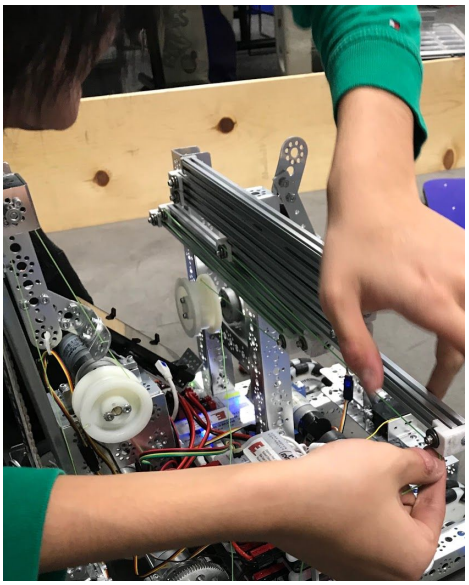
Tasks	Design Considerations and Results
Mount Extrusions on robot	We mounted our set of extrusions onto the robot. These extrusions will help us extend the relic and place it on the mat. However, we have encountered problems with stringing the extrusions due to lack of stability and flexibility. While the string itself should be strong enough to allow for controlled mobility of the extrusions, it has been difficult to string the extrusions in such a way to allow the arm to move back and forth and grab the relic. One method that we used involved attaching the string around the screws, however the pulley system has not been strong enough, and we have experienced little success in actually attaching the string around the screws.
Build a 2nd pair of extrusions for the alternate robot	We are making progress on making a 2nd pair of extrusions for the second robot. We have not finished yet, but we are making significant progress. Some problems we have encountered in the process are lack of proper materials(extrusion caps, hex nuts). We need to organize materials and find the appropriate screws for the extrusion system. We also did not drill holes into the extrusion caps to fit the screws in.
Cable Management	Before today's meeting, our cables were extremely messy, and it was an immediate emphasis of the meeting to clean it up. We spent a good amount of time sorting the wires in a systematic fashion, and it is much cleaner now. Now, our wires will not interfere with the functions of our robot. We also attached a metal plate on the top of the central wiring system, to hold the wires in place.

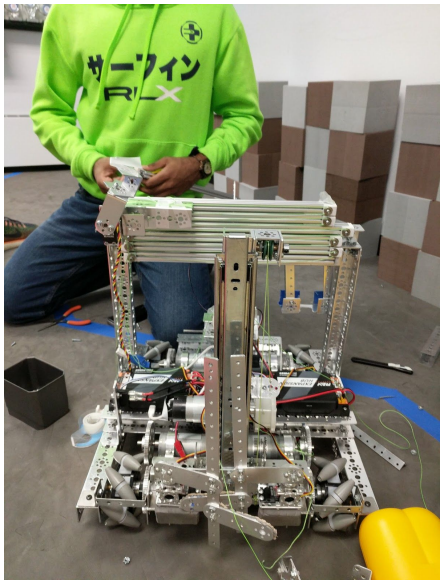
Figure 19.1: Fully extended extrusions and Alternate Extrusions



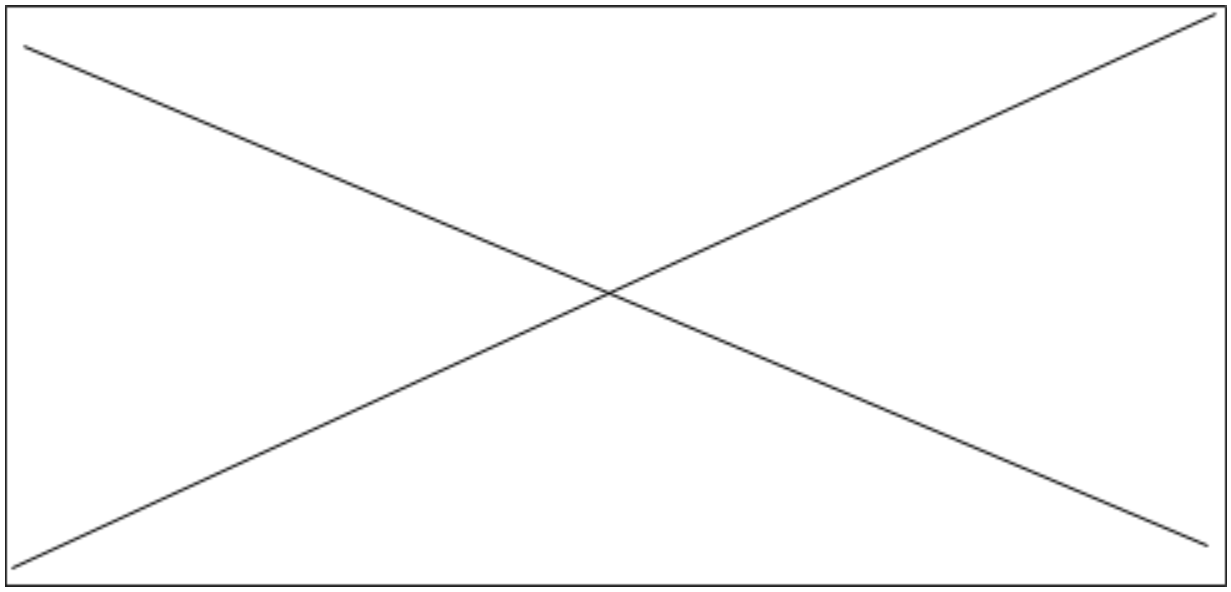
- The fully extended extrusions will allow for the relic to be dropped at the furthest spot for 60 points.
- Our plan for the wiring is to have a large amount of extension wires to power two servos required to grab the relic

Figure 19.2 and 19.3 : Extrusion Stringing & Mounted extrusions with Full stringing





Successes and Setbacks: 1. Finished cable management 2. Mounted Extrusion System 3. Lack of success in stringing the extrusions	**Reflections:** 1. We definitely worked on a potential problem with management of cables, because come time of the the competition, the positioning of cables should not be an issue when operating the robot. However, we still need to make progress with stringing the extrusions and actually working on the second system. One of our main obstacles moving forward is organization, because we need to gather many of the parts for the extrusion system as well as replace certain extrusion caps that are either broken down or need holes drilled.
Recorded By: Vinamr Pemmaraju	Reviewed by : Bhavesh Kemburu



Meeting #20
Date: November 22th , 2017
Attendance : Ragini, Ben, Sebastian, Thomas, Gunvir, Connor, Austin, Bhavesh, Vinamr
Duration : 6pm-9 pm
Goals: Finish Construction of robotic claw and shell

IN PROGRESS: Robotic claw for Relic and shell

Tasks	Design Considerations and Results
Robotic claw for Relic	After discussion and prototype testing, we decided to use a claw that uses a servo. The design consisted of a stationary metal piece, and another attachment attached to the servo. The mechanism would slide the stationary piece behind the relic, and the piece attached the servo would clamp down to the front of the relic, allowing it to be lifted up gently from the ground. We also considered using tape for less friction between the relic and the arm.
Wheel Guards and Shell Construction	We cut out a shell from a clear plastic tube, and poked in holes to attach it to the chassis of the robot. The purpose of the shell is to protect the electronics of the robot while also giving the robot a more aesthetically pleasing look. We also used blue aluminum plates on the outside of the robot.

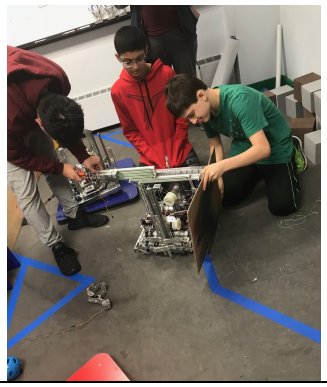
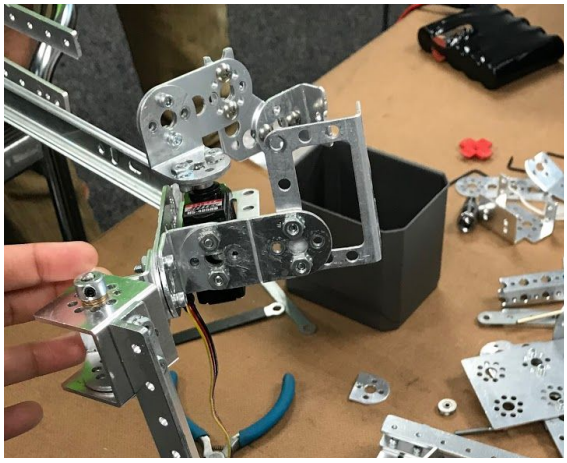
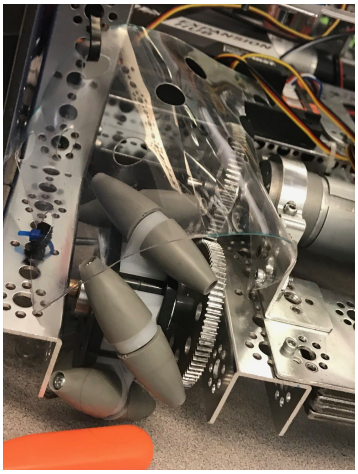
Figure 20.1: Shell Prototyping	
, 	Gunvir and Ben use cardboard to prototype the side pieces we will be making our shell out of. We plan on using the aluminium from the ramp in the FTC game two years ago for the shell. We had to decide if we wanted a large shell that may block us from quick making changes or smaller shell that protects the robot less. In the end we decided that a robot that had a smaller shell would be better for our robot, because we have so many moving components which may need to be repaired at qualifier.

Figure 20.2 and 20.3 : Relic grabber claws and plastic wheel guards
 

Completed: Relic grabber

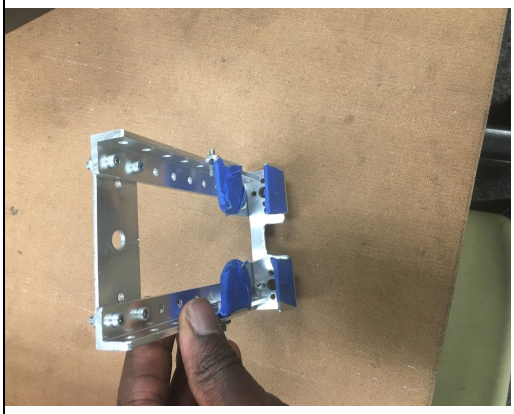
Successes and Setbacks:	**Reflections:**
• We were able to build a prototype design for the robotic arm that we will need to test in the future during driving sessions. • We were able to successfully finish a prototype system for grabbing the relic. However, this particular design has problems relating to size requirements and actually being able to mount it onto the robot.	• In the future we may need to redesign the phone mounts in order to fit the new phones. • We need to focus on more of the design process. Some of the ideas we thought suitable for the relic arm system as well as the robotic arm did not work out practically because we did not consider all of the factors that could affect their function. We want to draw out models for the designs taking into account scaling of the dimensions, and the specific parts we need. This way, we can build the prototypes and dedicate more time to testing for reliability during practice.
Recorded by : Thomas Ajala	Reviewed by : Bhavesh Kemburu

Meeting #21

Date : November 25th
Attendance : Zac, Connor, Vinamr, Thomas, Austin, Zac, Ragini, Gunvir, Ben, Bhavesh
Duration: 6pm - 9pm
Goals: Finish construction of Extrusions system

IN PROGRESS: EXTRUSION SYSTEM

Tasks	Design Considerations and Results
Attaching phone mounts	We were able to successfully to attach the phone mount to the robot in an ideal location that won't interfere with the electronics system or mobility of the robot. We made sure that the chassis and the pulley system don't interfere with the camera of the robot. Adjustments had to be made to the mount due to the new phones that we will be using for this year's competition, which are slightly larger in height. The phone mount design consists of two metal arms on the side and a metal base on the bottom. We also attached duct tape so that the phone can snugly fit into the mount with minimal risk of damage.
Attaching extrusion system	We made our final changes to the extrusion system on our main robot, These changes included and we are yet to complete the second set of extrusions. We are currently in progress in building it.
Scrimmage for practice	We scrimmaged against the Richard Montgomery and Watkins Mills robotics teams. This was a great opportunity to share ideas and interact with one another. During the scrimmage, we practiced driving and picking up the glyphs for competition. However, we stumbled into problems with the extrusion system and relic arm that we had to address.

Figure 21.1 Taped up phone mounts	
	Phone mounts were tape to make the phone mount more stable and allow for the phone to more snugly fit into the holder with minimal possibility of scratching or damage to the phone itself.

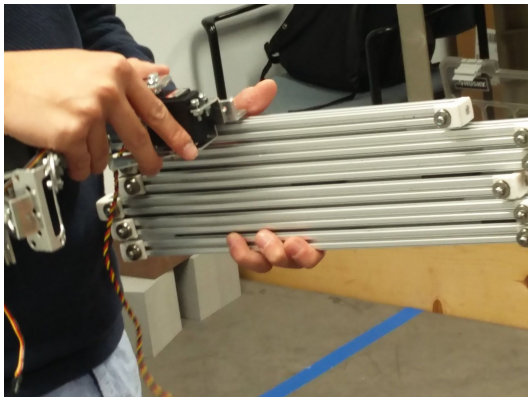
Successes and Setbacks: 1. We had our first scrimmage for the reason, so we were able to get some driving time in to prepare for actual competition. However, we ran into several problems immediately with extrusions and the relic grabber. The vast majority of the time was spent on fixing the robot rather than driving. 2. An extrusion system was finally attached, but it had to be done and fixed on the day of the scrimmage, reducing practice time.	**Reflections:** Overall, it is a good thing that we got the first scrimmage in, even though it could have been a little earlier. We need to keep track of what changes need to be made on the robot so that they can be handled routinely each week rather than try to fix too many problems on the day of the scrimmage. We will definitely need to practice driving more in the future, to get drivers familiar with the controls.
Recorded By: Vinamr Pemmaraju	Reviewed by : Bhavesh Kemburu

Meeting #22

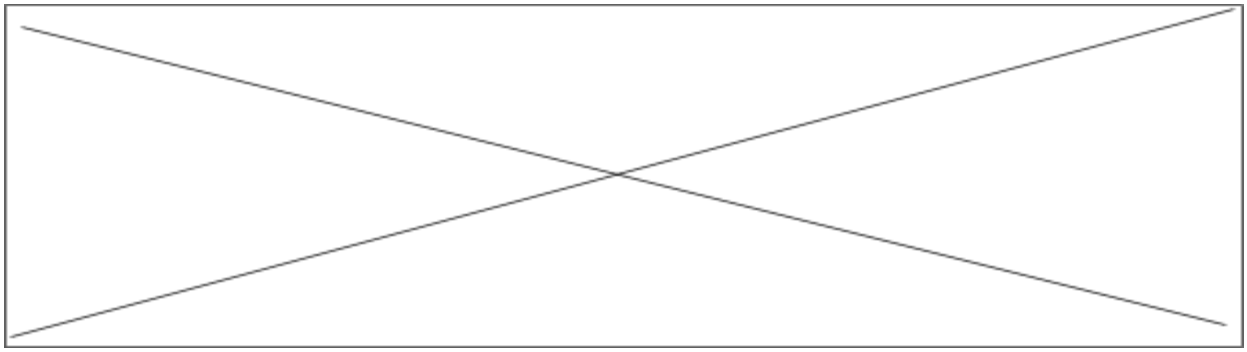
Date : November 29th
Attendance : Zac, Connor, Bhavesh, Thomas, Zac, Ragini, Gunvir, Ben
Duration: 10 am - 2 pm -
Goals: Finish building the relic arm and the phone mount

IN PROGRESS: Extrusions system

Tasks	Design Considerations and Results
Adjustment of phone holder	Although the phone mount could properly hold the new phones, we had to consider adjustments that need to be made that would allow the USB cable to reach the phone, and give the phone camera the ability to operate unobstructed. To fix the USB problem, we drilled a hole at the bottom of the phone mount to grant the USB cord access to the phone. To deal with the camera problem, we orientated the phone in such a way that the camera can see clearly without us giving up the stability the phone mount provides the phone.
Mounting of extrusions on the second robot	Mounting the extrusions on the second robot allows us to test out the extrusions and perform modifications as a preliminary model before we put it on our competition robot. The mounting process will also require us to figure out a method of stringing the extrusions.
Cut the Shell pieces out	After taking the measurements of the shell, and deciding on a partial shell design. We used a hack saw, and circular saw to get the precise cuts we wanted. We will have a shell piece covering both the right and left side of the chassis as well as piece in front of the extrusions that will serve as guard for the wiring. These shell pieces were also sanded down at the edges to prevent any possibility that our wire could be cut. In addition to this we are planning on adding our team name and number onto the pieces.

Figure 22.1 and 22.2 : Relic grabber and its placement on the extrusions itself
 

Successes and Setbacks: Extrusions built and work and claw is capable of picking up relics. We can improve our stringing and overall combination for completed ideas.	**Reflections:** We should work better as a team to better combonie or finished prototypes.
Recorded By: Ben Ganelin	Reviewed by : Gunvir Lubana

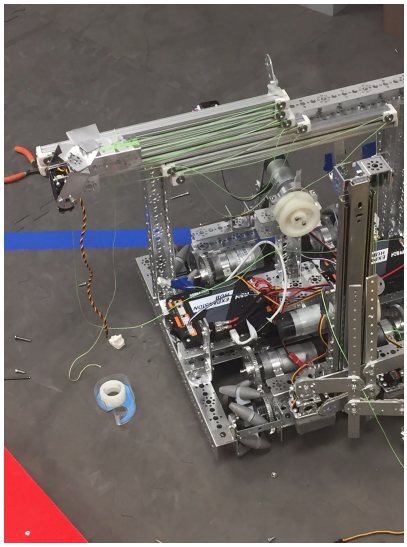
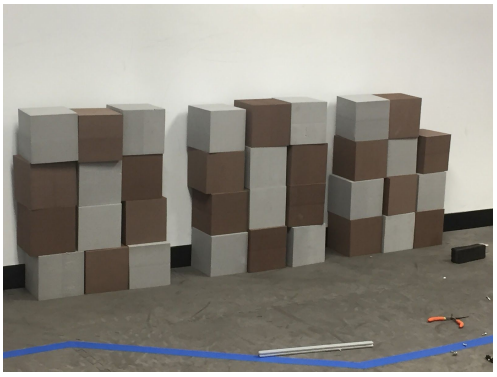


Meeting #23

Date : December 2nd
Attendance : Connor, Vinamr, Thomas, Austin, Zac, Ragini, Gunvir, Ben, Bhavesh
Duration: 6 am - 9 pm
Goals: String the extrusions and finish coding of the robot

IN PROGRESS: Extrusions system and autonomous coding

Tasks	Design Considerations and Results
Stringing the extrusions	We had to attach string to the extrusion system to make the system more mobilemake mobility easier for the system. This way, the relic arm can move more smoothly when grabbing and transporting the relic. Although the process was tedious, the system came out relatively smoothly and will be duplicated for the second robot.
Finalized relic grabber	Adjustments had to be made to the relic grabber system to conveniently attach it to the extrusions. This involved taking apart part of the arm and attaching screws in order to fit it onto the robot.
Discussed Detection of Pictographs on the side walls	We discussed methods for detecting the pictographs during the autonomous period. We need to work on some code for the autonomous portion, and we may need to focus more on using vuforia. At times we considered just hardcoding the robot to deposit at a random column, but vuforia may be the better option.
Creation of second extrusion system	After finishing the first extrusion system, we begin on the second. However, we had problems with finding the parts and we need to organize materials further to speed up the process.

Figures 23.1 and 23.2 Strung up Extrusions with claw, and the patterns we need to memorize for competition
 

Successes and Setbacks: 1. We were able to string the extrusions to allow for smooth motion. 2. We did not finish code for the pictograph detection for the autonomous portion.	**Reflections:** We definitely need to organize our materials more efficiently, because it was difficult to find materials for the second extrusion system and we have a lot to work on for it moving forward. We also need to drill holes into the extrusions to allow for screws to be tightened.
Recorded By: Bhavesh Kemburu	Reviewed by : Thomas Ajala

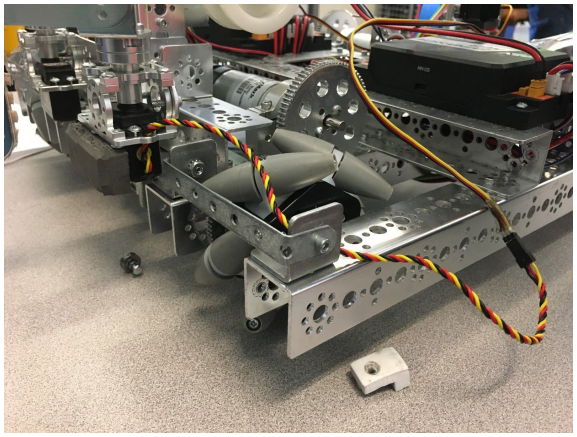
Meeting #24

Date : December 15th
Attendance : Zac, Vinamr, Thomas, Austin, Zac, Gunvir, Ben, Bhavesh
Duration: 6 am - 9 pm
Goals: Complete wiring, coding, and the stringing of the Extrusions system

IN PROGRESS: Driving

Tasks	Design Considerations and Results
Stringing the extrusions	We had to attach string to the extrusion system to make the system more mobilemake mobility easier for the system. This way, the relic arm can move more smoothly when grabbing and transporting the relic. Although the process was tedious, the system came out relatively smoothly and will be duplicated for the second robot.
Fixing Broken Servos	We had broken a couple of servos in the previous meeting, so we fixed them today. The servos on the claw burned out, so we had to replace them. We also wanted stronger servos on the tail, so we replaced those as well.
Electrical Wiring for the servos	We organized the servo wires in a neat fashion. They were getting in the way of some of the functions of our robot, so that was a top priority at today's meeting. We attached zip ties around the robots to hold the wires in place.
Add the shell	We mounted the shell into the planned spaces on the sides of the robot, and added the team name onto the topmost piece for aesthetic appeal.
Coding	The code has been fully completed and optimized for the robot. For the most part, it has been working as desired. The problems that we have had in relation to the mobility of the robot aren't related to code, but rather mechanical problems such as broken servos.

Figure 24.1 and Figure 24.2 : Servo Wiring Before and After (featuring our blu zip ties)



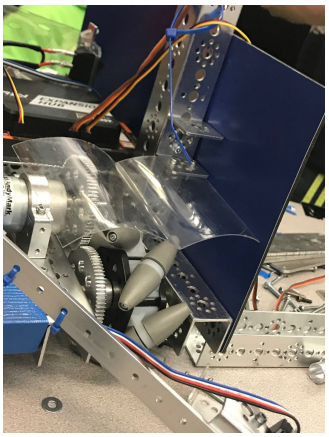
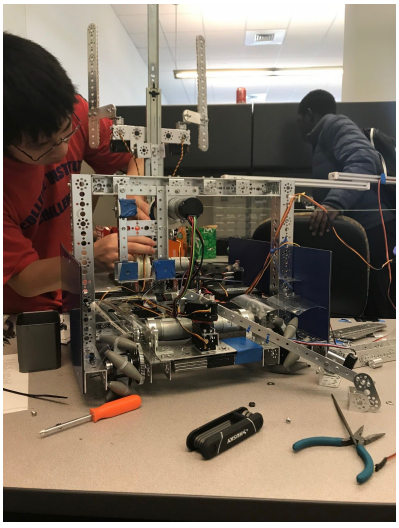
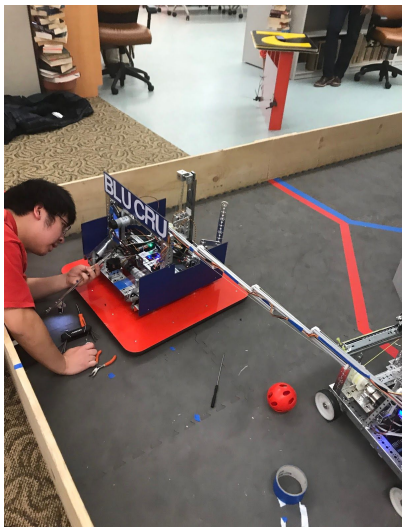


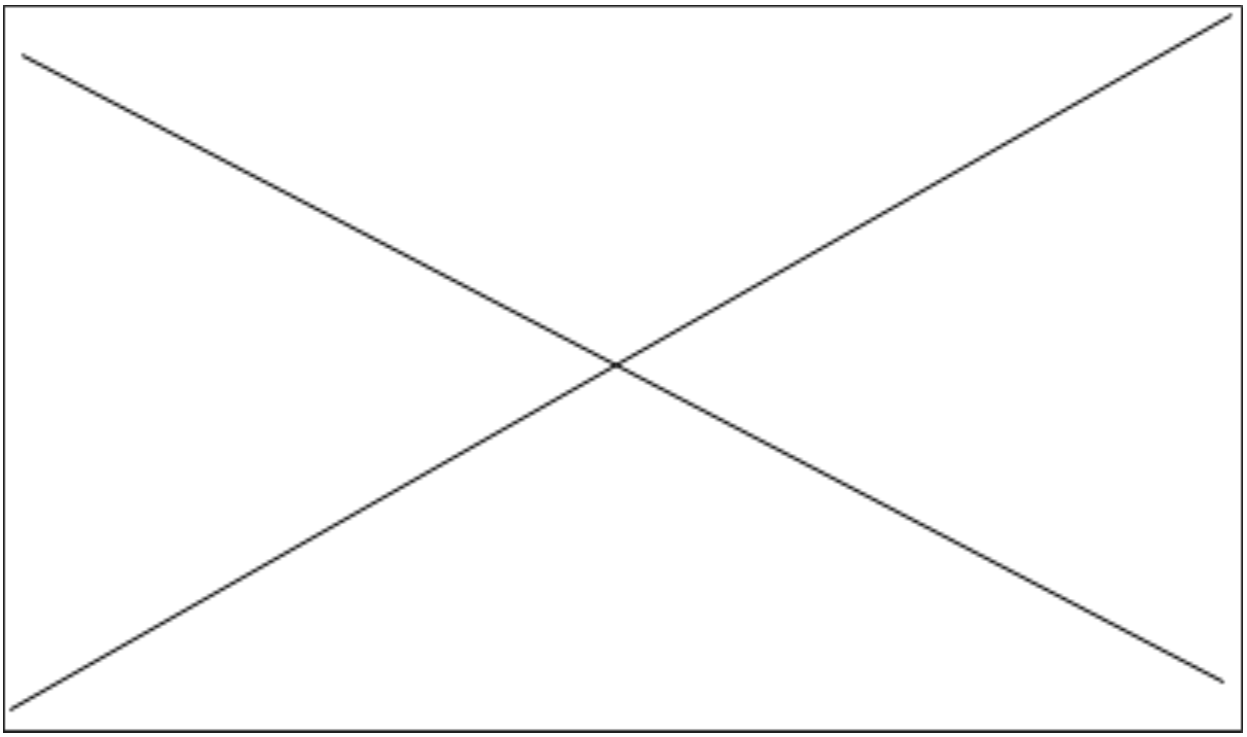
Figure 24.3 and Figure 24.3 : The attachment of the panels and the shell with team name





Finished: Shell and Wiring

Successes and Setbacks:	**Reflections:**
1. We have completely finished the autonomous code for the competition robot 2. In the future we need to allocate more time for driving in the future. We have completely finished the autonomous code for the bot 3. We need to allocate more time for driving in the future	1. In an effort to conserve servo,, we should consider what actions may or may not break a servo. In the future, we should consider what may or may not burn out a servo in an effort to conserve materials 2. We should also allocate more time to practice driving.
Recorded By: Vinamr Pemmaraju	Reviewed by : Bhavesh Kemburu



Qualifier #1 REVIEW

Date of Qualifier : December 17th
Date of Review: December 23th
Attendance : Thomas, Bhavesh, Ben, Gunvir, Rohit, Zac, Priya, Vinamr, Ragini, Austin
Duration: 7 am - 6 pm
Goals: Complete wiring, coding, and the stringing of the Extrusions system

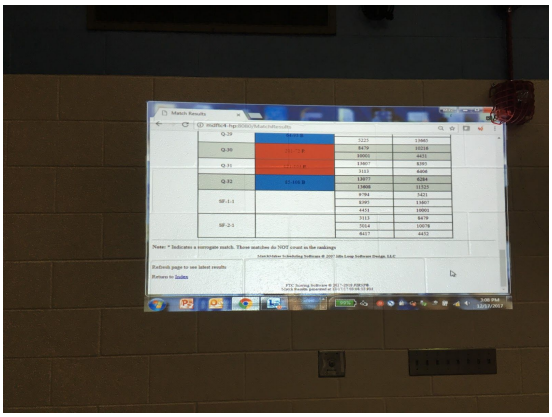
IN PROGRESS:

Tasks	Reflection
Scouting/Presentation/Inspection	- We were able to go to all the different teams and get a basic understanding of what their robots could do, but our notes were hard to read and we had little recorded data that we could use to evaluate the team. - We were all able to give detail about the various aspects of FTC and our experience through the process. However, we went a little over time for presentation and left time for them to ask questions. - We passed inspection! Our robot met the sizing requirements.
Match 1	- During our first match, we came across a lot of issues right away. For the autonomous portion, the robot was not able to perform any of the tasks properly. The jewel knocker did not extend for a wide enough range, and the glyph grabber could not function for autonomous. We also struggled heavily during the Tele-Op portion, where we did not score any glyphs into the cryptobox. We also did not grab the relic or attempt to balance on the stone during end game. These results clearly showed our lack of practice as well as a need for greater testing of the code.

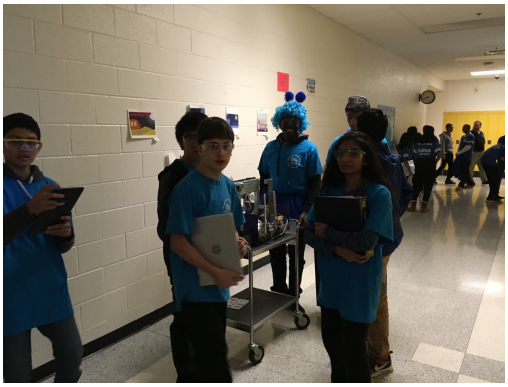
Match 2	- Unfortunately, the time between the first and second matches was not enough to make many significant changes, to the robot. The results for the second round during autonomous were very similar to what happened in the first round. During the second round, the jewel knocker was still too short and we could not grab a gryph and place it into the cryptobox. For the Tele-Op period, we were able to pick up a few glyphs, but in general we still struggled to pick up glyphs. Unlike the first round, we made an attempt to grab the relic, but we could not grab it. We also could not balance on the stone before the time went out during end game.
Match 3	After two losses, match 3 was a win. However, we still struggled to accomplish any of the tasks and relied heavily on our alliance team. The results were similar to that of the first two rounds.
Match 4	We finally made some significant progress during the 4th round. We successfully followed through with the autonomous portion. We knocked the jewel over, picked up the glyph, and parked appropriately to earn over 50 points. However, we still struggled with tele-op. We picked up four glyphs and made a row, but we still had issues with picking up the glyphs. Although partly a result of some of the mistakes our alliance team made, we could neither successfully pick up the relic during the end game, nor balance on the stone.
Match 5	Our performance during the 5th round demonstrated our growth over time. During our fifth match, the autonomous round went smoothly as before. We improved a little, considering we didn't have much time to practice between matches. Although we picked up the same amount of glyphs, the robot moved more smoothly. During the Tele-Op round, we had trouble grabbing onto the relic, but we did remember to get onto the balancing stone at the end of the round, and these points made a difference for winning the match.

Semifinals Round 1	We had a very tight round during the semifinals where we performed well but ran into several problems. During the autonomous period, our robot's jewel knocked did knock over the correct jewel, but it could not grab the glyph since the code had not been calibrated for the other side. We also did slightly worse in Tele-Op, since we only grabbed three glyphs and did not have a row or a column. We were finally able to grab and lift up the relic during the autonomous period. However, the arm could not hold onto the relic long enough to deposit the relic into the appropriate zone, which was disappointing because of the previous successes we had in grabbing the relic. Ultimately we lost the round by just 20 points, with significant room for improvement.

Figures 1 and 2: Photos From Our Qualifier



Figures 3 and 4 : Photos From Our Qualifier



Finished: Initial Review

Successes and Setbacks:	**Reflections:**
1. Autonomous Period: We were able to get the code working for some matches, but we need to maintain consistency throughout all the matches to maximize point efficiency. 2. Grabbing Glyph: We had a hard time grabbing the glyphs during all the rounds. 3. Extrusion System & Relic Arm: Our system has issues getting the relic in a timely manner so we need to increase practice time. 4. General Driving: We need to practice driving as whole more, because we were not as familiar with our systems we were not able to win.	1. Practice all aspects of driving: pick up moe glyphs at different angles, and pick up the relic. 2. We need to propose new designs for the glyph grabber and relic arm. 3. We will need to fix traction issues with wheels, for smoother movement around the field.
Recorded By: Bhavesh Kemburu	Reviewed by : Ragini Balachandran

Meeting #25

Date : January 3rd, 2017
Attendance : Zac, Bhavesh, Ragini, Rohit, Ben, Gunvir, Austin
Duration: 6 am - 9 pm
Goals: Improve our design based on competition performance results

IN PROGRESS: Robot Wiring and Drive Chain Modifications

Tasks	Design Consideration and Results
Improve on Robot Wiring	During competition, our wiring proved to be a hindrance that we hadn't considered until seeing our performance during the matches. For instance, the slider arm utilized a cable in order to power the motor, which kept coming off the connection during the matches, preventing us from scoring the relic in the recovery zones. We recognized in our team reflection that this was an imminent issue that needed to be tackled, and we began to rewire the robot in order to prevent any wires from getting snagged on extrusions or other moving parts.
Change the position of the Rev Robotics Module.	As part of the rewiring task, we also realized the position of our robotics module played a role in causing wiring problems during competition. Hence, we decided to turn the module 90 degrees in order to reduce space usage and prevent further wiring problems in the future. The modules are now supported by a two metal bars that allow them to be standing up vertically in their new positions.
Change the gears on the drivetrain to chains	During the our matches, the gears for the wheels would grind against each other, creating ear-piercing noise and preventing our robot from turning smoothly. By switching the gears that power the motor to sprockets and chain we are able to utilize the full capabilities of our mecanum wheels and are able to avoid problems with turning.

Figure 25.1 and 25.2: Sprockets and New chain

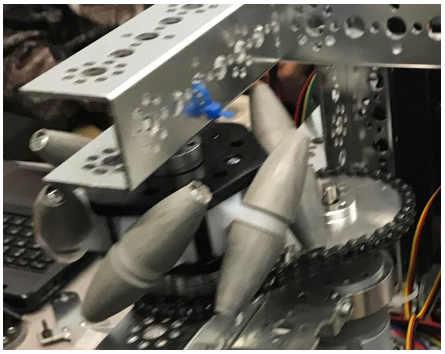
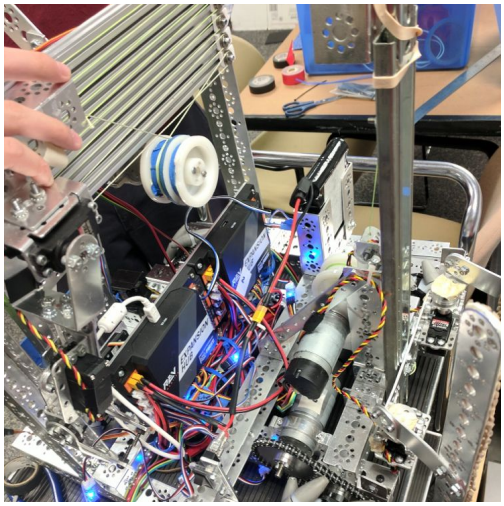
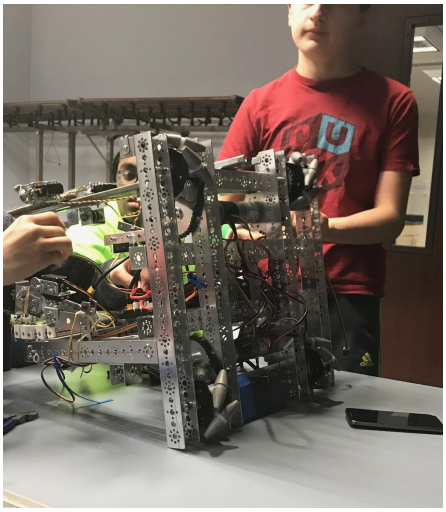


Figure 25.3 and 25.4 : Upright Rev System (New Wiring) and the completed chains

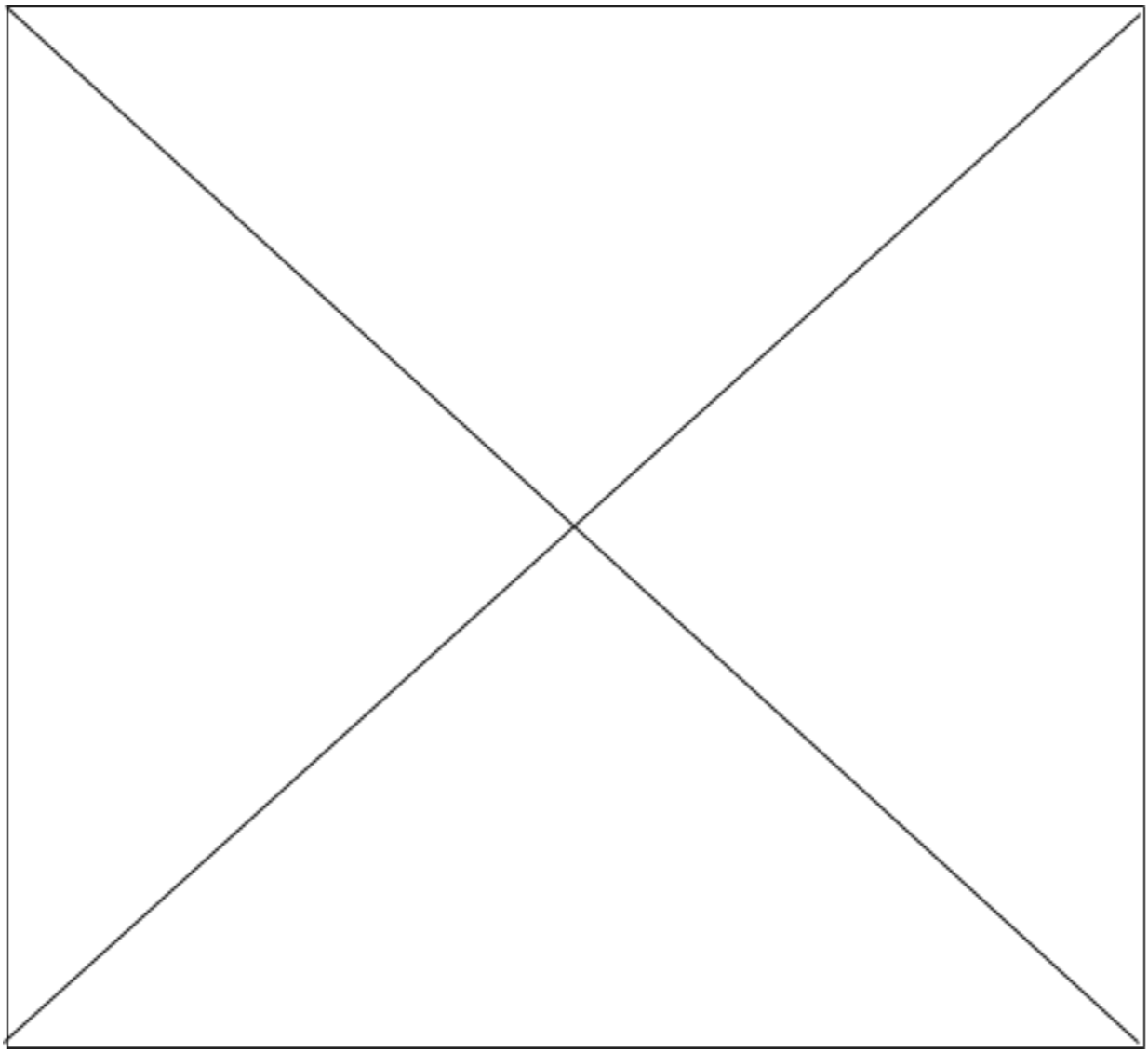




Finished: Rev Robotics Module Position, Adding Chains to Drivetrain

Successes and Setbacks:	**Reflections:**
1. We were able to complete the changing of the position of the rev robotics module, which created new space that we can use, and helped stop previous wiring problems in the area.	1. Continue to rewire the robot entirely before the next competition to eliminate a majority of the problems faced during last qualifier. 2. We should really emphasize driving in our future meetings so we can diagnose problems

2. Rewiring the robot is proving to be a harder task than initially thought, as so many factors need to be taken into account before making a change.	and get the necessary practice for the competition.
Recorded By: Rohit Harapanhalli	Reviewed by : Gunvir Labana



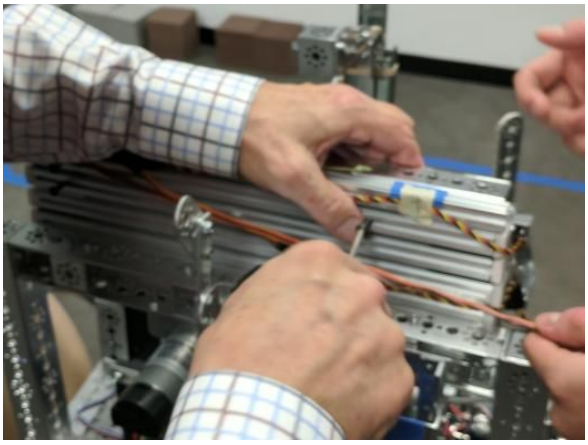
Meeting #26

Date : January 9th, 2018
Attendance : Zac, Bhavesh, Ragini, Rohit, Thomas, Vinamr, Connor, Sebastian
Duration: 6 am - 9 pm
Goals : Modify our design based off what we observed in drive practice

IN PROGRESS: Wiring + Driving

Tasks	Design Consideration and Results
ReWiring of the Relic Recovery System	The original wiring of the relic grabber was very unorganized and got in the way of other functions of our robot. We decided to fasten each segment of wire onto the middle of each extrusions. We did this by putting the servo wire between a screw and a nut, and fixing the nut into the middle, open section of the extrusions.
Fixed Left, Back Wheel	We had a broken spacer (a gray lego piece) on the axle of one of the wheels, and this was causing issues with our turning because the wheel was not properly aligned and was hitting the metal side supports on either side. We believe the spacer broke because the plastic came into contact with the loctite, weakening it. We removed the wheel from the base of the bot and added the needed lego piece , and then reattached the wheel.
Switch servos	We were having issues with the our servos being able to lift heavier metal pieces on the relic recovery system. We resolved this issue by adding more powerful servos.
Connected Motor Encoder Wheels to the Rev Expansion Hubs.	The logic converters arrived and we attached them to the encoder wire. With the logic converters we connected the encoder wires to the Rev Expansion Hubs. This was a crucial as it allows us to run our autonomous code efficiently.
Coding : Added new Control Scheme	After practicing our driving to change the the way our controls correspond to the the driver controllers. We initially had issues with driving and picking up glyphs in the time constraints, so we decided to modify our control.

Figure 26.1 and 26.2 : Inserting the nuts into the extrusions and fastened wires



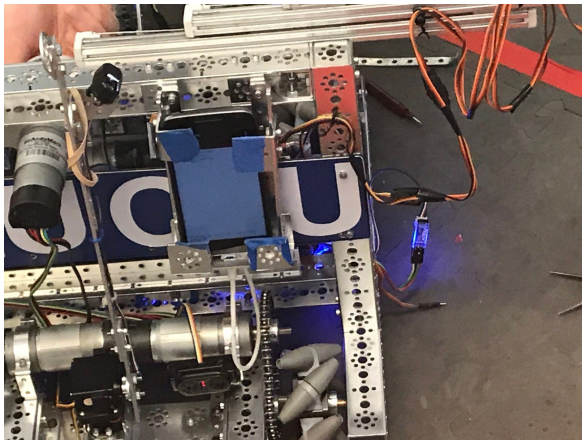
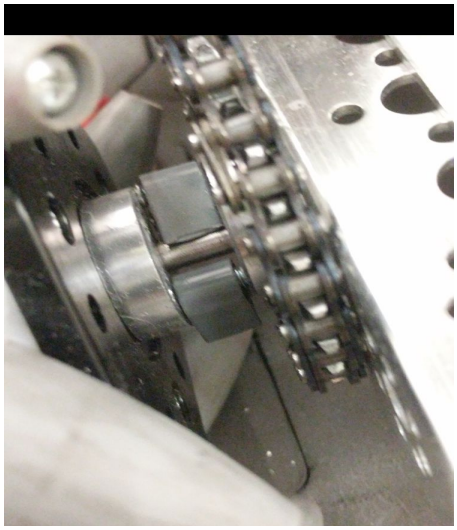
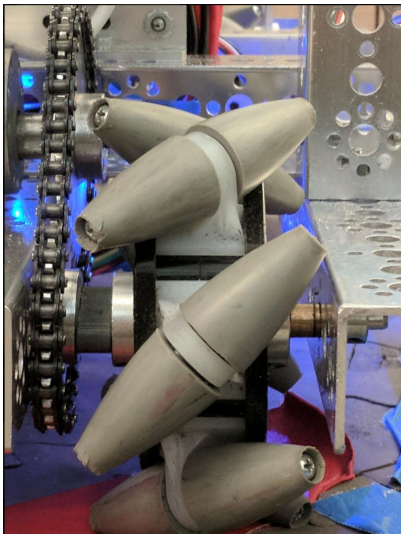


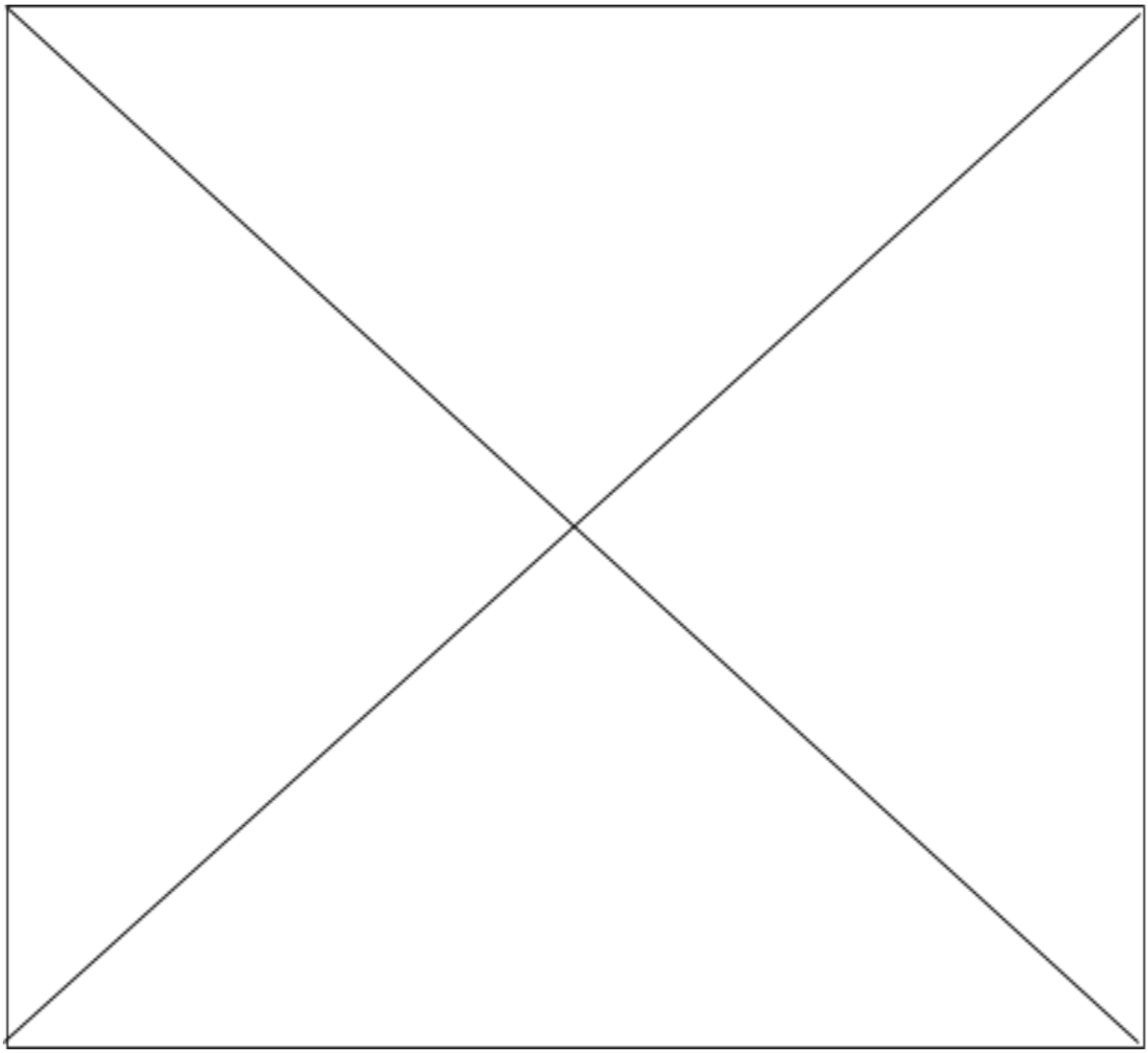
Figure 26.3 and 26.4 : The broken spacer and the replaced spacer





Finished: Drive Train Modifications & Wiring

Successes and Setbacks:	**Reflections:**
1. We were successful in wiring, and communicating as a team, and at replacing the broken spacer.	1. We need to spend more time practicing, and make more thought out decisions in order to to save more time.
Recorded By: Rohit Harapanhalli	Reviewed by : Ragini Balachandran



Meeting #27

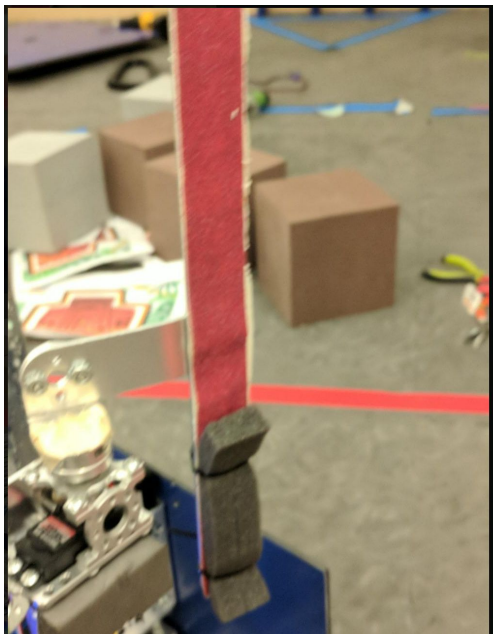
Date : January 12th, 2017

Attendance : Zac, Vinamr, Thomas, Austin, Zac, Gunvir, Ben, Bhavesh
Duration: 6 am - 9 pm
Goals: Complete wiring, coding, and the stringing of the Extrusions system

IN PROGRESS: Driving

Tasks	Design Considerations and Results
Fixed/changed the glyph grabber	We had many problems with the origin felt material on the glyph grabber as it caused a lost in friction causing the glyphs to drop while we had them in the glyph grabber. We swapped the glyph grabber to sandpaper after a lot of testing. The sandpaper increased the friction allowing the glyphs to be picked up easier. Also, after testing we found the glyph that will now stay in the glyph grabber unless the operator releases it.
Fixed the male and female xt30 connectors	We had a major problem where the male and female did not make a proper connection between the rev hubs and the battery. Due to this problem the second rev expansion hub would not supply or receive power. We used a camera and split open the connector with a probe to allow for more surface area to improve the connection.
Re Added the shell	We mounted the original shell into the planned spaces on the sides of the robot, and added the team name onto the topmost piece for aesthetic appeal.
Coding	The code has been fully completed and optimized for the robot. For the most part, it has been working as desired. The problems that we have had in relation to the mobility of the robot aren't related to code, but rather mechanical problems such as broken servos.

Figure 27.1 and 27.2: The modified glyph graber



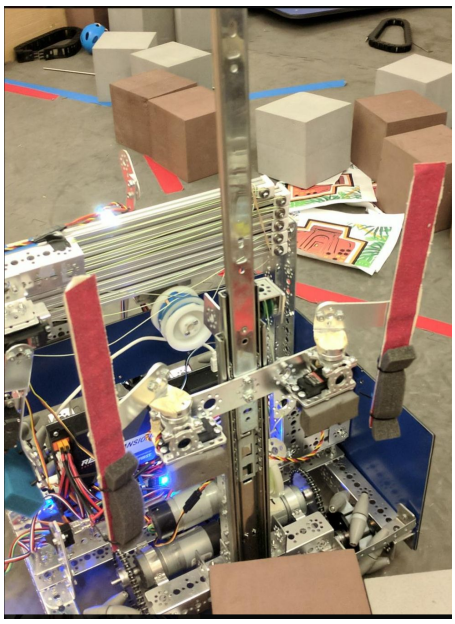
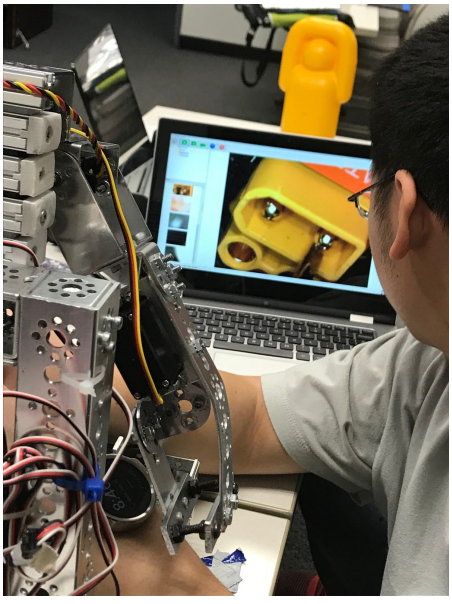
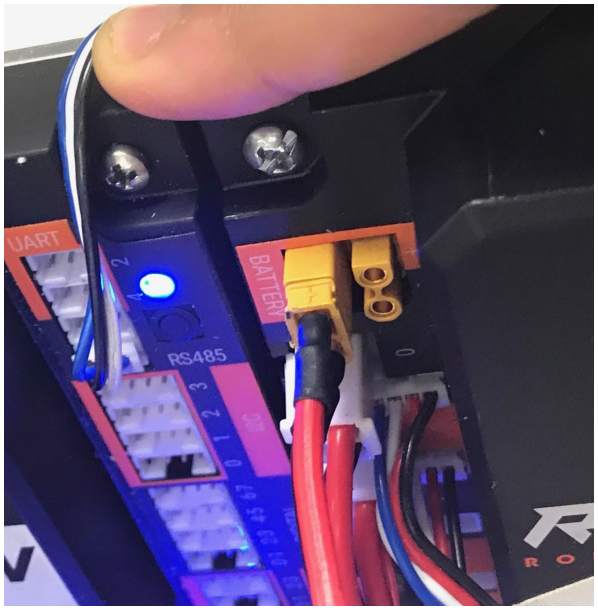
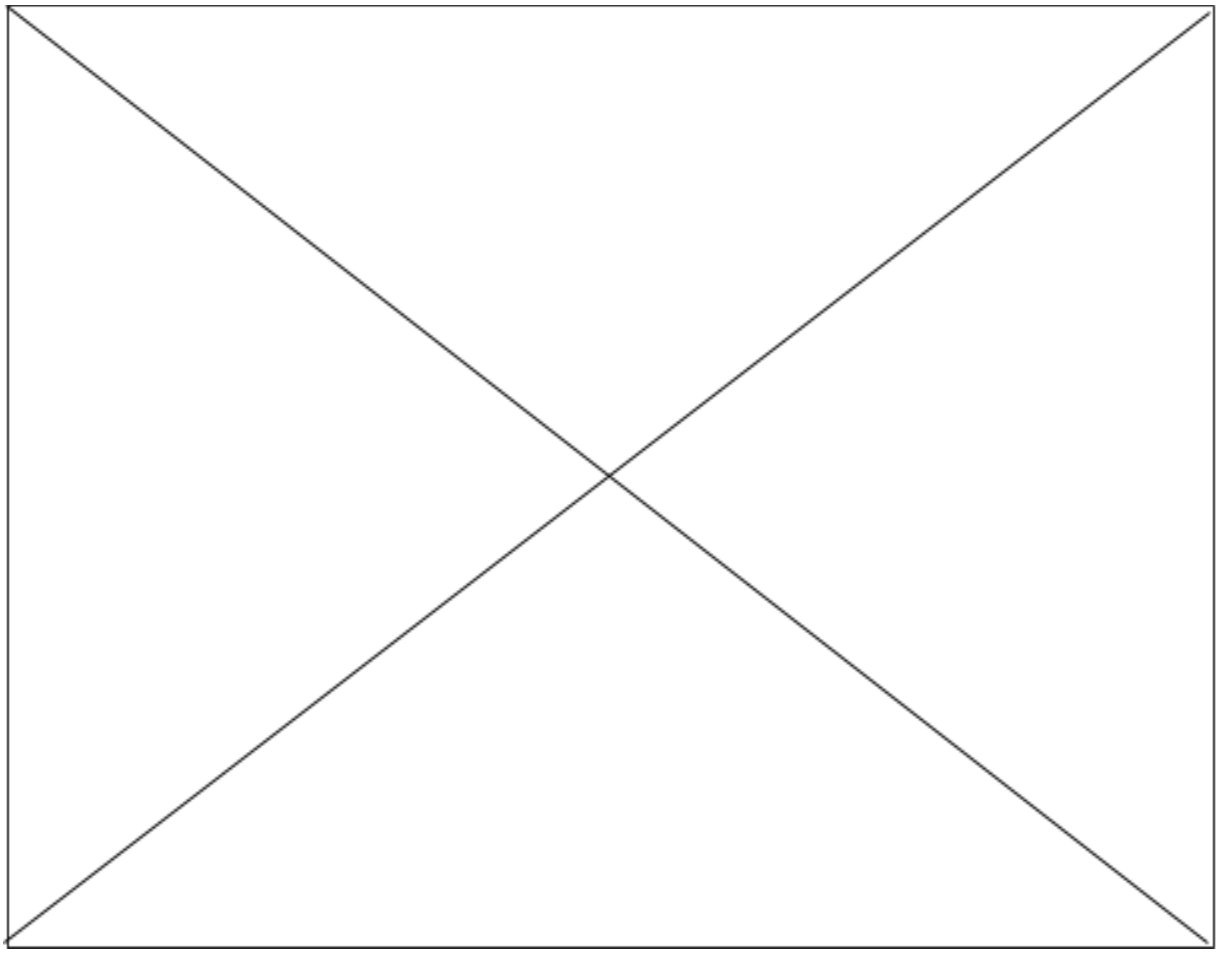


Figure 27.3 and 27.4 : The probing process to fix the xt30 connectors





Successes and Setbacks: 2. We were successful in wiring, and communicating as a team, and at working together to solve/diagnosis problems.	**Reflections:** 2. We need to spend more time practicing the autonomous and driving so we score to our full potential at competition.
Recorded By: Austin Long	Reviewed by : Ragini Balachandran



Meeting #28

Date : February 3rd, 2018

Attendance : Whole team present!
Duration: 10 am - 5 pm
Goals: Complete wiring, coding, testing, and the stringing of the Extrusions system

IN PROGRESS: Testing

Tasks	Design Considerations and Results
Tested the glyph grabber	We heavily tested the new glyph grabber as we do not want any major problems at the worlds ftc competition. We found slight errors with programing and fixed them so that we can stack glyphs faster than we previously could
Tested new battery holder	We made a new battery holder which can hold both the standard 12 volt battery and the Rev battery.
Fixing relic arm	The original relic arm we made had a 25% success rate however with the new relic arm has a 80% success rate and can score a relic in about 10 seconds
Memorizing how to string the relic arm	The relic arm could only be stringed by one member but, in this meeting the other members of the team learned how to string the relic arm. This was important because, the current relic arm only uses one string to move inward and outward.

Meeting #28

Date : February 3rd, 2018

Attendance : Whole team present!
Duration: 10 am - 5 pm
Goals: Complete wiring, coding, testing, and the stringing of the Extrusions system

IN PROGRESS: Glyph grabber

Tasks	Design Considerations and Results
Changing the glyph grabber	After running through three different prototypes we came to the final product which is two pairs of arms. These arms are programmed to close and open at the same time in order to stack glyphs faster. We also increased the length of each arm so we do not have to worry about the angle of the cubes.
Change the material on the glyph grabber	We changed the material on the glyph grabber arms from thick foam to prous foam which can squish around the glyph for a better grip.
Practicing relic arm	We got the time for the relic arm down from 10 seconds to 5 seconds.
Wiring	We prioritized safety on our checklist and rerouted all the wires so that they were safer the robot was safer allowing for better aesthetics and a more safe experience for viewers and other teams.

Meeting #28

Date : February 3rd, 2018

Attendance : Whole team present!
Duration: 10 am - 5 pm
Goals: Complete wiring, coding, testing, and the stringing of the Extrusions system

IN PROGRESS: Testing

Tasks	Design Considerations and Results
Fixed relic arm structural integrity.	We noticed that the relic arm would lean one way which was a major safety concern as well as the fact that it created the fear that the relic arm would snap off. To solve this we purchased vex aluminum profile plates which fit on to the back of the extrusions and made it so that the relic arm would not lean one way or the other.
Stress teste	We made a new battery holder which can hold both the standard 12 volt battery and the Rev battery.
Practiced relic arm	The original relic arm we made had a 80% success rate however with the new relic arm has a 100% success rate and can score a relic in about 4 seconds
Practiced stringing the relic arm and glyph grabber	We practiced how to string the relic arm and the glyph grabber so that we could restring the relic and glyph arm as fast as possible. This made it easier so that we could have no problems at worlds

Analysis of Qualifier 2 Results and Needed Improvements

January 17, 2018 Qualifier Bullis 2 Results

Match	Field	Status	Jewel	Glyph	Parked	Glyphs	Relic	Balanced
1	1	loss	missed	yes	yes	3	failed	no
2	2	win	yes	yes+?	yes	3	dropped	yes

3	2	win	both	failed	no	crashed		
4	2	win	yes	yes+?	yes	3	In 3	yes
5	1	win	no	no	no	5		yes
6	1	loss	missed	out	yes	3	standing	yes

Overall performance

During our qualification matches, we were able to win four out of the five qualification rounds for a total of 8 points, before we were eliminated during the first round of semifinals. Looking at our individual scores, we were able to improve progressively through the rounds. However, we had inconsistent results during the Autonomous and Tele-Op periods. For the Tele-Op rounds we struggled with both knocking over the jewel and with depositing the glyph. For the jewel, our jewel knocked did not extend far enough to knock over the appropriate jewel. Also, during one qualification match, our jewel grabber knocked over both jewels, and this occurred because the color sensor did not detect the appropriate color jewel to knock. We also struggled with depositing the glyph into the appropriate slot because of our slow grabbing system.

Necessary Changes

1. We need to modify our glyph grabbing to maximize our scoring during the main portion of teleop.
    a. Need to go from a passive intake (non moving) and active intake (moving components) using some sort of wheel.
2. We need to ensure autonomous is working perfectly during the competition.
3. Prevent of Relic Grabber from getting stuck in the field, by modifying it with 3 D printed parts
4. Fix Drivetrain issues

Meeting #28

Date : January 20th, 2018
Attendance : Ben, Austin, Ragini, Bhavesh, Connor
Duration: 10 am - 4 pm
Goals: Fix chain system on wheels, Prototype glyph grabber system.

IN PROGRESS: Driving and Redesign

Tasks	Design Considerations and Results
Identify problems with Drivetrain	During the qualifier we encountered several problems with the wheels, relating to speed and torque. We decided to investigate the problem by investigating the way we mounted the wheels. We noticed that the set up for the wheels were both inconsistent and incorrect. For a few of them we did not use screws of correct size or the correct amount of screws. In addition, we did not use washers on the side of axle hubs, and as a result of the contact the c- channels supporting the wheels were heavily damaged. We also noticed that the set screws were not tightened on the axle.
Fix Problems with the drivetrain	We fixed the problem in four main ways: 1. We reinforced the sides of the C channels so they would not give way during the competition. 2. We made sure to replace axles and use 4 3 inch long screws in every wheel. 3. We adjusted the placement of each wheel, so that they would not hit the sides of the C-channels. 4. We changed the chain length so that it would not be too tight or too loose, and affect our ability to strafe or drive.
Glyph Grabber System Modification: Active Grabbing	We came up with several possible ideas to alter the glyph grabber system to improve the system's speed and gripping strength. We decided that a system with an active rather a passive system would be more effective.

	One design involves using wheels on the arm. The previous grabber arm still makes up the foundation of the robot. However, the new design consists of four wheels, and two sets of inner arms controlled by two sets of servos. The wheels would allow for better grip of the glyphs at different angles, and the arms would fold into the robot. The second design involves just a wheel at the base of the current glyph grabber, to help spin the the glyphs into the wheel.

Figure 28.1 1st Possible Glyph Grabber Design

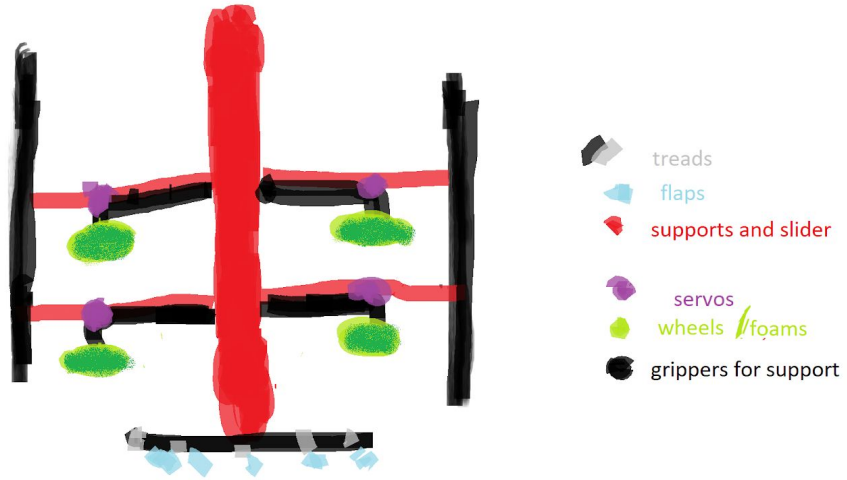
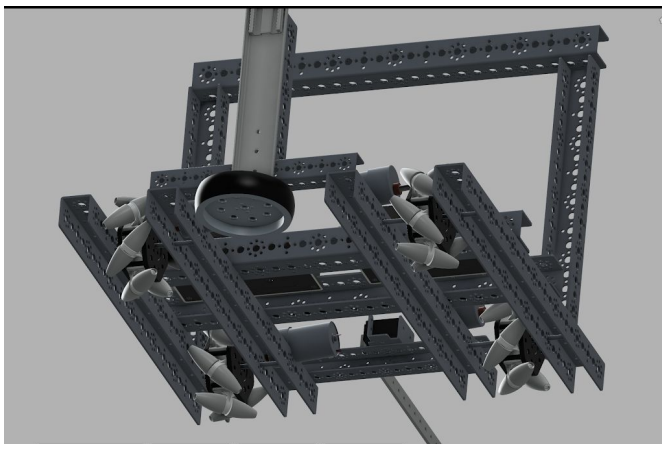
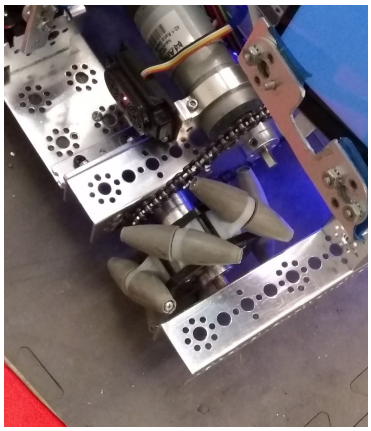


Figure 28.2 and 28.3 : Second Possible Glyph Grabber Design and Adjusted Wheels





Successes and Setbacks:	**Reflections:**
1. We were able to adjust the wheels so that the robot could move strafe more smoothly. 2. We constantly had trouble finding parts for certain components of our robot, due to a lack of proper organization.	We were able to fix a problem that troubled us during qualifiers, but it took a longer time than expected. We still need to make progress in other aspects of the robot, including creating a new system for grabbing glyphs. While some of the decisions seem efficient in concept, we have often learned that after we build, the design ceases to be practical. We need to continue to make progress building so that we have enough time to practice before States. To do this, we need to come up with detailed designs that involve dimensions and what parts we will need. We also need to better organize all our parts so that we can build more quickly. One thing that we can do for future meetings is assign roles for what each group member can contribute, since there are a lot of different aspects that we need to focus on, including presentation, outreach, and PROMOTE video.
Recorded By: Bhavesh Kemburu	Reviewed by: Austin Long

Meeting #29

Date : January 27th, 2018

Attendance : Ben, Austin, Ragini, Bhavesh, Connor
Duration: 10 -4pm
Goals: Fix chain system on wheels, Prototype glyph grabber system.

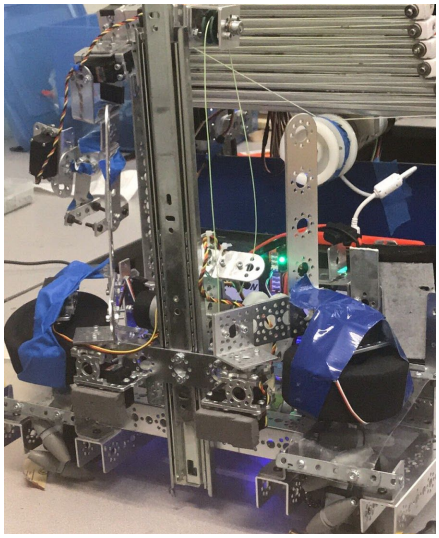
IN PROGRESS: Driving and Modeling of the Wheel Intake

<table>
<tr><th>Tasks</th><th>Design Considerations and Results</th></tr>
<tr><td>Decide which possible glyph collection system modification to pursue</td><td>
<table>
<tr><th>System 1- Four Wheels</th><th>System 2- One Wheel</th></tr>
<tr><td>Pros
1. More Reliable Gripping at Both Heights
2. Faster

Cons
1. More complex integration in our current system
2. Needs stronger servos or vex motors to use</td><td>Pros
1. Simpler Implementation
2. Provides a means of rotating the blocks the correct angle
Cons
1. This wheel may not be big enough to maintain to contact with the glyphs so it may hurt more than help</td></tr>
</table>
Decision : Go with a system that is more likely to work even though it may be more complex. We will go with the four wheel design.
</td></tr>
<tr><td>Finalize design and Recognize design constraints</td><td>Since we decided that the arms that support the wheels and simultaneously grab are going to fold into the robot to save us time modifying the main structural components of our design. We decided that we may need to use smaller wheels and change our actual grabber which support the wheels . We will also need to use wheels smaller than 4 inches to make sure we fit</td></tr>
</table>

	into the sizing cube.
Replace Current Design with the New Design made out of actobotics	Once we finalized our design , we constructed our design out of actobotics parts which allowed us to mount continuously rotating . Using two long actobotic pieces we attached continuously rotating servos and mounted wheels on the system.
Create a New battery mount	At our competition we need to use both rev batteries and old tetrix batteries, but our current system only allows for us to use the new rev battery. We modified the old holder with l pieces that enable us to place the bigger battery securely if we are not using the rev battery.

Figure 29.1 and 21.2 Glyph Grabber prototype construction



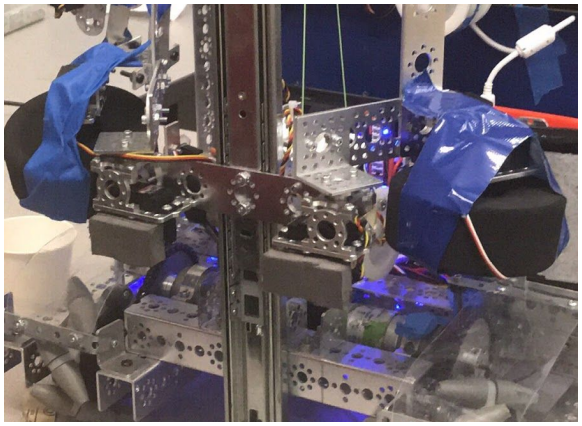
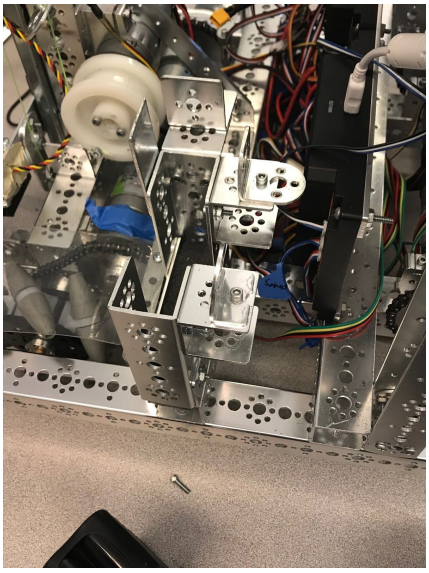
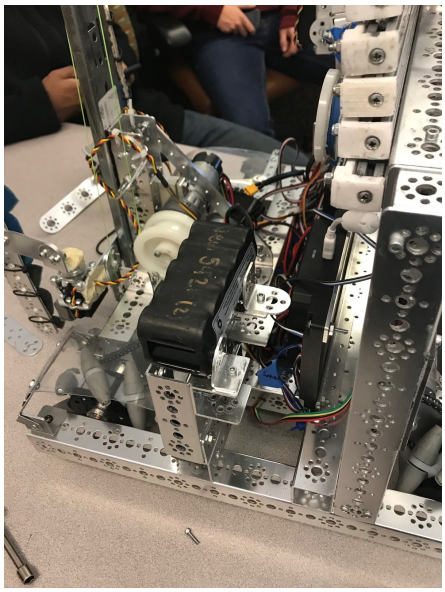


Figure 29.3 and 29.4: New Battery Mount





Successes and Setbacks:	**Reflections:**
We were successful in executing our design plan, but we encountered setbacks in the availability of the parts. We were not able to use the correct size wheels, or get all the parts to finish assembly.	We ordered the VEX motors to use, and we will need to use them in order to improve our speed and capture the necessary glyphs to win at states. Overall, this was a successful meeting, but we have a lot left to do with very little time
Recorded By: Ragini Balachandran	Reviewed by: Austin Long

Meeting #30

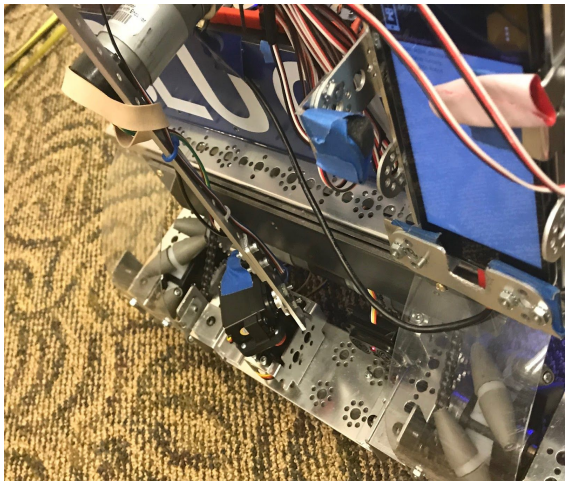
Date : February 7th ,2018

Attendance : Ben, Austin, Ragini, Bhavesh, Connor, Zac, and Bhavesh
Duration: 6-9pm
Goals: Add major aspects to robot collectio system

IN PROGRESS:Glyph System

Tasks	Design Considerations and Results
Added Weights and Wheel Covers to the back	We added weights beneath our plastic name plate on our robot in order to back sure both the back and the front of the robot were balanced. An uneven weight distribution would cause problems with our strafing ability, which affects our performance during autonomous, with putting the glyph into the appropriate cryptobox.
Finish wheel system assembly	We decided to replace our older glyph arm system with a different design that can more easily pick up the glyphs. The new system consists of two arms consisting of several L-brackets. Each arm consists of two wheels and a servo that allows for rotation of the wheels during operation. The wheel system has several benefits: 1. Pick up glyphs more easily at different angles 2. Pick up glyphs at a faster rate 3. More durability and further range of motion We finished our assembly by using 2 inch tetrix wheels along with vex motors and continuous rotation servos. We used 3d printed adapters to allow us to use the square vex axles, and be able to attach the system to our actobotics robot arms.
Attached servo power module	We recently purchased a servo power module and attached it to the front of the robot. The power module powers the vex motors, as well as amplifies the power of all the servos. This should allow our robot's arm as well as other parts that rely on servos to move with more fluidity.

Figure 30.1 and 30.2 : Added weights/ wheel covers, and our 3d print adapter piece



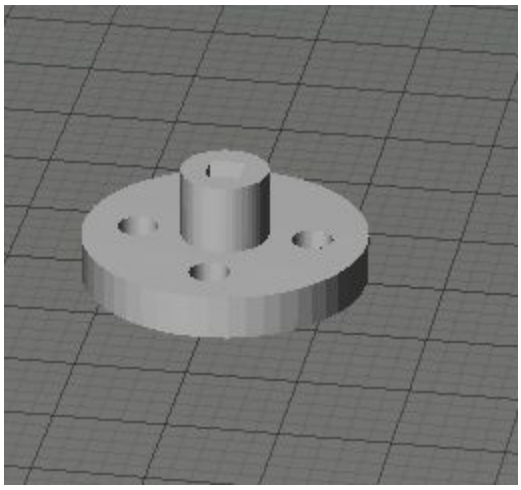
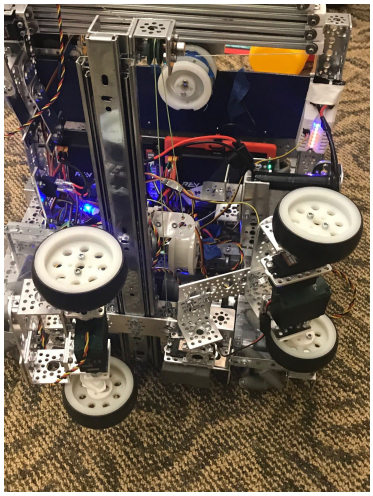
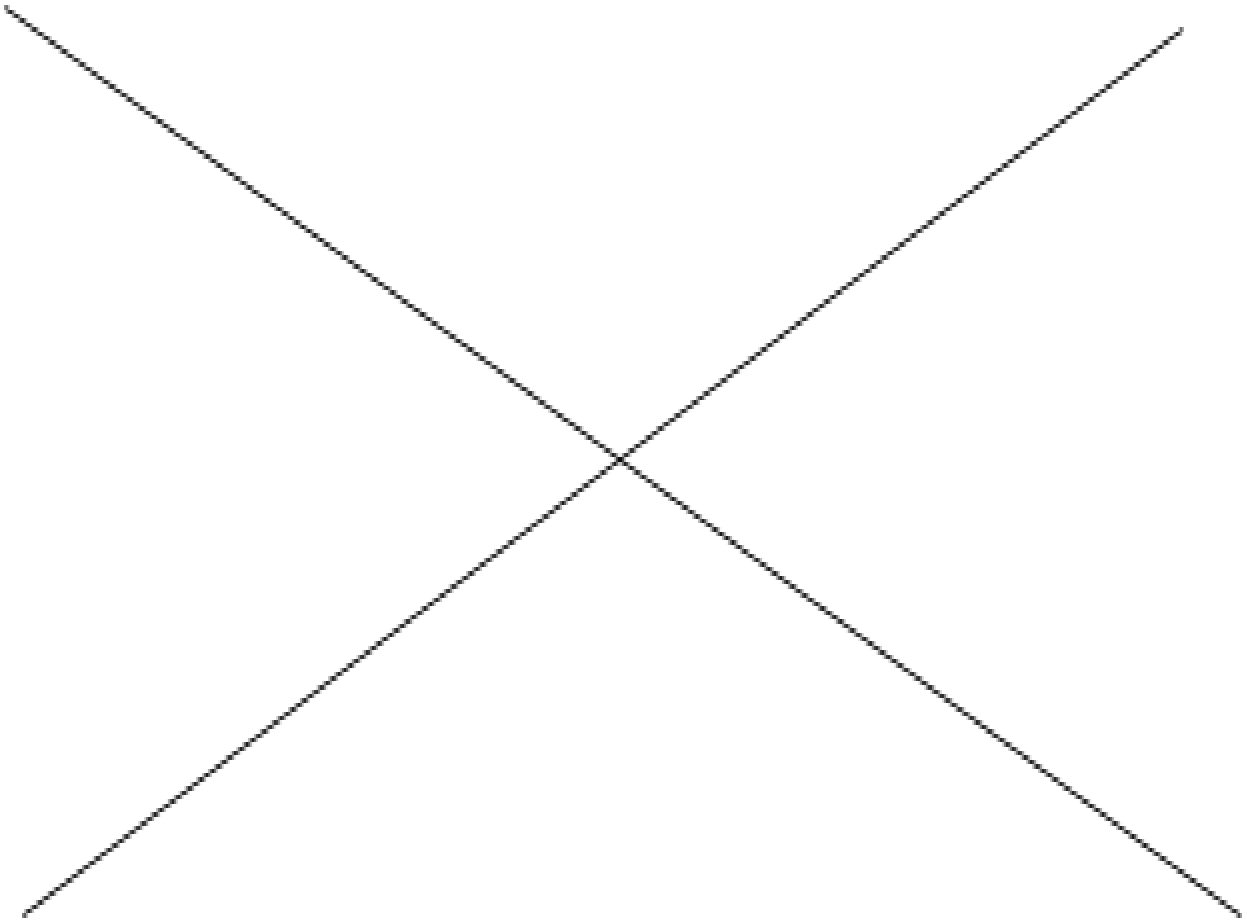


Figure 30.3 and 30.4 :Finished Glyph arm system and the servo power module



Successes and Setbacks: We were successful in quickly creating our glyph grabber system, and using our machinery to the fullest potential.	**Reflections:** We would like to 3D print a new glyph grabber, and we are in the process of coming up with a new design. We are, however, in a time crunch because of the incoming states competition on February 17th.
Recorded By: Bhavesh Kemburu	Reviewed by: Austin Long



Meeting #31

Date : February 12th, 2018

Attendance : Ben, Austin, Ragini, Bhavesh, Connor, Zac

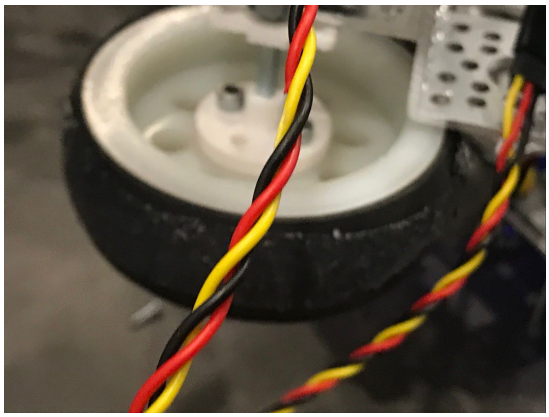
Duration: 5-9 pm

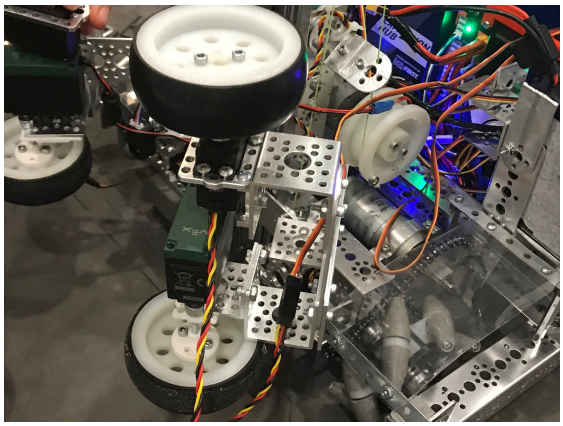
Goals: Finish Final adjustments before competition and be as prepared as possible

IN PROGRESS: Driving and Continued modifications

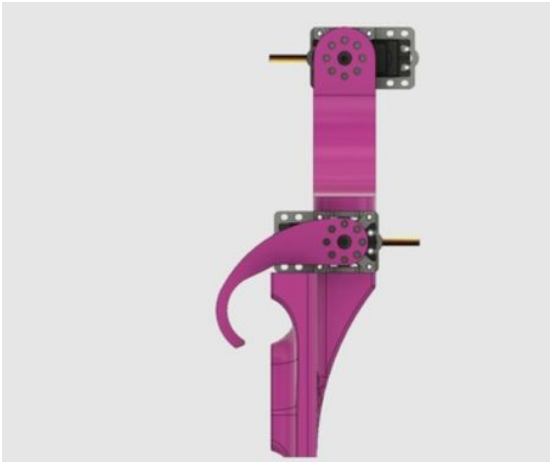
Tasks	Design Considerations and Results
Cadding and 3d Printing of New Relic grabber	We cadded our relic grabber using Fusion 360, with the goal of having a more durable relic grabber with precise dimensions. The design consists of a relic mold of the face of the relic, so that the relic arm can actually grip the relic with precision and accuracy. It will connect to the robot with a servo that will move the entire grabber back and forth, and another servo at the bottom of it will move the claw itself. The strength of the new grabber will be far more than the previous one, therefore picking up the relic with more ease.
Addition of Friction tape on wheels	We added friction tape to the wheels on the glyph grabber system. A minor addition to the system, the tape ,should allow for better grip of the wheels when grabbing the glyphs at different angles.
Final Wiring	We firstly soldered an xt 30 connector to a wire to which we then connected to the rev power hub and to the servo power module. Following this we were able to organize , label, and manage servo wires a

Figure 31.1 and 31.2 : Friction Tape and up close view of the System



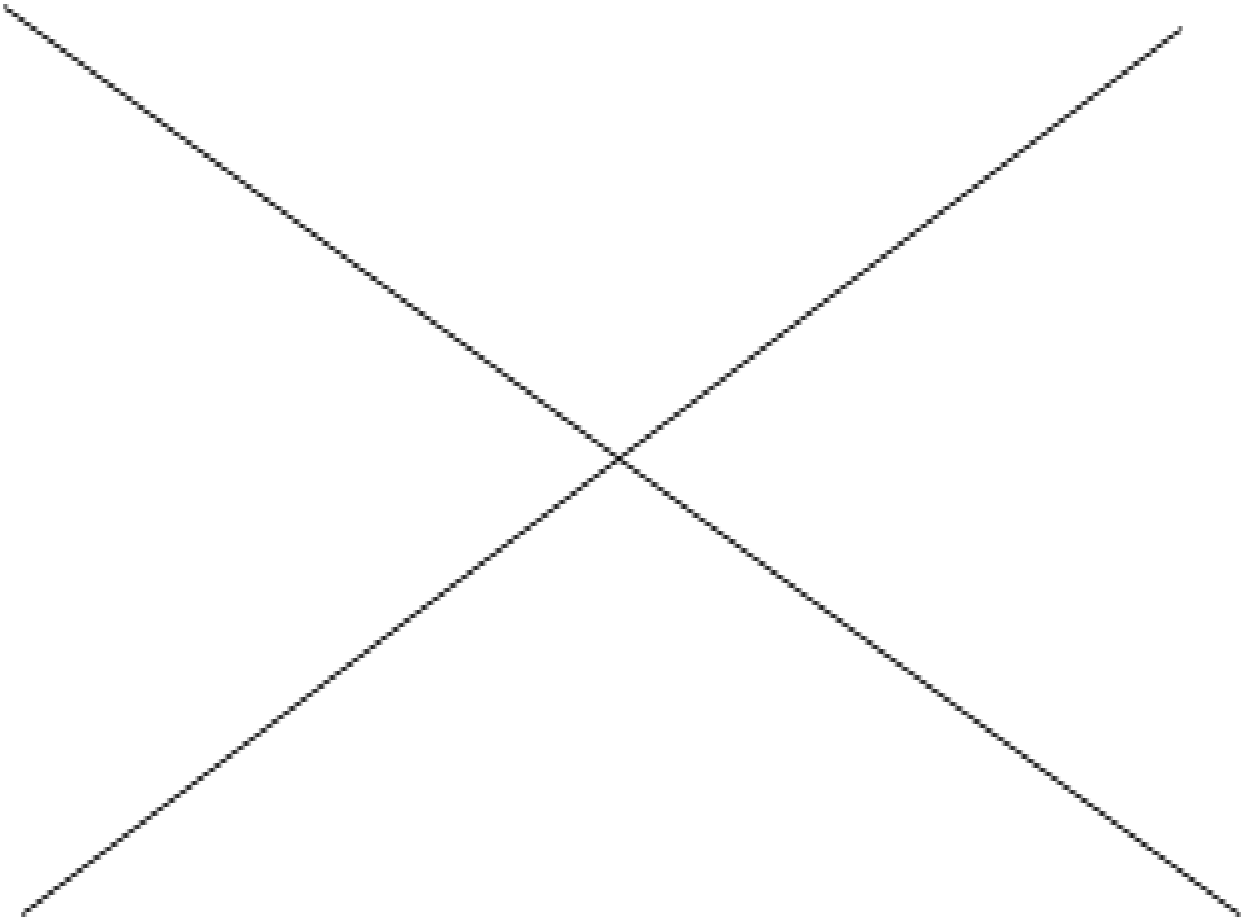


Cadded Relic Grabber



Successes and Setbacks:	**Reflections:**
We were successful in our testing methodology , but we faced a major setback in terms of time. We spent a large portion of our meeting soldering so we did not have much time to practice.	We will need to prioritize practicing and our new relic grabber may need to wait until after states. While we can get it printed before states but it is not feasible to integrate it into the system.

Recorded By: Bhavesh Kemburu	Reviewed by: Austin Long



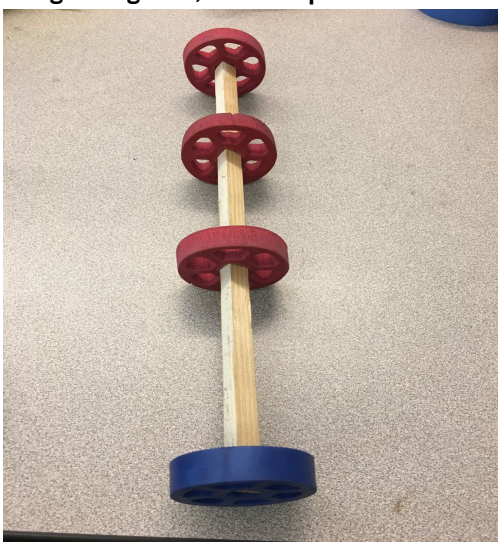
Meeting #32
Date: March 24th , 2018
Attendance : Ragini, Ben, Sebastian, Thomas, Gunvir, Connor, Austin, Bhavesh, Vinamr
Duration : 10am-6 pm
Goals: Assess what improvements can be made

IN PROGRESS: Glyph Grabber

Tasks	Design Considerations and Results
Redesigning glyph grabber	After discussion and analysis of the original glyph grabbers performance at states, we decided to redesign the system. The previous glyph grabber used grip/friction tape across wheels of a wheel intake system. We discovered that the system was slow, but effective. For the new system we would like to incorporate the aspects of the original glyph grabbers effectiveness. Possible designs can be in Figure .1 a
Robotic Arm	Similarly to the process of the Relic claw, deciding a improved design design for the arm needed much thought to ensure its success. Our current design uses a motor and string to extend and expand with ease. Although the design has been effective, we are always searching for ways to improve
Wiring	Although the current position of the wiring prevents the wires from being tangled/torn in the moving parts of the robots, the the way wires are right now needs to be more organized and aesthetically appealing.

Figure1.1: Possible Relic Arm Design

1) Using a long axle, we can spin a series of compression wheels to hold the glyphs



Completed:

Successes and Setbacks:	**Reflections:**
• We were able to successfully brainstorm possible glyph grabber designs • Improvements to the relic grabber/ arm still needs to be done	• In the future we may want to consider space limitations to the new designs that are being offered
Recorded by : Thomas Ajala	Reviewed by :

Meeting #33

Date: April 14th , 2018

Attendance : Ragini, Ben, Sebastian, Thomas, Gunvir, Connor, Austin, Bhavesh, Vinamr

Duration : 10am-6 pm

Goals: Assess what improvements can be made

IN PROGRESS: Glyph Grabber

Tasks	Design Considerations and Results
Drawer Slides	One idea that we are experimenting with is using an extremely long screw, attach to the drawer sliders. The drawer sliders would be attached to a pulley, which will allow it to capture a block from the top of top, opposed to the sides which made it difficult to grab glyphs when many glyphs are placed side by side. The system is shown on our test robot in Figure 33.1
Glyph Grabber	We decided that by slightly adjusting our original glyph grabber system, we could improve the main system greatly. Using four servos , we have four servo arms, two on each side of the drawer sliders. Having two sets of servo arms prevents the size variation of the glyphs to stop the robot from picking up more than one glyph successfully, which was a problem with the previous system. An example of such a servo arm can be seen in Figure 33.2 Additionally, we attached a plate to the front of the drawer sliders. Placing a plate will help correct the positioning of an glyphs pushed against it, and make it easier for the robot to pick up.
Wheels	After drive testing the drivetrain, we discovered that the wheels and the chains we used for them required tightening. Otherwise, the wheels would not be able to move as fast as they could, as they are weakly connected to the motors.

Figure 33.1: Possible Drawer Sliders System

1) Using a pulley to manipulate drawer sliders that rotate, we can pick up glyphs in an easier manner

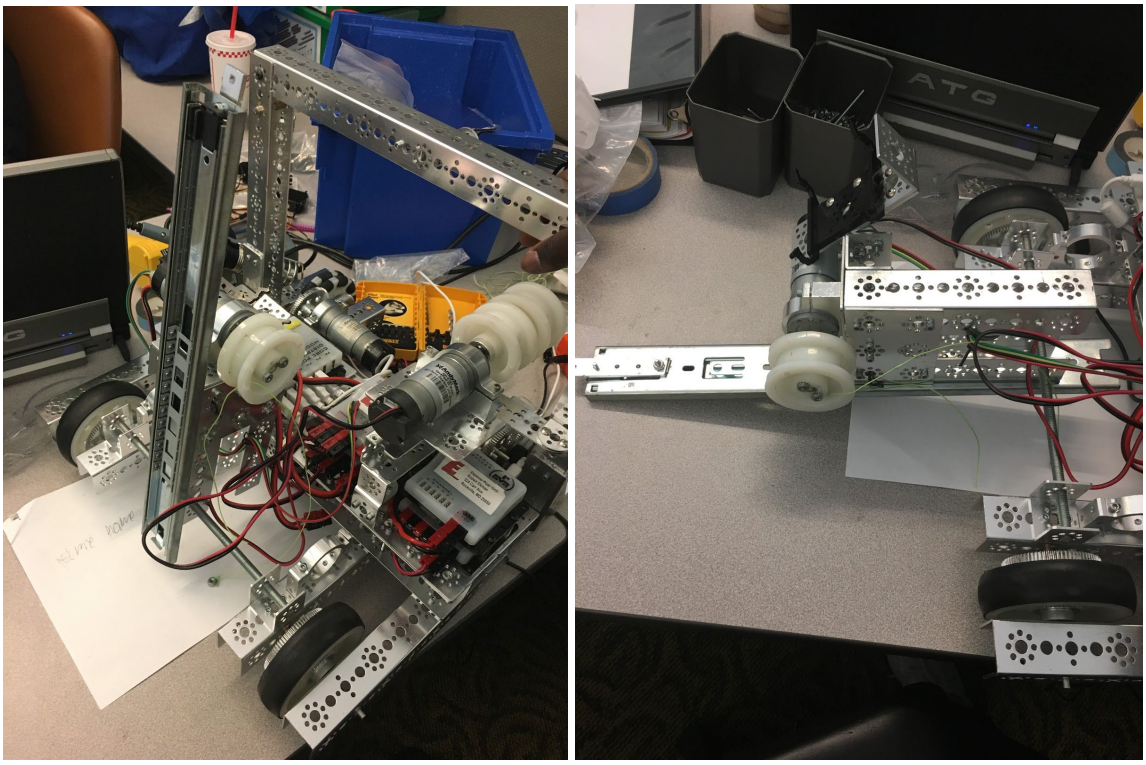
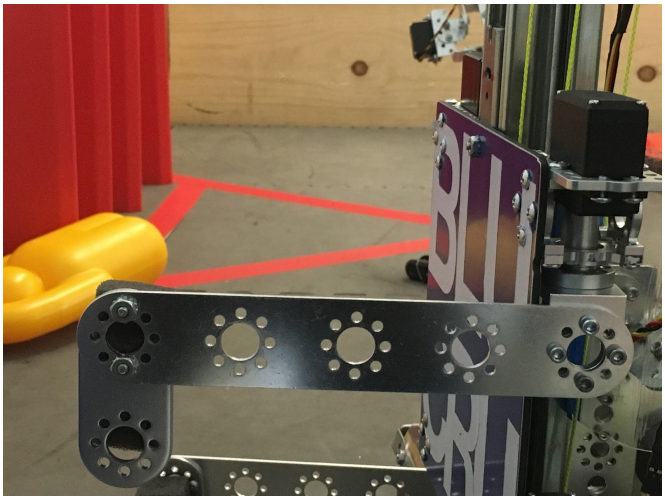


Figure 33.2: Servo arm

2) Using multiple servo arms we can pick up glyphs easier than before



Completed: WHEEL CORRECTION

Successes and Setbacks: • We were able to successfully correct the problems with the wheels • An improved system for the glyph grabber was made and attached	**Reflections:** • We should assess the effectiveness of the potential drawer sliders system before implementing them
Recorded by : Thomas Ajala	Reviewed by :

Science and Mathematics Section

Calculation 1: Robot Speed and Timings

Purpose: These calculations help us approximate how much time we need to take collecting cubes and placing them in the crypts, as we only have 2 minutes to score as much as we can. This can also help us manage our time for the relic placement during the endgame.

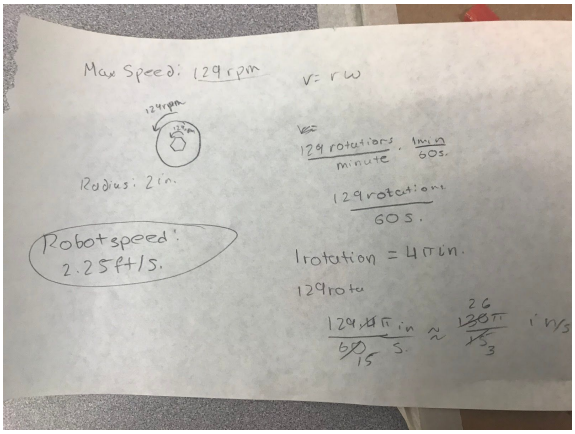
Background & Calculations : We know that the rotation speed for our motors for the wheels is 129 rpm. Now, the speed of the motor is equal to the speed of the wheel, which has a diameter of 4 inches. Therefore, 1 rotation is 4pi inches, by the circumference formula. Now, we must convert the angular velocity from inches/sec to radians/sec in order to utilize the below formula:

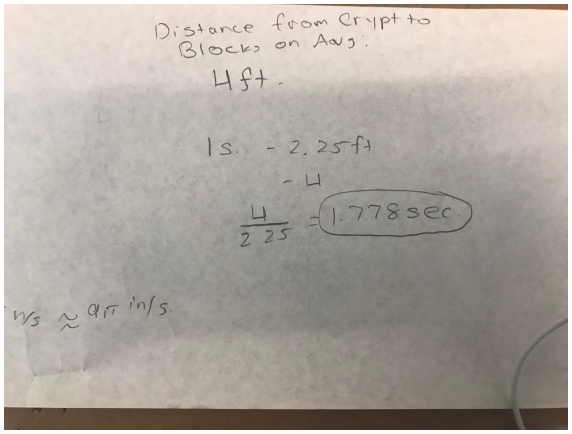
$$v = \omega r$$

129 rpm
r = radius in meters

Converting our answer to feet/sec yields 2.25 ft/sec as the speed of our robot, negating gravitational forces.

Now, through measurement of the field, the average distance from our starting tele-op position to the cubes is 4 ft. Solving for time yields an average time of 1.778 seconds for the robot to travel to the cubes and back.





Calculation 2: Torque Calculations

Purpose: To determine if the robot will be sturdy when we extend the arm for the relic delivery.

Background & Calculations :

As seen in the diagram below, we need to compare the extension moment of the arm with the center of mass. With a measuring tape, we find that the distance the arm extends to is 53 inches, or 1.35 meters. Now, looking online for extrusion specs, we find the weight to be around 1 lb, and we estimate the claw to be around 1 lb as well. While we've visually seen that the robot doesn't tip over, we want to mathematically prove so.

We determine the center of gravity to be one of the wheels, so we base our calculations around there. We estimate the robot to be around 20 lbs, and that the vertical beam on the opposite side of the wheel to be 1 lb as well, so we know that 19 lbs of weight are on the other side. This means that all we need to prove is that:

$\Sigma r \leq \Sigma l$ where r is the weight on the right side, and l is the weight on the left side, or 19 lbs. If we can show that, then we prove that it won't tip over.

Now since the weights of all the components are relatively equal, we can reduce the weight to ratios, summing 1+1+1 to get 3 lbs empirically. There is no way that this weight is greater than the 19lbs, so it won't be able to tip over. Therefore, the arm won't cause the robot to tip over during the endgame.

ϙεδ (QED)

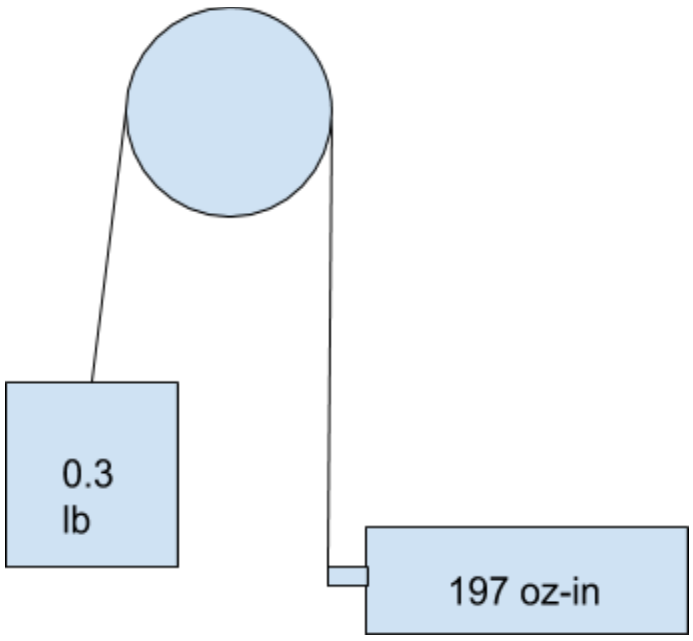
Calculation 3: TPI Calculations

Purpose: To determine the force the motor exerts on the pulley, and whether it will be able to sufficiently lift one block or two.

Background & Calculations :

We see from a Google search that the motor has a stall torque of 197 oz-in. In order to calculate the linear force exerted, we must utilize the equation:
$\tau = rFsin\theta$ where T is torque, r is the radius, and F is the force. Because the linear force is always perpendicular to the motor, the trig function returns 1, so we can ignore the sin function.

The radius of the axle is 0.73 inches, so dividing gives us a force of 75 N. Now, the only opposing force we must worry about is the gravitational force the blocks apply on the wheel mechanism. One cube weighs 0.3 lbs, so converting to kg and multiplying by 9.8 yields 1.33 N that each cube exerts in terms of gravitational force. Clearly, even with two blocks, the force exerted by the motor surpasses the gravitational force by a long shot. The strength is augmented further with frictional force the wheels exert on the cube, which we didn't consider.



QED

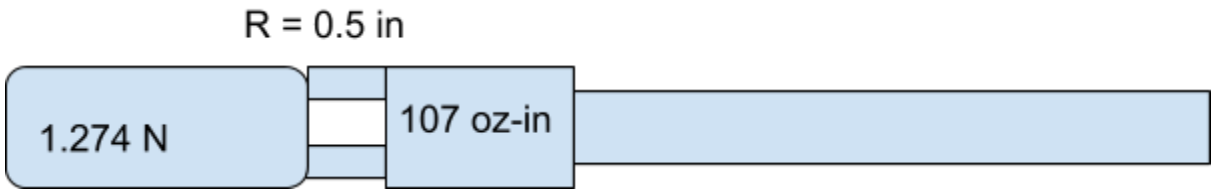
Calculation 4: Claw Calculations

Purpose: To determine the force the servo exerts on the claw, and to see if it can easily lift the relic.

Background & Calculations :

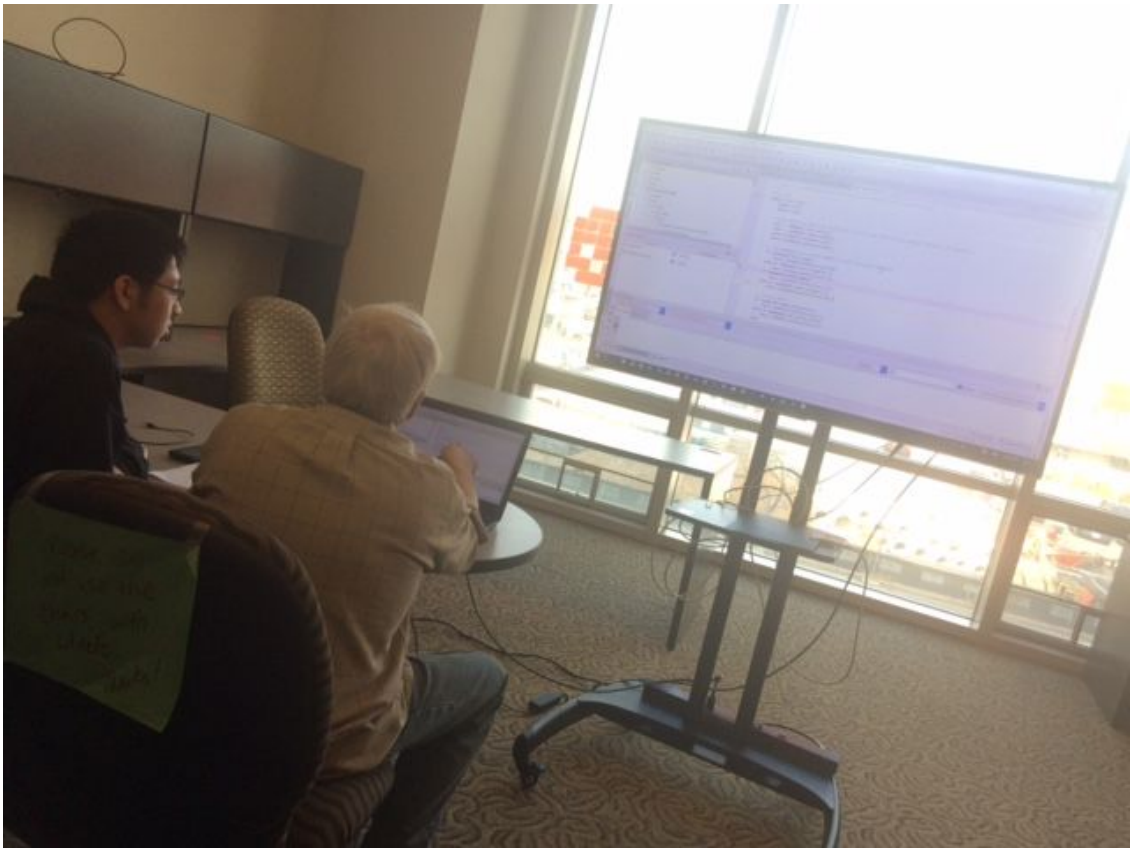
A quick Google search and use of Google calculator yielded a gravitational force of 1.274 N per relic. Now, we must show that the force the motor exerts exceeds the gravitational force, or is equal to 1.274 N as well.

Now the radius of the disk that is mounted on the servo is 0.5 inches, and we know that the least amount of torque of the servo is 107 oz-in. Utilizing the fact that sin90 = 1 and dividing the torque by the radius yields an oz-force of 214, which is 59.92 N, which is much greater than the 1 N the relic exerts on the mechanism.



QED

Coding & Autonomous Development Section

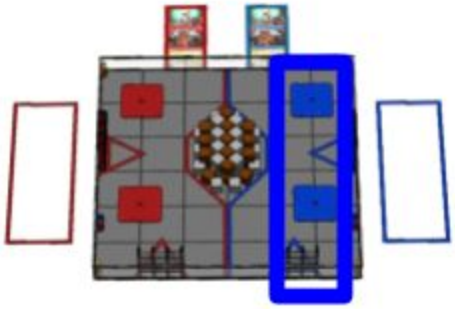


Using The templates given to us by FTC resources, we have adapted them to fit to our needs

Our autonomous scoring has multiple scoring strategies to adapt to every alliance.

First, Second, and Third Autonomous strategy (Blue Side)

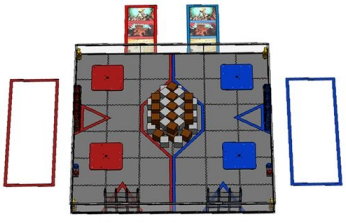
1. First
    - Lower arm and use color sensor to sense color
    - If it detects blue, move to the red ball and knock it over. Otherwise, immediately knock over the red jewel.
2. Second - Works off both stones
    - Lower arm and use color sensor to sense color and knock off correct jewel
    - Move to safezone using a hardcoded pathway and place glyph into a column randomly
3. Third
    - Knock off correct Jewel
    - Estimate distance and direct ourselves to the correct cryptobox using vuforia
    - Place the glyph into the right column



- We cannot do this with 100% accuracy
    - Depending on our confidence level we may attempt this at states

Fourth, Fifth, and Sixth Autonomous Scoring Strategy (Red Side)

- Fourth
    - Lower arm and use color sensor to sense color
    - If it detects red, move to the blue ball and knock it over. Otherwise, immediately knock over the red jewel.
- Fifth- Works off both stones
    - Lower arm and use color sensor to sense color and knock off correct jewel
    - Move to safezone using a hardcoded pathway and place glyph into a column randomly
- Sixth
    - Knock off correct Jewel

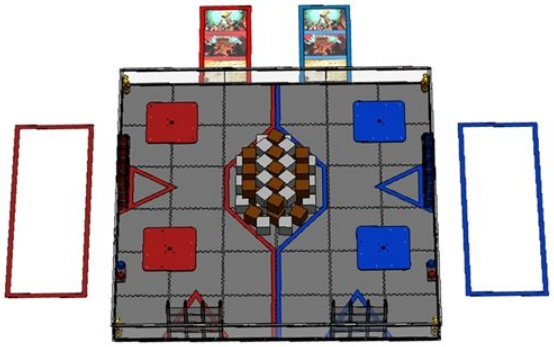


- Estimate distance and direct ourselves to the correct cryptobox using vuforia
- Place the glyph into the right column

- We cannot do this with 100% accuracy
  - Depending on our confidence level we may attempt this at states

Autonomous Scoring

We plan on knocking off the correct color jewel, from our starting position using two servos which enables us to rotate enough to hit the jewels off. We hope to also be able to deposit a glyph in the correct column using Vuforia.



Tele-Op Scoring

In our time, we plan on scoring the glyphs into the cryptobox and solve with the correct pattern. We also plan on to deposit the relic in the highest recovery zone with the relic standing up.

Teleop Coding Summary and Analysis

This is the code for the tele-op segment of our game matches. At the start, we instantiate boolean variables for whether the claw is open, and whether the tail is down. Once the mentor hits the INIT button on the Driver Station Phone, the code instantiates the hardware variables that the robot utilizes. Next, we initiate our wheels in strafe mode by coding the joystick to drive the wheels at such a speed so as to allow the robot to move horizontally. However, we made sure to add bounds to our speed so as to avoid making the robot drive too fast and crash the robot. We then program the bumper to control the claw, as well as when it is open and when it should be closed. We then write code for lowering the tail that we use in the autonomous section.

We have split up the tasks into two gamepads, as there are two drivers. On the second controller, we have programmed the joystick to maneuver the sliding system for the endgame. We also use the second controller to control the lifting of the cubes into the crypts.

```
//Creates a speed variable for the left front wheel, and assigns it to
the left joystick.
double LFspeed = gamepad1.left_stick_y + gamepad1.left_stick_x;
double LBspeed = gamepad1.left_stick_y - gamepad1.left_stick_x;
//Creates a speed variable for the right front wheel, and assigns it to
the right joystick.
double RFspeed = gamepad1.right_stick_y - gamepad1.right_stick_x;
double RBspeed = gamepad1.right_stick_y + gamepad1.right_stick_x;

      //Make sure values in acceptable range
        LFspeed = Range.clip(LFspeed, -1, 1);
        LBspeed = Range.clip(LBspeed, -1, 1);
        RFspeed = Range.clip(RFspeed, -1, 1);
        RBspeed = Range.clip(RBspeed, -1, 1);
//Assigns the variable for the setPower method to the speeds created
above.
        robot.leftFront.setPower(LFspeed);
        robot.rightFront.setPower(RFspeed);
        robot.leftRear.setPower(LBspeed);
        robot.rightRear.setPower(RBspeed);
//Adds the data to the central computer.
        telemetry.addData("Left Front", LFspeed);
        telemetry.addData("Left Rear", LBspeed);
        telemetry.addData("Right Front", RFspeed);
        telemetry.addData("Right Rear", RBspeed);
```

Here, we initialize our variables for the speeds of each mech wheel, and assign them as the speeds for the wheels. We also utilize these speeds for further programs.

```
    //Control claw
        //Trigger closes claw
        if (gamepad1.right_trigger>0.1 && robot.clawLeft.getPosition() <
robot.CLAW_LEFT_MAX) {
            robot.clawRight.setPosition(robot.clawRight.getPosition() +
.05);
            robot.clawLeft.setPosition(robot.clawLeft.getPosition() +
.05);
            clawOpen = true;
        } else if (currBumper && currBumper != prevBumper){
            //first bumper click = release block
            //second bumper click = fully open claws
            if(clawOpen){
                robot.clawLeft.setPosition(robot.CLAW_LEFT_INIT);
                robot.clawRight.setPosition(robot.CLAW_RIGHT_INIT);
                clawOpen = false;
            } else {
                robot.clawLeft.setPosition(robot.CLAW_LEFT_MIN);
                robot.clawRight.setPosition(robot.CLAW_RIGHT_MIN);
            }
        }

        prevBumper = currBumper;
```

This is the code for our claw that collects the cubes and puts them into the crypts. We have two cases: if the claw is open, we have the right bumper close the claw and sets the variable to false. If it is closed, we have similar methods for opening the claws and making the variable true.

```
currTail = gamepad1.x;

        //control tail up/down with X button
        if(currTail && currTail != prevTail){
            if(tailDown) {
                robot.tailServoY.setPosition(robot.TAIL_UP);
                tailDown = false;
            }else {
                robot.tailServoY.setPosition(robot.TAIL_DOWN);
                tailDown = true;
            }
        }

        prevTail = currTail;


        //control lift with left trigger/bumper
        //code limited to prevent over-running
        if(gamepad1.left_bumper) {

            //robot.liftMotor.setTargetPosition(2350);
            robot.liftMotor.setPower(robot.LIFT_UP_POWER);

        } else if(gamepad1.left_trigger>0.1) {

            robot.liftMotor.setTargetPosition(0);
            robot.liftMotor.setPower(robot.LIFT_DOWN_POWER);

        } else
            robot.liftMotor.setPower(0);
```

This code controls the tail that we can control via the first game controller. The X button on the controller is used to run code that determines whether the tail goes up or down. Hence, we utilize a few cases and have the tail move accordingly rather than assign two buttons to it. The left bumper also controls the lifting of the arm, and also has its own set of cases it tests for.

```
    //GAMEPAD 2 CONTROLS

        //scale gamepad 2 joysticks to appropriate values
        double slidePower = -gamepad2.left_stick_y;
        double armPower = -gamepad2.right_stick_y;
        slidePower = Range.scale(slidePower, -1, 1, -.8, .8);
        armPower = Range.scale(armPower, -1, 1, -.1, .1);

        //code limit slider positions
        if(slidePower > 0)
            robot.slideMotor.setTargetPosition(3800);
        else if(slidePower < 0)
            robot.slideMotor.setTargetPosition(0);

        robot.slideMotor.setPower(slidePower);

robot.arm.setPosition(Range.clip(armPower+robot.arm.getPosition(), 0,
1.0)); //control arm movement speed with joystick


        double armClawPos = robot.armClaw.getPosition();

        //arm claw controls with gamepad 2 right trigger/bumper
        if(gamepad2.right_bumper && armClawPos > robot.ARM_CLOSED) {

            robot.armClaw.setPosition(armClawPos-.05);

        } else if(gamepad2.right_trigger>0.1 && armClawPos <
robot.ARM_OPENED) {

            robot.armClaw.setPosition(armClawPos+.05);
        }
        //send debug encoder positions
        telemetry.addData("lift", robot.liftMotor.getCurrentPosition());
        telemetry.addData("slide",
robot.slideMotor.getCurrentPosition());
        telemetry.update();
```

Here, we initialize the speed variables for the slider arm and the lifting motors for placing the cubes. We bound the speed variables between -1 to -0.8, and -1 to -0.1 respectively, which ensures the motors do not burn out. We also assign the movement of the slider to the right bumper, and create test cases to consider based on what is being pressed.

Autonomous Programming

This is not an opmode program like the tele-op one earlier, but rather a class that defines the hardware that the 6417 Robot is using. In the beginning, the speed values and initial positions of the claw arm, slider, tail, and other extrusions are initialized into the code, and then subsequently utilized to define the motors used and the other hardware. We further define variables to represent actions. For instance, when we want to REVERSE the robot, we would add a negative sign to the variable defined at the beginning of the code. Furthermore, we initialize the motor speeds to 0 and allow them to be changed based on the joystick controls in the previous code. We also defined a method that makes the robot wait for a certain amount of time, which is very useful in autonomous and in some parts of the tele-op mode. Finally, we programmed the color sensor to accurately detect whether the jewel is red or blue, and knock off the jewel accordingly.

```
  while (opModeIsActive()) {

            /**
             * See if any of the instances of {@link relicTemplate} are
currently visible.
             * {@link RelicRecoveryVuMark} is an enum which can have the
following values:
             * UNKNOWN, LEFT, CENTER, and RIGHT. When a VuMark is
visible, something other than
             * UNKNOWN will be returned by {@link
RelicRecoveryVuMark#from(VuforiaTrackable)}.
             */
            RelicRecoveryVuMark vuMark =
RelicRecoveryVuMark.from(relicTemplate);
            if (vuMark != RelicRecoveryVuMark.UNKNOWN) {

                /* Found an instance of the template. In the actual game,
you will probably
                 * loop until this condition occurs, then move on to act
accordingly depending
                 * on which VuMark was visible. */
                telemetry.addData("VuMark", "%s visible", vuMark);

                /* For fun, we also exhibit the navigational pose. In the
Relic Recovery game,
                 * it is perhaps unlikely that you will actually need to
act on this pose information, but
                 * we illustrate it nevertheless, for completeness. */
                OpenGLMatrix pose =
((VuforiaTrackableDefaultListener)relicTemplate.getListener()).getPose();
                telemetry.addData("Pose", format(pose));
```

```
                /* We further illustrate how to decompose the pose into
useful rotational and
                 * translational components */
                if (pose != null) {
                    VectorF trans = pose.getTranslation();
                    Orientation rot = Orientation.getOrientation(pose,
AxesReference.EXTRINSIC, AxesOrder.XYZ, AngleUnit.DEGREES);

                    // Extract the X, Y, and Z components of the offset
of the target relative to the robot
                    double tX = trans.get(0);
                    double tY = trans.get(1);
                    double tZ = trans.get(2);

                    // Extract the rotational components of the target
relative to the robot
                    double rX = rot.firstAngle;
                    double rY = rot.secondAngle;
                    double rZ = rot.thirdAngle;
                }
            }
            else {
                telemetry.addData("VuMark", "not visible");
            }

            telemetry.update();

            //end vuforia stuff
```

Here we utilize Vuforia to attempt to rotate our robot in the correct orientation to score the glyph in autonomous. Since we've had trouble simply hardcoding it Vuforia may provide the necessary frame of reference to rotate our robot correctly.

```
        robot.init(hardwareMap);
         robot.colorSensor.enableLed(true);
         telemetry.addData(">", "Press Play to start");
         telemetry.update();
```

```
waitForStart();

robot.clawLeft.setPosition(robot.CLAW_LEFT_INIT+.1);
robot.clawRight.setPosition(robot.CLAW_RIGHT_INIT+.1);
robot.tailServoY.setPosition(robot.TAIL_DOWN);
sleep(500);

//check color of ball and hit corresponding one
if(robot.colorSensor.red() > robot.colorSensor.blue()){
    robot.tailServoX.setPosition(robot.TAIL_LEFT);
} else {
    robot.tailServoX.setPosition(robot.TAIL_RIGHT);
}

robot.liftMotor.setTargetPosition(200);
robot.liftMotor.setPower(robot.LIFT_DOWN_POWER);
sleep(150);

//reset tail position
robot.tailServoX.setPosition(robot.TAIL_INIT);
robot.tailServoY.setPosition(robot.TAIL_UP);

//start vuforia
relicTrackables.activate();
sleep(200);

//start rotating toward VuMark
robot.leftFront.setPower(.5);
robot.rightFront.setPower(-.5);
robot.leftRear.setPower(.5);
robot.rightRear.setPower(-.5);
```

Here we detect the color of the Jewel, and knock the correct color off. Following this we initiate Vuforia controlled sequences.