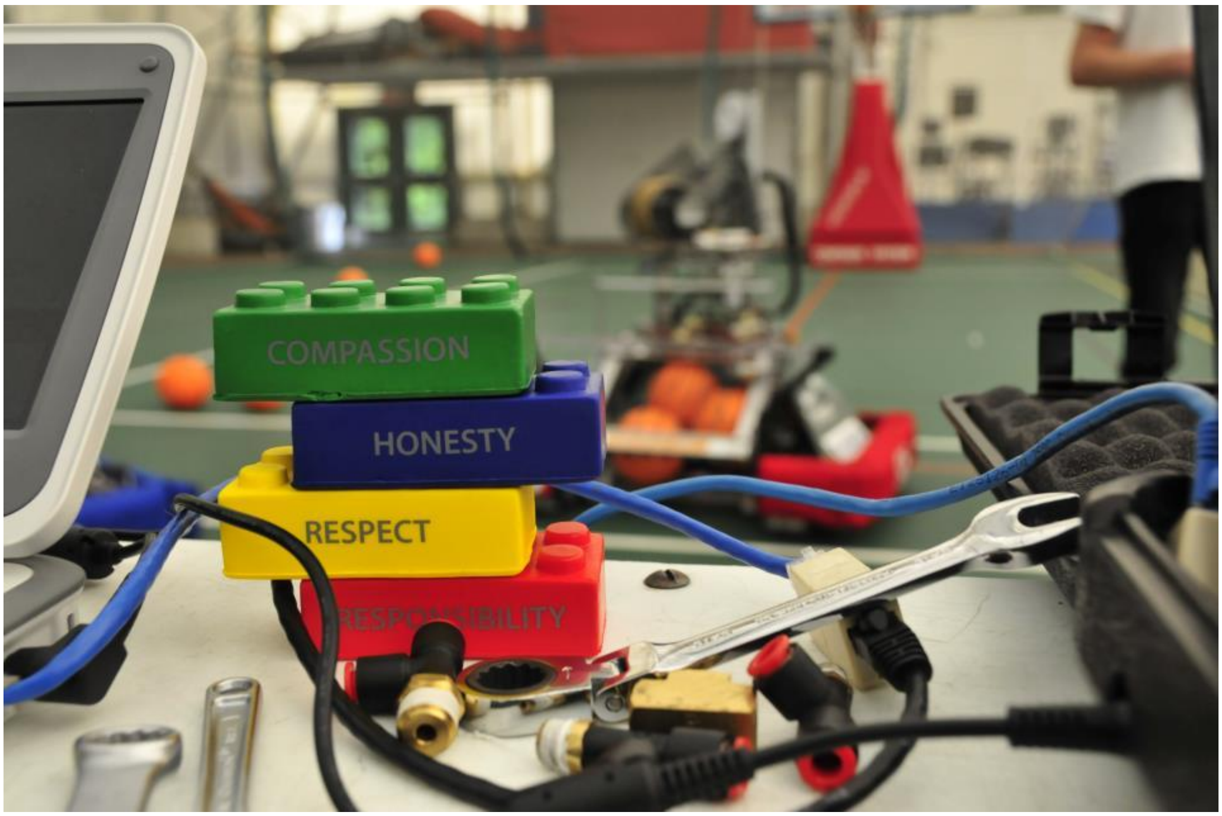
610 Engineering Notebook
Crescent School



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Introduction

When Team 610 started over 15 years ago, it was simply a robotics club where students could join together to build a robot over six weeks. Over the years, our team has grown in size and spirit, and has expanded not only within our school, but also into the greater Toronto community. Our team's passion for engineering has led us to develop handicap-friendly technologies for the children of Sunnyview School, incorporate FIRST-related activities in our school's many tech design courses, and annually host both FLL and VEX tournaments, to spread our love of FIRST with the community. Beyond our school doors, we have taken on the challenge of mentoring teams with limited FIRST experience. To our team, robotics programs serve as essential factors in bringing people from all grades and cultures together, to collaborate and celebrate the scientific and technological achievements of Canada, and the rest of the world.

In this notebook, you will find information on the technology related initiatives we run within and outside of our school, as well as a detailed, daily account of our build season. It has been an incredible season for our team this year; we have seen much promise from our aspiring engineers. As we move towards our collective goal of becoming a world-class team, we look forward to having many more great seasons in the future.

Preparing our Engineers

Grade 9 Exploring Technologies Program

Over the years, robotics has seeped into every level of our Upper School. To build interest in robotics right from the get-go, Grade 9 students participate in a program that introduces them to CAD, RobotC programming and the Design Process. The skillset the students acquire is then integrated into a Final Evaluation Challenge Project. The course attempts to spark an interest in science and technology in the students, with the outcome of them taking the Robotics class or joining the FRC robotics team the following year.

The curriculum begins with an introduction to Solidworks (CAD). They begin to create simple models and gradually gain an appreciation for computer-aided design and the design process. By following lesson plans designed by our own FRC mentor, Mr. Stehlik, students are guided through the preliminary step of the design process. They are tested on occasion with CAD quizzes and complete assignments such as modeling a water gun.

Once the first third of the course has been completed and the students have mastered the basics of Solidworks, they move into the second part – programming. Students learn basic and intermediate elements of RobotC including autonomous coding, light sensing, ultrasonic sensing, and using encoders. They gain this knowledge from the lesson plan designed by team mentor Mr. Stehlik and taught by team mentor Mr. Grant. This section culminates in a programming challenge that varies every year. This year, students had to traverse a maze using only light and ultrasonic sensors. In the few weeks they were given from start to finish, every student was able to complete the challenge.

The final third of the course allows students to gather all of the knowledge they have gained and apply it to a final project. First, the project required students to CAD a part that would attach onto their VEX Squarebot to complete the following challenge, called Robo Ringer.

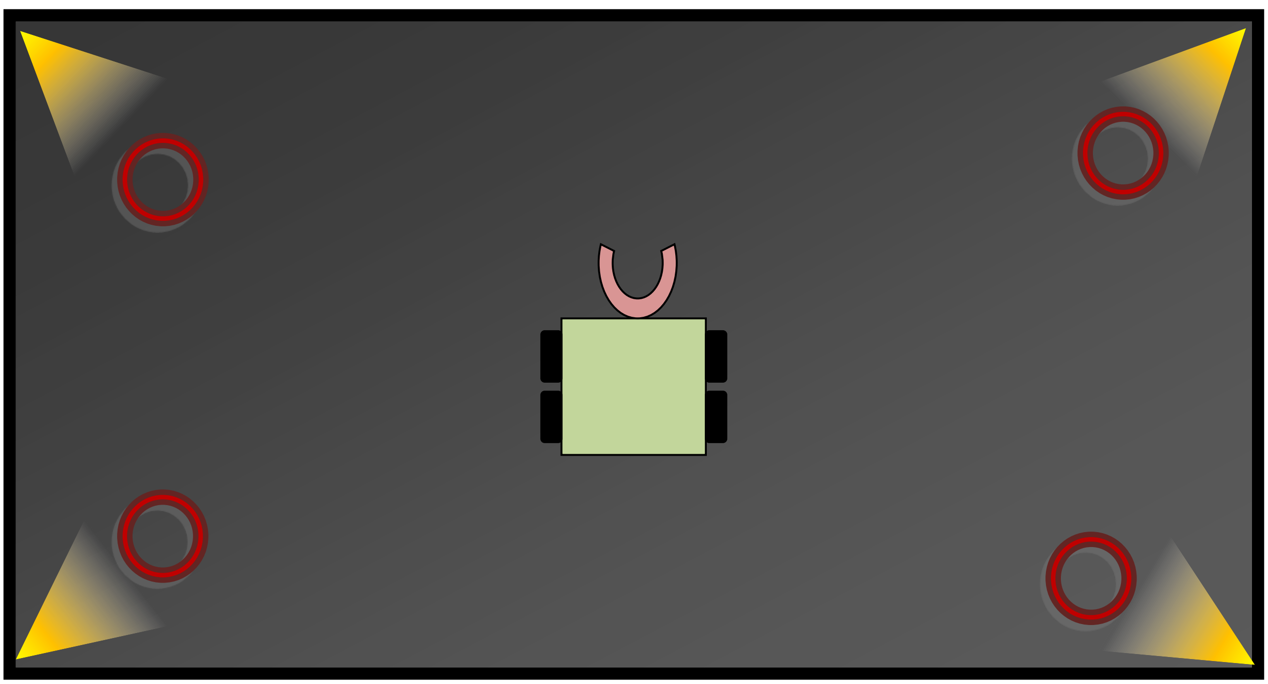
Robo Ringer

Your challenge is to design and build a mechanism for your robot that will enable it to transport rings.

The robot will start in the middle of the table, and attempt to collect a ring from one of the corners, and then transport it to the circle in the middle of the table. To aid in navigation, lamps will be placed in each corner so the light sensors can detect them. Only one lamp will turn on at a time. Once the robot has successfully retrieved a ring and placed it in the middle circle, another lamp will turn on, indicating where the robot should go next.

The rings are made of plastic and are approximately 3.5" in diameter, and 1.1" tall.

Your mechanism has to lift the ring off the floor. The goal is for the robot to autonomously retrieve all the rings as within a 1 minute time period.



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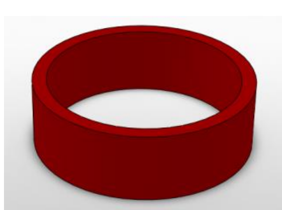
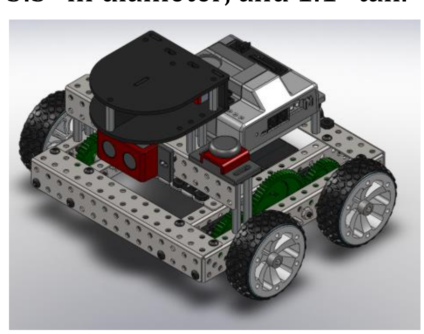
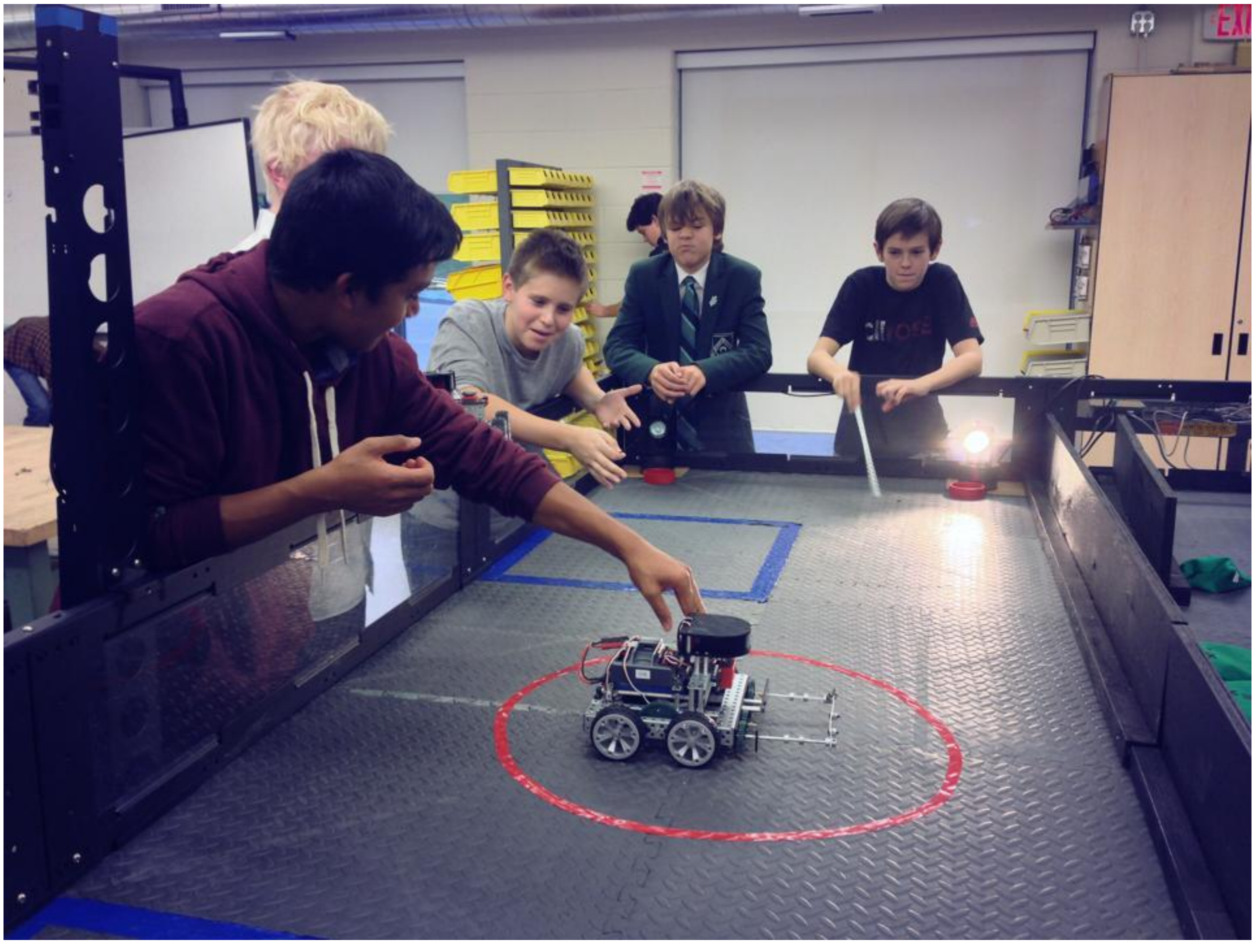






Grade 11 Technological Design

At Crescent School, one of courses that is offered for Grade 10 and 11 students is the Grade 11 Technological Design class. This is class is meant to offer a course that will show students what engineering is all about. The course uses students' prior knowledge from the Grade 9 Tech class and begins to build upon these skills. The first term is finished with the students splitting up into 4 teams and creating VEX robotics robots that they use to compete at VEX competitions. This was the first year that the tech class went to two different tournaments with their robots. Their first tournament was the inaugural Crescent Vex Scrimmage. The next tournament that they travelled to was the tournament that all the prior classes have gone to. They travelled down to St. Catherine's to compete in the Southern Ontario Vex Championship. Once the students return from the holiday break, they begin possibly the most exciting and interesting projects you can complete while at Crescent. The students in the class are given the opportunity to design and build another VEX robot out of custom metal. The students begin by CADing their designs; they can then create drawings of every part and prepare to cut the parts to their requirements. The students have the opportunity while making these custom pieces to use the Mill, CNC, Lathe, Chop saw and drill press. In addition, the students have the opportunity to program the robot themselves. At the end of the year, the final exam consists of three parts. The first part is programming skills. This is where all of the robots and teams are able to program the robot. With these pre-programmed functions, the robots are supposed to score as many points as possible in 60 seconds. The next part of the exam is robot skills; this is the same as programming skills, except the team is allowed to control the robot with the controller. The final part of the exam is a tournament that has all the teams and their robots face off against each other in 2 v 2 matches.

Hosted Tournaments

First Lego League

610 has been running the FLL Middle School program since 2003. The program was launched after veteran mentors Mr. Grant and Morrison first discovered FLL at the FRC World Championships in 2002. They were very impressed with FLL and in that moment, they decided to bring it to our school. The two mentors immediately worked together with FIRST Robotics Canada to not only implement FLL in our school, but to spread it across the province of Ontario and further afield. They were successful that the following year, they hosted the 2003 Mission to Mars Inaugural Ontario Provincial Championships in the school's field house. Since then, we have worked tirelessly to improve the program for our own students, and for the attendees of our regional event.

Each year, a large group of young, aspiring engineers from grades 5-8 accept the Lego League Challenge. The purpose of the program is to promote science and technology through creativity and teamwork. We want to show students, at an early age, that robotics is exciting. The ultimate goal is that the children will continue their involvement in robotics, or at least take away other skills they have developed from the experience. Many of the students on team 610 have competed in Lego robotics. Most would say that FLL at Crescent was what first got them excited about robotics and technology, and they would attribute their high level of involvement in FRC to their enriching, enjoyable FLL careers.

Our FLL program has been able to thrive to this day because through the help of our dedicated mentors and every member of the FRC team volunteering their time. Middle school teachers mentor the youngsters while balancing numerous other responsibilities. Over the years, they have been able to make the program extremely fun and educational for the students. Every year, the FRC team volunteers to host a regional FLL competition, with around 20 teams returning to compete every year. Our Crescent teams may not always come out on top, but are very big advocates of self-improvement and selflessness. Even at such a young age, the kids do all they can to improve their robot, regardless of whose idea it was; they want to do the best job they possibly can, and it is this wonderful quality that continues to be reflected years later in the 610 FRC team. Crescent's FLL program clearly sows the seeds for the future.

Crescent VEX Scrimmage

This year, Crescent hosted our inaugural Vex Tournament. The tournament hosted 16 of the most talented teams from around Ontario including 5 teams from Crescent School. The tournament was held in our Centre for Creative Learning and the tournament field was located in our theatre. The tournament gave teams the opportunity to qualify for a World Championship through robot and programming skills. The tournament was practically completely student led by the robotics team.

Throughout the day, the members of the robotics team who didn't have specific jobs were helping and assisting other teams in the tournament with mechanical and programming issues. Even the Crescent VEX teams themselves tried their best to be gracious hosts and assist these teams as well. Two of the Crescent teams that participated emerged as champions – 610A and 610X. 610X will be competing at the World Championships in Anaheim this year.

Community Outreach

Sunnyview School

A program in which Team 610 has delved into, is the effort to improve the quality of education at Sunnyview, a special needs school in Toronto. Beginning in 2010, our robotics team began partnering with Sunnyview Public School, a local elementary school for disabled children. Our contact at Sunnyview is Dale Zimmerman, a renowned education assistant who specializes in adapting toys and education specifically for each child's needs. Her goal is to give the children a greater level of independence, and results have been astonishing. Our robotics program has connected with Dale and has offered to lend some assistance with mechanizing some of her adapted toys. Last year, we worked on motorizing a mirrored wheel, which is used to stimulate the children's senses. The motorized wheel was built with a switch, and depending on the child's abilities, the switch can be modified to suit them.

In the past, we have taken on several ambitious projects, including the collaboration with the art teacher at Sunnyview. The first project involves the modification of a paint spinner. Several of our senior members have taken on the challenge of building both the spinner and the paint dispenser from scratch. This involves a detailed design in CAD, selecting the proper motors and gears, wiring up a power supply, and cutting the parts out - essentially all of the skills obtained during a robotics build season. Another project we are currently working on is converting the controls for a toy to make it more suitable for disabled kids. The "Color Bug" is a commercially available toy that has a marker attached to a remote-controlled car in the shape of a bug. Sunnyview has had a number of these toys donated to them, but while they are immensely popular with the kids, the fine motor skills required to operate the joysticks have proven to be far too difficult for the physically challenged children to truly appreciate this toy. We have taken on the project of converting the controller to one with touch-sensitive buttons, so less precision is required. The last project Team 610 is helping Sunnyview with is converting a toy similar to a spirograph to be remote-controlled, making it more accessible to the students.

It has been very rewarding for members of the robotics team to take some of their skills acquired during the robotics season and apply them to a real cause. For some of the students that helped out, Sunnyview was more than just a technological case project - it was a place with life, hope, and shared excitement for technology. We hope that our partnership with Sunnyview continues to flourish in years to come.

Grade 12 Technological Design

A program offered to Grade 11 and 12 students alike, the Grade 12 Tech Design course is the highest-level technology course we offer to students. Building on knowledge gained from two previous years of robotics instruction, students are given the opportunity to use their skills to impact the community. Taught by two Woodie Flowers Finalist Award winners Don Morrison and Shawn Lim, students are instructed by knowledgeable, highly certified mentors. The course, which can be divided into 3 major parts, is how Crescent School prepares our students for University and for FIRST Robotics.

The first few months of this course is dedicated to refining students' skills in the workshop. They have regular CAD quizzes and practice machining parts, to ensure they are experts at using the tools they will need later in the year. The beginning of the year sets a solid foundation, allowing the rest of the year to run smoothly. By the time January rolls around, every single student can confidently contribute to building the FRC robot.

The limited time Team 610 has to build the robot is expanded thanks to the students in this course; many of which are on the FRC team. Since our team machines an enormous amount of parts ourselves, it is greatly beneficial having students making them during class, expediting the process. Students partake in other tasks such as constructing field elements and assembling machined parts onto the robot.

In the final part of this course, we partake in a program that is dear to our hearts. For many years, we have been working with Sunnyview Public School, a school for physically disabled children. Students in the Grade 12 tech course are challenged to build toys for these children with simple controls, so they can also play with fun toys. A notable toy made for them in the past, built by alumnus Aidan Solala, is a remote control ladybug operated by large touch panels. This is yet another way Team 610 reaches out to the community, and a cause we believe impacts us the most.

The Grade 12 Technological course gives students the opportunity to refine engineering skills, contribute to the FRC robot, and impacts the community though our connection with Sunnyview Public School. Led by two outstanding mentors, this program is one we are proud to have at Crescent.

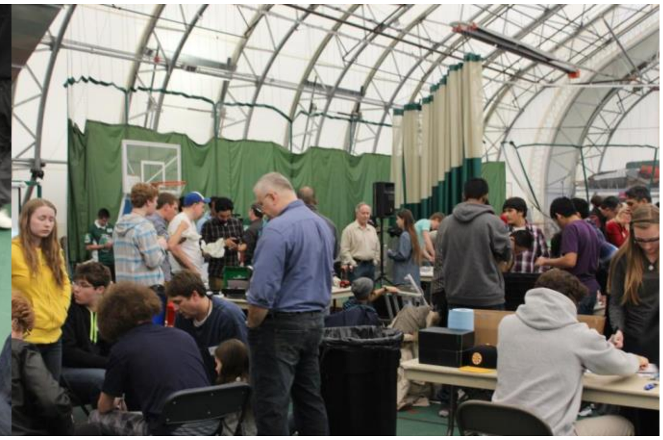
Design Process

Week 1

Saturday, January 5th – Kickoff Day

This year's new game finally arrived. Everyone gathered in the Centre for Creative Learning, all extremely eager to see what this year's game would be. Much speculation was heard from our team, as well as two other teams we had invited to watch the webcast with us. After watching the game animation, people were saying: "This year's going to be tough," or, "I have an amazing idea for the (subsystem)!" and also, "This is going to be EPIC!" Excitement rose and cooled as we headed to the cafeteria to study the rules. In the cafeteria, we broke into groups that became specialists on one section of the rules. Each group then presented the details of their rules to the rest of the team. We always kick off the season by learning the rules thoroughly. We can't brainstorm or make any decisions until we understand our limitations. We then moved on to a strategic aspect of Ultimate Ascent – deciding on the score we would need to win 90% of our matches. The figure we came up with for our robot was 104 points. It may be a bit ambitious, but we knew with dedication it could be achieved.

Meanwhile, a workshop was being hosted for local teams in the school's Field House, helping them build their kitbots. It can extremely beneficial to teams to get

their kitbot out of the way so they can focus on scoring and the other aspects of the game. A few of our new grade 9 students joined them and were able to build a kitbot of their own; they did an excellent job!

Sunday, January 6th

Two major tasks were completed the day after kickoff. Firstly, a select group of students wrote a rules quiz, prepared by our administration heads, Kevin and Jason. We took the quiz and refined it for the students that were taking it the next day. The rules quiz was of moderate difficulty to ensure the team understood the rules and could apply them to some degree. Secondly, we created our second-by-second textbook strategy and list of needs and wants for the robot. The second-by-second textbook strategy outlines everything our robot will do in a match while closely estimating the time it takes to perform a task. Doing so leads us to create a list of things we need the robot to do in order to fulfill the textbook strategy. To that list, we also add things that we want on the robot – things we aren't sure we need but would be nice to have if possible. Our preliminary textbook strategy can be found at the end of the notebook.

Monday, January 7th

The rest of the team came in on Monday and wrote the rules quiz. With a preliminary textbook strategy already made, we went through it as a team, critiqued it, and even changed some of it. For example, we originally thought that we could perform 4 cycles of 4-disc loading and shooting. After group discussion, we decided 3 cycles was more reasonable as unforeseen defense, human error and other factors would inevitably slow us down. We then had everyone break into groups to create their own list of needs and wants. A master list of wants and needs was made with everyone contributing their opinions. A copy of the master list will be at the end of the notebook.

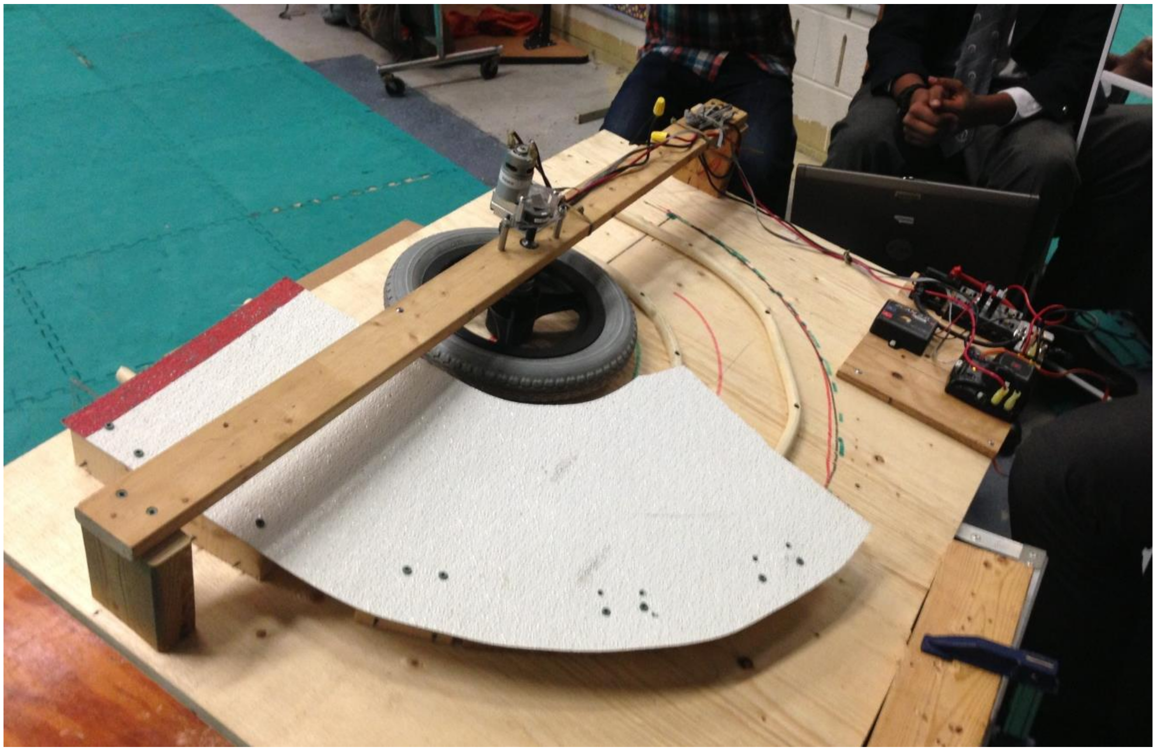
After creating the list, individuals were divided into groups based on what prototypes they wanted to work on. The 3 types of prototypes we developed were shooters, hangers, and feeders. All would be necessary to ensure a robust, well-designed machine.

By the end of the day, prototypes of shooters, feeders, and hangers were being built in an attempt to test and determine the best designs for the various subsystems.

Tuesday, January 8th

Students discuss robot wants/needs in addition to the textbook strategy.

Prototypes have started to take form, but most are not operational. A prototype that was working at this point is the semicircle shooter. It has a track of a half-circle with a regolith hood, and is launched by an 8" pneumatic flywheel powered by a BaneBots motor (Picture below shows 1/4 track). By today, it was able to run, and the results were impressive. The shooter was able to launch discs over a distance of 50 feet with great accuracy. With the wheel spinning at over 3000rpm, the discs had adequate spin to give it lift and fly straight over a long distance. We would be able to fulfill our #2 strategy with this shooter: to park at the feeder station and repeatedly launch discs across the field into the 2 or 3pt. goals. Unfortunately (as always), there was a problem. The whole thing required at least 30 inches of space, and it was already outside of our frame perimeter. We had to shorten the track, but it was amazing to see the shooter perform so well.



Wednesday, January 9th

Mechanically, this day was mostly dedicated to working on prototypes. The shooter ran more tests, the hangers were still being built, and the feeding systems became more and more intricate. In addition to these prototypes, a scale model of the pyramid was beginning construction. The design team was producing field elements on Solidworks. Everyone had a job to do, and they were busy at work.

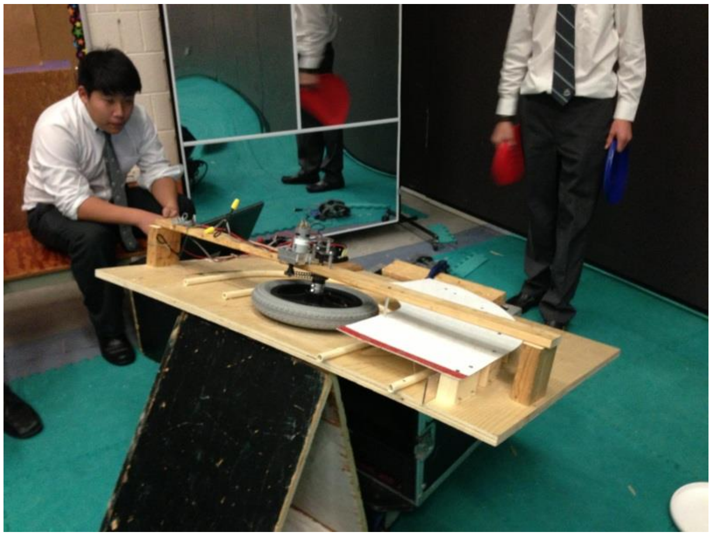
Thursday, January 10th

Prototypes are now well developed and have earned their nicknames. Here are the prototypes for the various subsystems:

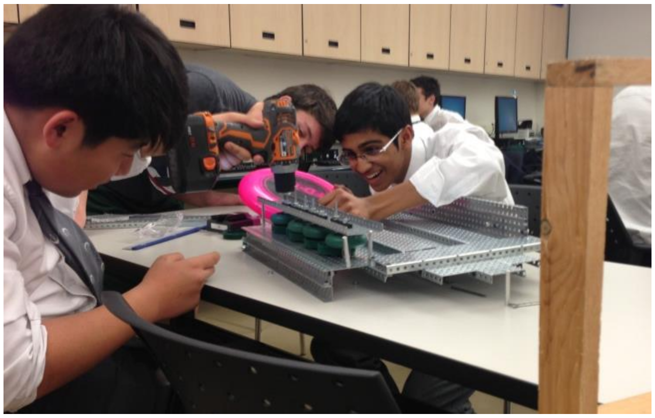
Shooters

Cyclops 1/4

It was reduced to a quarter track, and as a result, the discs have been flying considerably lower. They tend to drift left and right much more easily. This is disconcerting, as we wanted to park at the feeder and hit the long shot. We haven't given up hope, though, as the discs are only about 3 feet shy of the target vertically.

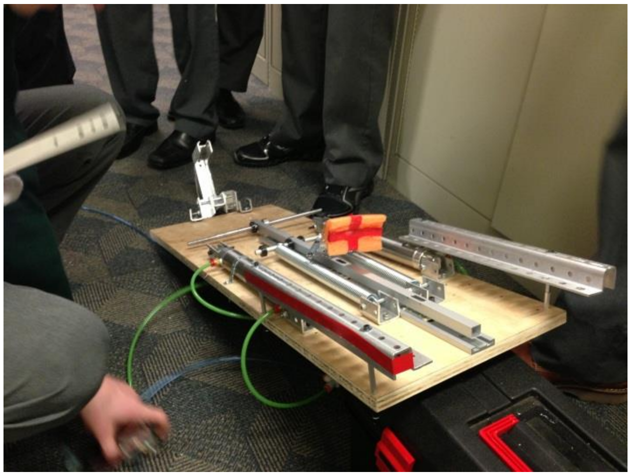


Straight Flush

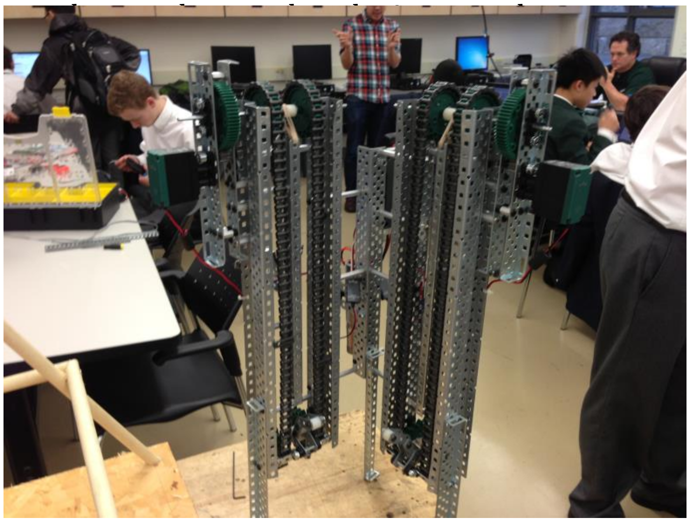


This prototype is in the early stages of development. It cannot shoot more than 5 feet because of problems with the spacing between the wheels and the wall. We will be adjusting it to increase compression and hopefully get more distance.

The Enterprise (Nerf Gun System)



The Enterprise is also in early stages of development. This group got their idea from a NERF gun that was able to shoot flying discs quite far with spin on them. Grade 9s are using pneumatics for the first time. It can only shoot a couple of feet at this point, but they



Hangers

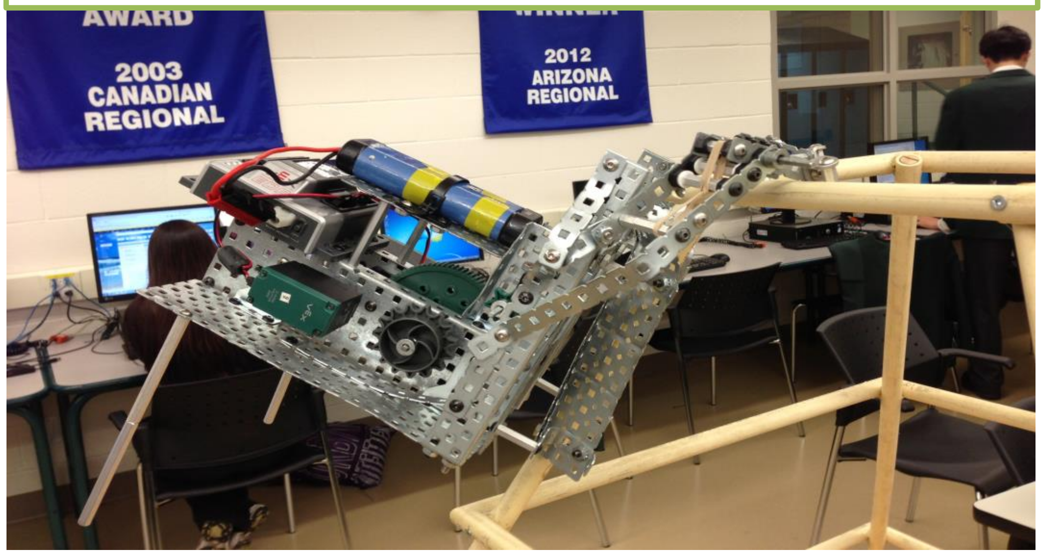
Ice Climber

The Ice Climber concept is one of two hanging prototypes that parts of the team are working on. The explanation of how it works is that the mechanism has two vertical tank treads fixed at a ninety-degree angle. When the mechanism starts the tread brings a claw that is attached to the tread up and over the apex of the tread. The claw will then fall down and hook onto the first bar (Level 1). As the tread continues the robot will raise up. Just as the first hooks get to the bottom and fall off a second pair of hooks comes around the apex of the treads and attaches onto the second level. The mechanism does the same for the third level and is then able to remain climbing until above the second level and completely in the third level. As of today the prototype is working well. It is able to climb the scale model pyramid with minimal human assistance

Bowser

Bowser is our other hanging prototype. It is super compact and efficient. The idea behind this design is that when the robot drives up to the tower 2 sprockets would spin and force two separate pieces of one-way chain up and above the robot. At the end of the chain there would be a hook to attach to the first level of the pyramid. Next, the 2 sprockets would reverse and the robot would slowly climb up. After that, there would be 2 hooks attached to the robot's frame which would then latch onto

Below you can see the prototype Bowser "hanging out" at the top of the scale model pyramid. The pyramid was built out of CPVC and completed on Wednesday to test our hanger prototypes.

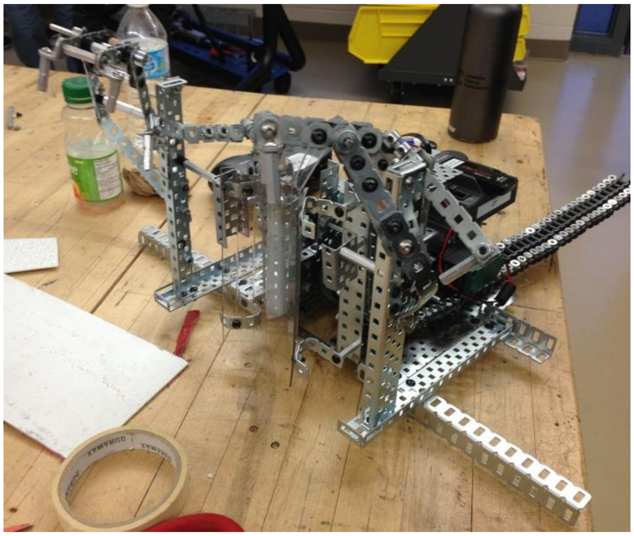


the first level as well. Once the second set of hooks is attached the sprocket would then begin to feed the chain out again and it would latch onto the second level. The mechanism would repeat the procedure until it is in the third level. As of today the prototype is performing well and can climb the mini pyramid with minimal human assistance.

Friday, January 11th

Prototypes have been developing steadily, and all of them have made small improvements from the previous day. A few modifications were added to Bowser, the feeder made vast improvements, and a new shooter was constructed.

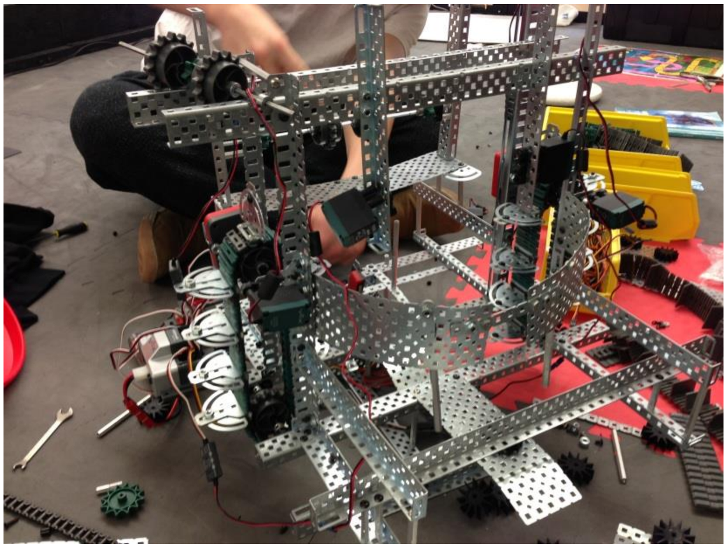
Bowser



A Lexan tray was on the front to help Bowser slide along the edge of the pyramid and avoid the corners.

Feeder

This feeder system was designed in an attempt to provide a solution to a major feeding problem. When discs were stacked on top of each other in a gravity feeder style manner it was a common occurrence for two discs to get jammed an exit slot.

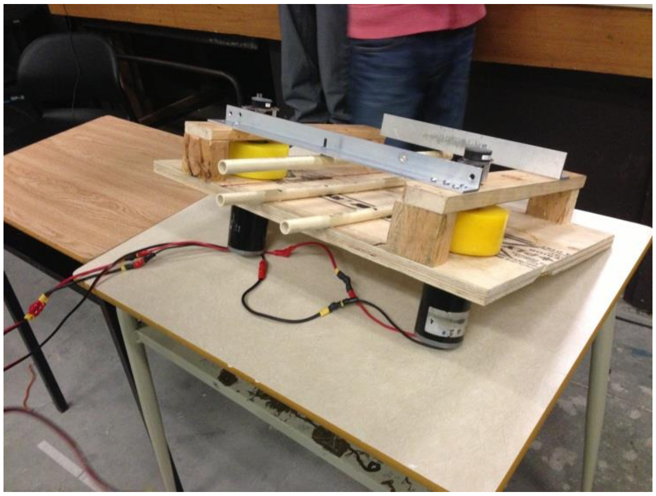


This design accepts a disc, which hits a limit switch, raising the disc. We used standoffs to guide the discs upwards. Next, to integrate the feeder with the shooter, we put rollers at the top to spit out the discs (to have the ability to feed directly into a shooter). At the other end of the process we had to ensure the feeder would interact with the feeder slot properly at the 30 degree angle it sits at. We found that the gravity pulling down the discs was enough to get the discs to slide into the feeder and trigger the limit switch to get the indexing process going. We decided that we wanted to have a robot that could fit under the lowest pyramid rung. This means the feeder would have to interact with the 22 inch feeder slot, and would also have to be very compact height-wise to ensure it fits within our desired dimensions.

"Zeus" Linear Shooter

This started construction on Thursday. On Friday it was able to shoot discs 20ft.

These are the problems it encountered: it wasn't shooting straight, discs were on an upward slanted angle, and, after extensive testing, chunks were ripped out of the urethane flywheels.



Week 2

Saturday, January 12

Saturday was designed to be a “work day” for each division. The accomplished tasks are as follows:

Energy Systems worked with the Cyclops shooter prototype by cleaning up the wiring and replacing some worn components.

Programming worked alongside the Energy Systems division. The shooter’s PID was tuned. Another group of programmers worked with vision targeting with the Kinect and were successful in tracking the vision targets.

Design and Manufacturing continued the modeling and fabrication of field elements and prototypes. Later on, Design and Manufacturing met to discuss the hanger prototypes. This meeting covered the climbing prototypes, Bowser and Ice Climber. Pros and cons such as consistency, versatility, and size were discussed regarding the two climbers. In the end, Bowser was selected for its overall safety in lifting the robot, its compact size, and simple design. The issues with Ice Climber were its large size and complex design, even though its more fluid and quicker climb of the pyramid.

Overall, the day proved to be an important day for building and repair, as well as making important decisions.

Monday, January 14th

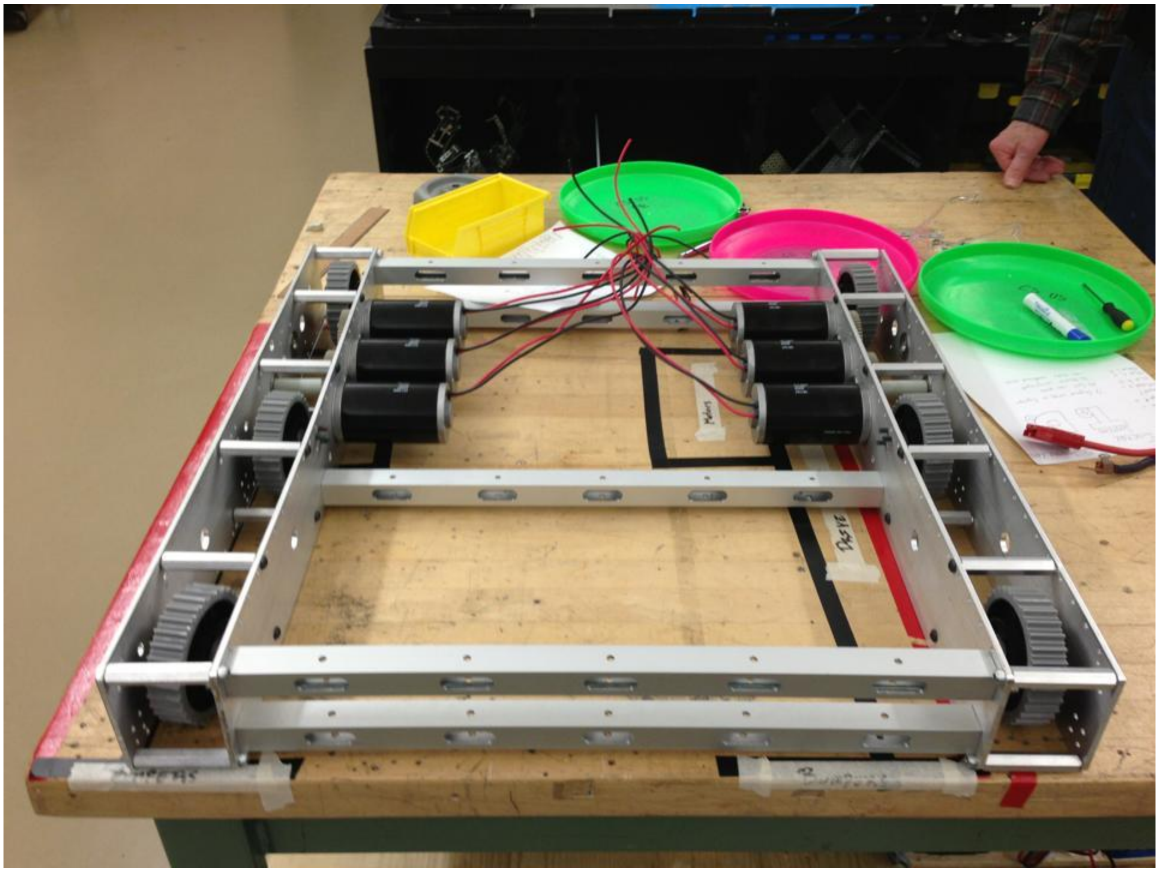
The enterprise shooter changed around quite a bit. The students working on it exchanged the spring for surgical tubing and extended the rails for increased firing distance. As well, Warfa, our Programming head, implemented PID control on the Cyclops shooter. He is now able to change the values through an interface instead of changing it in Netbeans and reloading code. Other programmers fixed the scouting application, which was having technical issues, such as formatting errors. The CAD model of the feeder station was finished, so it is now in the process of being built. There was a critical team meeting today where we decided to revise our strategy. The team has decided to forget about a level 3 climb and focus our efforts more on shooting and intake ability. This decision will hopefully benefit us in autonomous and most likely during tele-op, as well as the robot's overall simplicity.

Tuesday, January 15

Today the drivetrain was finalized and Ryan, a student member of Design and Manufacturing, began and finished CNCing the drivetrain side plates. The electrical division worked on the layout of the electrical board on the robot. This year they are working with a particularly small amount of area and therefore they are considering mounting components on the side of parts on the robot. A multi-layer electrical board will almost certainly be necessary. The programming division had a quieter day today; they tested one of the shooter prototypes with PID control and are planning to test another shooter tomorrow. Tim and Jamie, a student member and assistant head of the Design and Manufacturing division, worked on the CAD of the shooter and they are making good progress on the design. Some members of the Energy Systems division organized the wiring on the shooters; this will help make repairs easier. Taran and Austin, assistant head and head of Design and Manufacturing, worked on one concept of a mechanism that combines an intake and feeder. They decided to skip the physical prototyping phase and jump right into the CAD phase. Meanwhile, Jacob, another member of Design and Manufacturing, and his team worked on another feeder concept. They also worked on the CAD of the subsystem instead of prototyping.

Wednesday, January 16

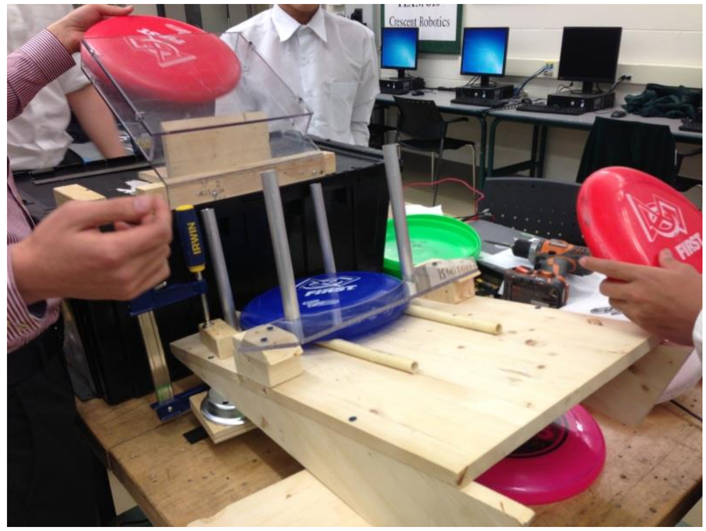
Today the rules update was made available to teams, and the rule about the robot's horizontal diameter was changed so that as long as we touch the pyramid while climbing the "cylinder" will no longer be oriented with the floor. This was a huge factor in our strategy and we decided to switch back to our original strategy with the 3rd level climb. As well, the drivetrain components were finished today, and it will be assembled tomorrow.



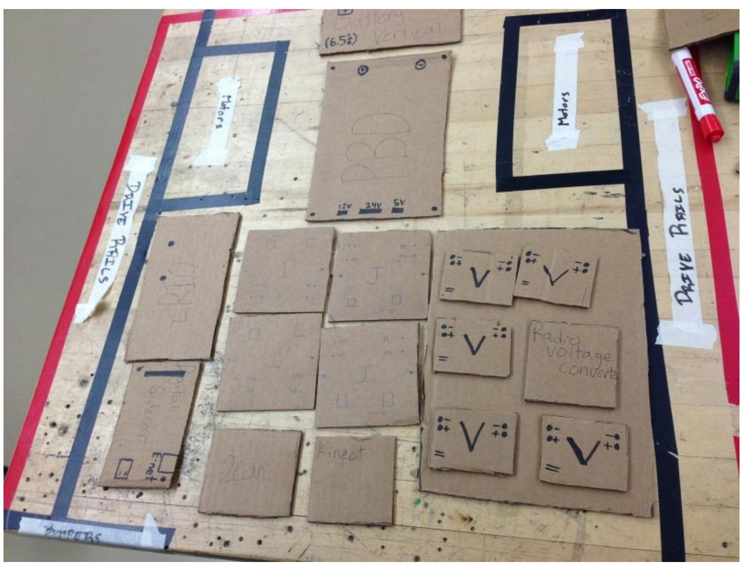
Thursday, January 17th

Two important things the team worked on today were a gravity feeder prototype and a mock electrical board.

When we started prototyping feeders, we first attempted the gravity feeder design, but could not come up with an efficient solution to prevent multiple discs from getting forced through, and subsequently stuck in, the slot. After testing a more complicated indexing design, a group of students revisited the gravity feeder. They used the logic that if the poles (pictured right) were angled backwards, it would prevent discs from covering the front section of the disc below it. A hook on the bottom would then pull the bottom disc through the slot and the one above will fall to the bottom.

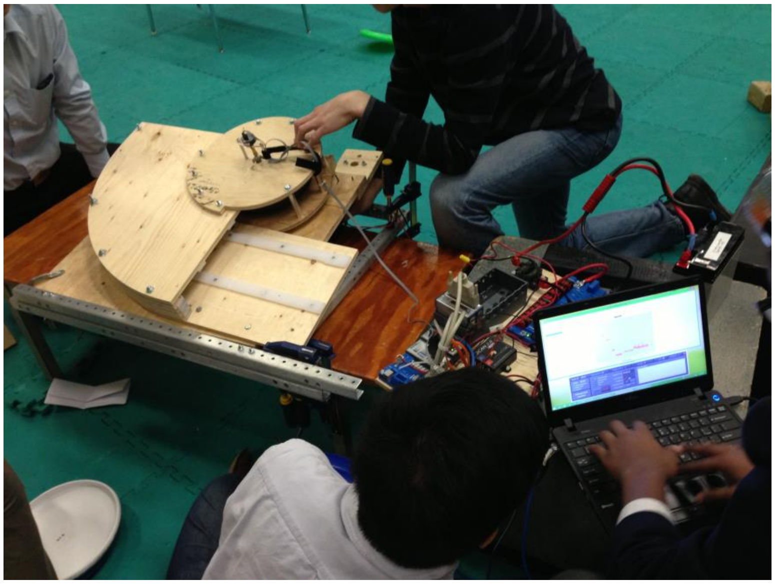


The Energy Systems division members have created a mock electrical board to begin the planning of our robot's electrical board. They have included all the necessary elements such as motors, Jaguars, Victors, cRIO, a battery, and all of the other components. 610 electricians will be ready to move forward with their job as we move nearer and nearer to our final robot design. It's important to note that this is only the first level of our electrical board, and we plan to have another level above it. It may add to the complexity of our robot, but we see it as a rewarding feature that will reduce clutter and the overall elegance of our design.



Friday January 18th

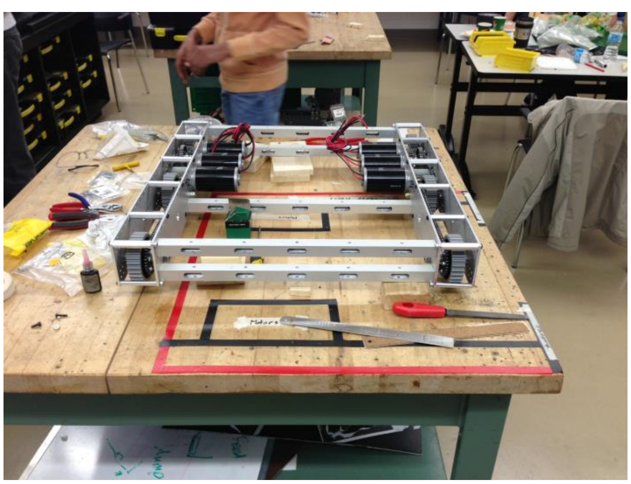
Today the Programming division worked on the quarter circle shooter. They were trying different angles and trying to fine tune the speed, simulating a shot from the feeder station. The accuracy they were achieving was between 80-90%. Some of the Design and Manufacturing division was working on a revised quarter circle shooter. This design will be more compact and will fit onto our robot much more easily. Another group of the mechanical guys worked on the chain on the robot's drivetrain. Taran, an assistant head of Design and Manufacturing, worked on his CAD model of the hook that we will use on our climbing mechanisms.



Week 3

Saturday January 19

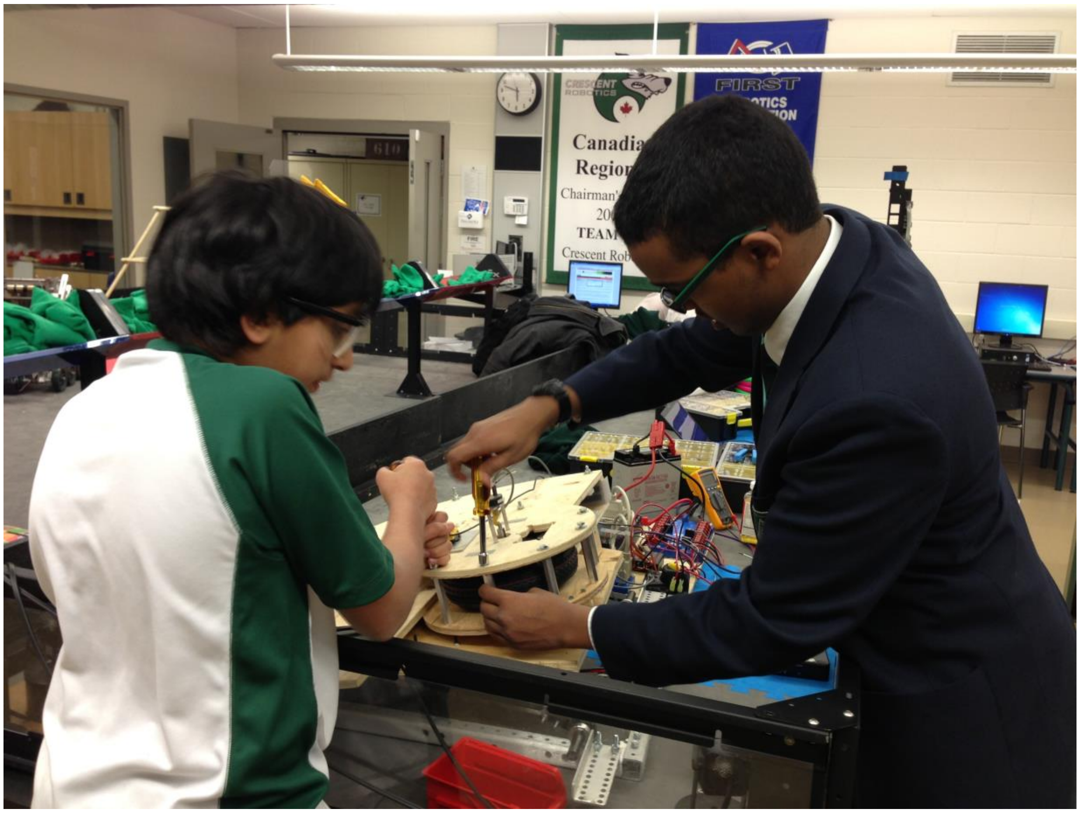
Today part of the Design and Manufacturing division finished assembling the drivetrain completely. The chain was sized to the specifications that the CAD team



designed it for, and then the wheels were remounted. The next step for the drivetrain will be to figure out where the electrical panel on the robot will go and have the Energy Systems division begin assembling it and wiring up the drivetrain. Other members of Design and Manufacturing were building and fine-tuning shooter prototypes and Austin, head of Design and Manufacturing, assembled a gearbox for the straight-line shooter. Other students continued to work on feeders, allowing the disks to be fed in while maintaining the correct orientation is becoming an issue, so we have multiple prototypes currently under construction. One of the prototypes changed their aluminum rods to a Lexan tray to ensure the disks will not fall out of the feeder. They also modified it to ensure that Frisbees would stack properly and that they would be able to be sent out of the feeder and into the shooter without jamming the feeder. The programming team took a shot at fine-tuning the quarter circle shooter; it was working well today and is a lot sturdier than the half circle shooter, not to mention it is more compact. Finally they added a new optical encoder that is more accurate than a mechanical encoder at high speeds and a feeding system was added to minimize the variance in humans feeding the shooter.

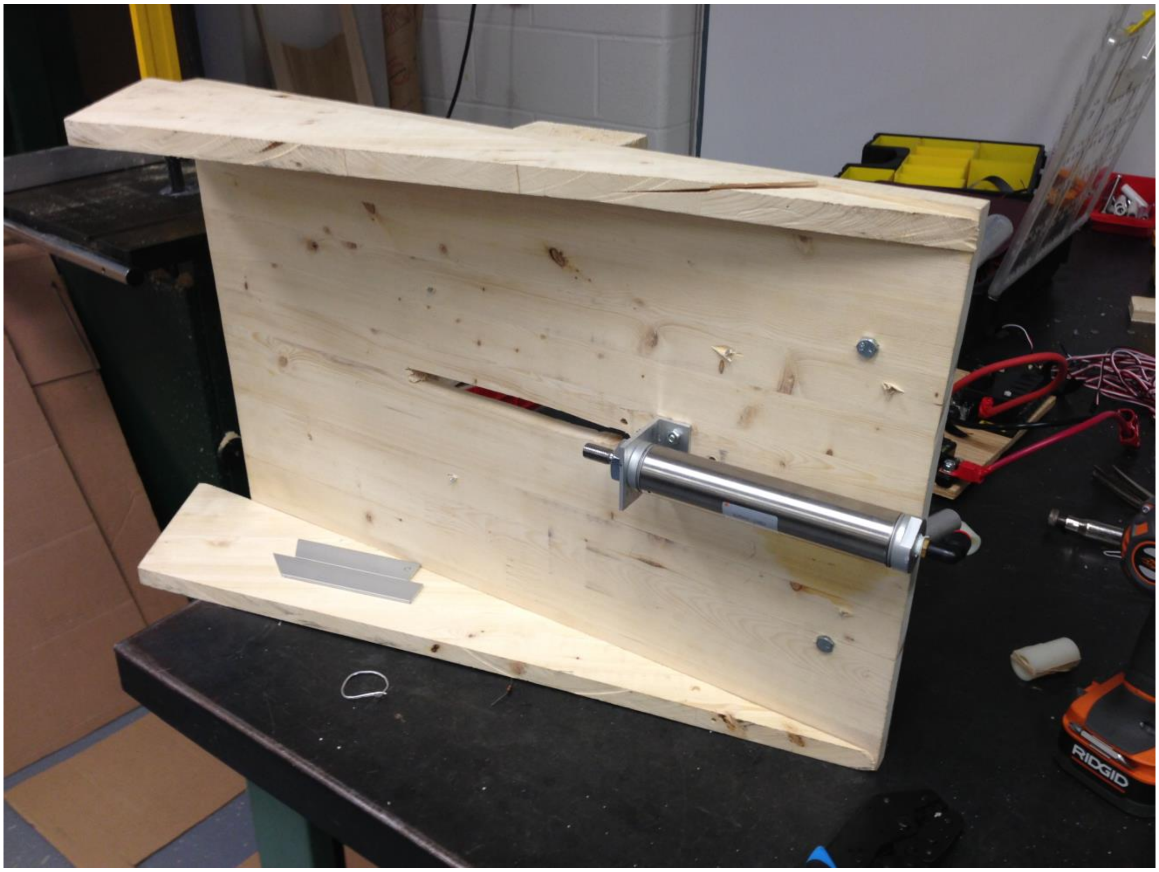
Monday January 21

There was a stupendous amount of progress made today. The programmers were working on tuning and programming the optical sensor. The optical sensor will track the speed of the shooter; currently they are installing the sensor on the quarter circle shooter. This sensor will give the programmers more accurate numbers and allow them to fine tune the shooter further than they ever have before. Jamie, an assistant head of Design and Manufacturing, made a CAD model the Lexan feeder. Two of the angles were incorrect, however, and he had to make a new CAD model of the prototype. Taran, the other assistant head of Design and Manufacturing, was working on the hanging mechanisms. He finished making a CAD model of the mechanism's gearbox. The gearbox will be attached to the drivetrain, and at the end of the match a piston will shoot forward to the outsides of the drivetrain and push a dog gear towards the outside of the drivetrain. This dog gear, when pushed by the piston, will disengage the drivetrain,
engaging the hanging mechanism's gearbox.



Tuesday January 22

Today the Energy Systems division started their work on this year’s robot. They installed a Lexan tray on the bottom of the robot and began installing the electrical components. They made room for the battery and installed the cRio power distribution board, 4 Jaguars and 4 Victors. These components were only installed temporarily; they were only making a plan for the electrical board. Since our other subsystems had not yet been finalized, they had to hold off on the electrical board. Nevertheless, the drivetrain is now complete and Energy Systems will have the green light once the other subsystems have been fully modeled in SolidWorks, our CAD program. In regards to other subsystems, a piston was installed on the feeder prototype. The pneumatic piston will pull the disc at the bottom of the stack out without disturbing the other discs. The feeder needs to be finished soon so we can move on with the design process, but it will also need to be made well as it is a vital part of our strategy for scoring.

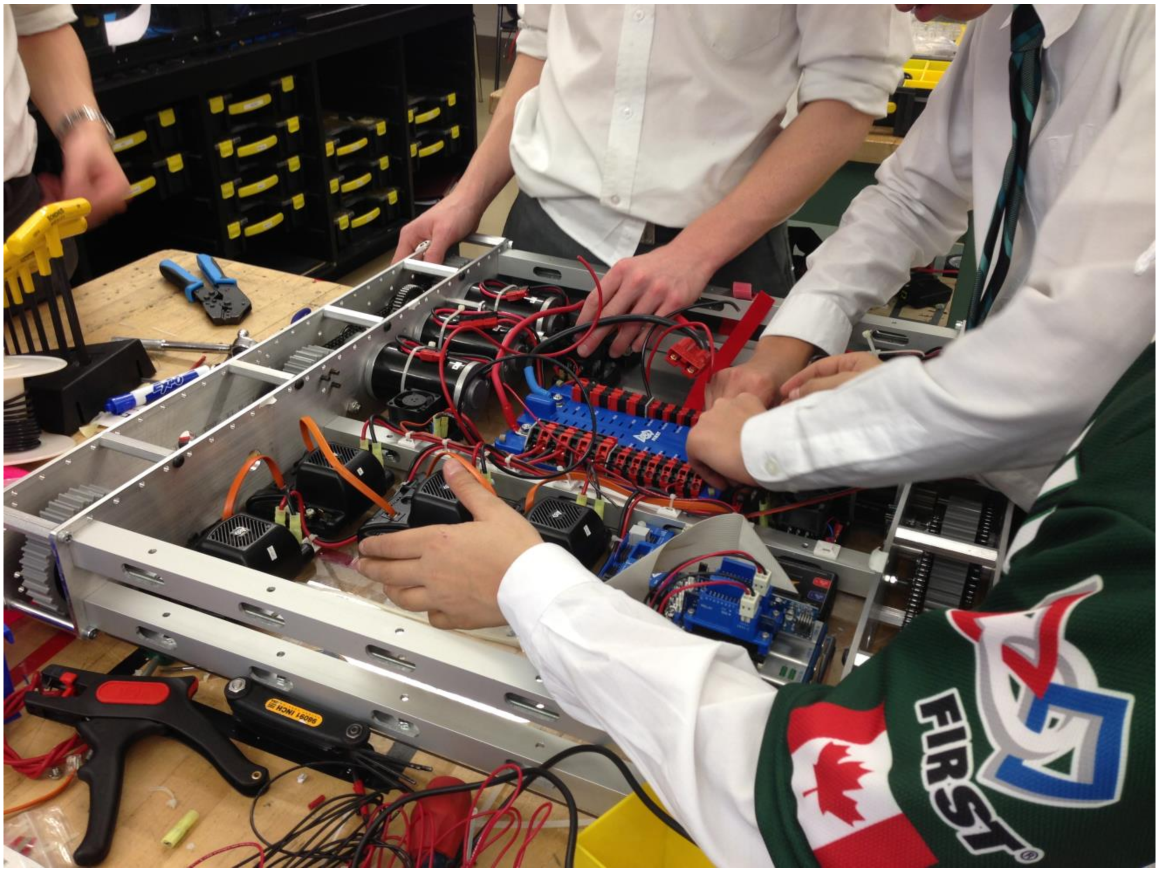


Wednesday January 23

Drivetrain: Today the team worked diligently on the drivetrain. This time around the various electrical components (cRIO, PDB, Jaguars, Victors, air tanks) were properly mounted and wired. We were able to power on the drivetrain for the first time. The programmers then re-imaged the cRIO.

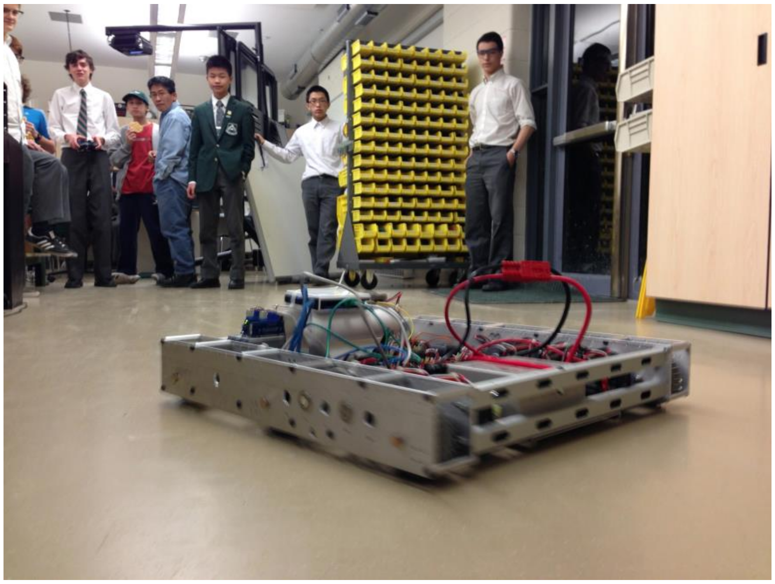
Feeder: The feeder team re-drilled holes and adjusted the piston, essentially re-iterating the whole feeder prototype. The piston was repositioned so it could actually push discs out the slot. The Lexan funneling tray was attached so the discs could actually be automatically sorted. The next step for this team is to attach the feeder to the 'Cyclops' shooter prototype and figure out how to integrate the subsystems.

Programming: Vision tracking was fixed. The robot can now track 2 vision targets of various shapes with the push of a button.



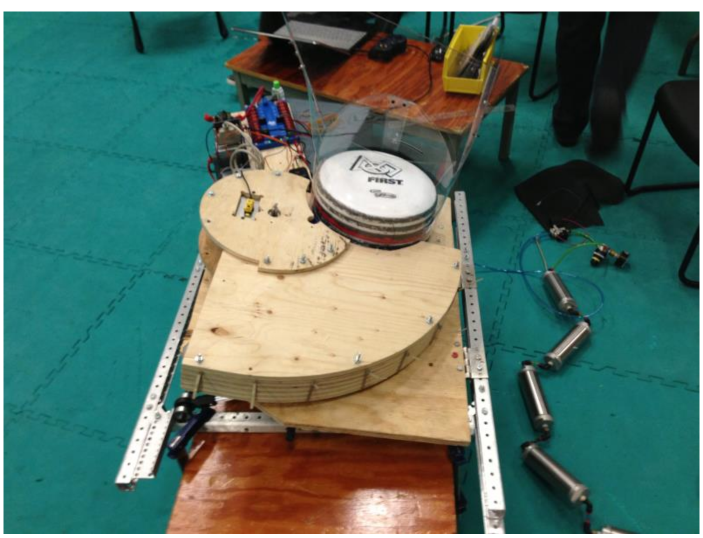
Thursday January 24

Today was a big day for the team. The programmers got the drivetrain moving through the controller for the first time today. Austin, our driver, was quoted as saying "It's fast. It'll be tons of fun to drive this year!" The programmers were uploading code to the robot and setting up the drive code. Austin also worked on making CAD models of the feeder and quarter circle shooter and integrating them together. Today the electrical team mounted the pneumatic cylinders to the drive train. The D-Link router and radio were mounted as well. The electrical division labeled every feature so that they can trace their wires more easily in case something is damaged. The mechanical team added grease to the gears to help the gears on the drivetrain move more smoothly.



Friday January 25

Today Hugh, a member of Design and Manufacturing, continued to make a CAD model of the second level of the electrical board. He made a shelf below the plate for a place where the netbook will go. This netbook will communicate and send information between the cRio and Kinect on the robot. The team mounted the feeder prototype to the shooter and the programmers began to tune the shooter with the feeder. With the feeder mounted, the programmers were able to get proper PID values because the risk of human error in feeding the shooter was removed.

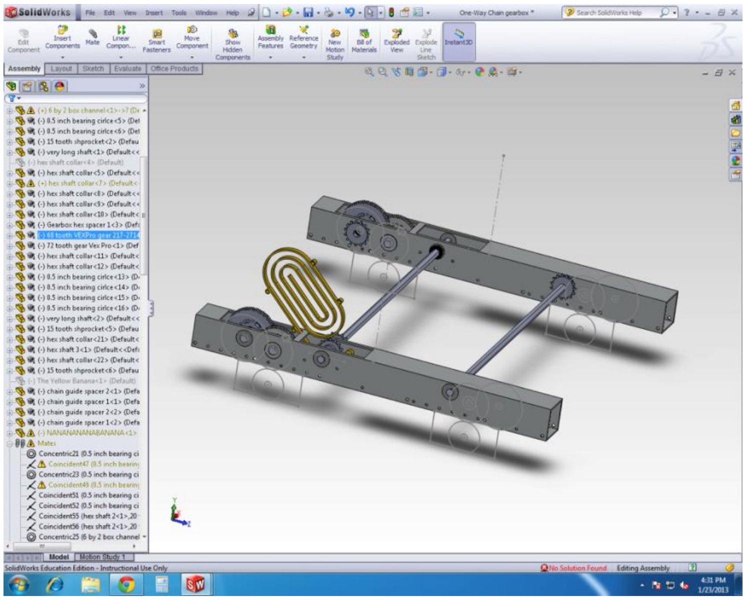


Week 4

Saturday January 26

Today Austin, head of Design and Manufacturing, continued to make CAD models of the final version of the quarter circle shooter, the CAD is close to being done and we hope to start building the shooter by next Saturday. Taran, an assistant head of Design and Manufacturing, continued to work on the CAD model of the hanging mechanism. He is getting close to finishing although there is still a lot of fine-tuning to do with his assembly. The team hopes that this CAD model will be done by next Saturday. Some of the younger members of Design and Manufacturing were using our CNC router to make the Lexan shelf that will be the second level of the electrical board and will be used to store the netbook. The programmers were trying out different angles and speeds with the quarter circle shooter that would allow the robot to shoot through the pyramid into the 3-point goal. They assembled a mock pyramid with some of the supplies that were available to them.

Monday January 28



To begin the workday today the team had a meeting to update everyone on what all the divisions have been up to. Taran, an assistant head of Design and Manufacturing, was to work on his hanging mechanism in SolidWorks. Sadly the one-way chain mechanism based on our Bowser prototype was too weak, so he has changed the design to involve a telescoping arm. Energy Systems added the air compressor onto the robot. David, assistant head of Energy Systems, and Ian, a member of Design and Manufacturing, repaired one of the Logitech controllers. Another Ian, assistant head of Programming, and the programmers continued to tune the quarter wheel shooter. His goal is to tune the shooter's revolution as best he can in the next day or two. Matthew from Design and Manufacturing repaired one of the sprockets on the drivetrain. As well, Jeffrey from Programming worked on his drivetrain code and integrated his code for the piston that will push the dog gear into the hanging mechanism gearbox, engaging the power takeoff.

Tuesday January 29

Members of the design team are coming up with a design for this year's bumpers. They have begun the process in Solidworks.

Today, many of the pieces necessary for the construction of our shooter were fabricated. The doorstep, tracks, slides, and wheel mount had reached their final stages in CAD, and after a few clicks on Visual Mill, students were able to select stock and CNC their pieces, followed by the standard deburring process.

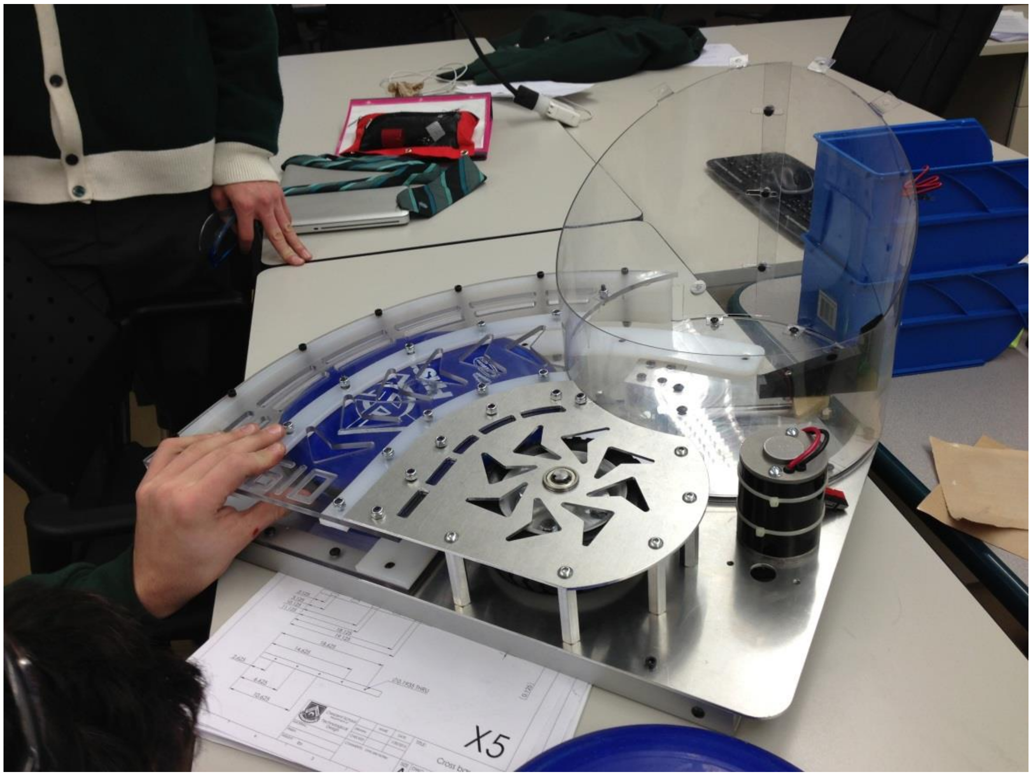
The programmers have been working on targeting and integrating the subsystems. They have also been diagnosing drivetrain problems. Some pistons were not firing properly, so they were able to reconfigure the pneumatics to get them working properly again.

Wednesday January 30

Today the programmers had a massive code review. Code for various subsystems was coming in from a few different programmers. During the code review, programmers were able to implement all of the code to date into a Competition Code file that would be used on the real robot. They also removed unnecessary code, cleaned up the commenting, and planned out a structure that they could build on for the future. Finally, they created some new classes, such as 'Climb', that could be expanded upon. The top plate, two metal plates, and the side rails of the shooter were fabricated on the CNC, getting us a step closer to completing the shooter.

Thursday January 31

Today the programmers were hoping to work with the drivetrain and improve the Kinect, however Design and Manufacturing was trying to fix a few things, so the programmers were forced to focus on improving the scouting application. Hugh and Matt, members of Design and Manufacturing, were finalizing their CAD for the electrical board. The mechanical team finished building the parts for the shooter and assembled it. Energy Systems got right to work and assembled an electrical board so the programmers could work on it.


X5

Friday February 1

Programmers have been given access to the shooter and are now shooting with it. They are tweaking code for the shooter for things such as calibrated angles and the shooter's PID. A problem they encountered with the shooter was that disks were not leaving the shooter flat, but were instead curving and losing distance. This, however, was a mechanical error.

Assistant head of Design and Manufacturing, Taran Ravindran, has been working alone and under the guidance of Mr. Stehlik, our mentor, on the CAD for the hanging mechanism. The fact that we had to design something that would prevent the robot from falling, a subsystem that was completely theory even at this point, while still staying within weight limitations was a difficult task. This grade eleven student was up for the challenge. The one-way chain, which we initially planned on using, did not meet our expectations, so Taran had to redo his design. The CAD model needs to be done by tomorrow night, and it will need to be machined in less than a week. This is a fairly tight deadline for such a key part of the robot.

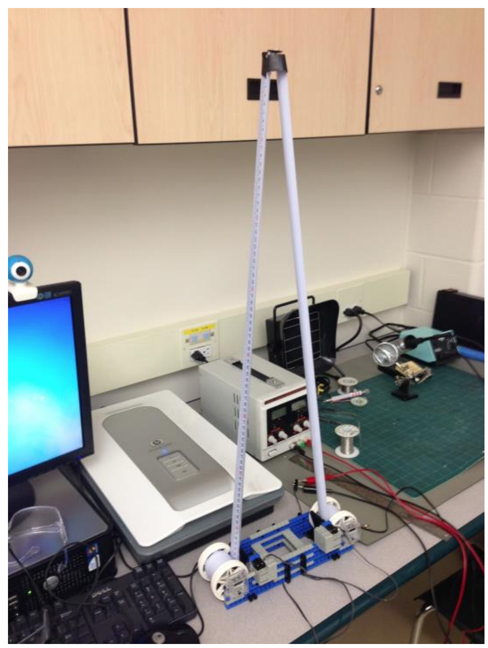
Week 5

Saturday February 2

Today the Design and Manufacturing worked with Energy Systems to build and mount the second tier for the electrical board. Below the top of the second level, there is a shelf for the netbook that will communicate and send information between the Kinect and cRio. On the top shelf of the electronics board there will be only pneumatics components. As well, the Programming division was able to try and tune the final shooter. The discs, however, were curving to right quite a bit so the Design and Manufacturing division is trying to correct this flaw by modifying the thickness of the rails on the shooter. One of the more important things that happened today was that Taran, an assistant head of Design and Manufacturing, began building the prototype hanging mechanism.

Monday February 4

Today some of the Grade 9 students in Design and Manufacturing finished their CAD drawings for some of the bumper mounts. After this, Jacob, a member of Design and Manufacturing, worked with them to cut the holes for them on the mill. The programming division tested a lot of their code and made sure every subsystem they have created so far are fully functional. Some students in the Grade 12 Technological Design class built the mount for the Kinect today. They realized that the mount was too heavy given the weight of our robot and began brainstorming ways to redesign it. Today, Taran, an assistant head of Design and Manufacturing, and Mr. Stehlik, a mentor, decided to change the design of the hanging mechanism to use tape measures. This new design will be very lightweight and could be just as strong as the last design. The new design is similar to our first design, but it should be sturdier and possibly faster.



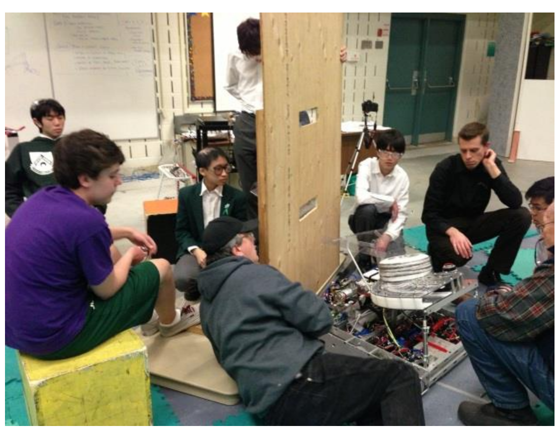
Tuesday February 5

Today was a quite a day in the tech lab due to parent teacher interviews. Taran, an assistant head of Design and Manufacturing, was able to successfully able to finish his CAD models of the hanging mechanism. This was the last large barrier that the Design and Manufacturing needed to get through. From here on, there should not be too many CAD models to make. Ian, assistant head of Programming, was able to work with robot. He was trying to fine tune the PID values that will be applied to the drivetrain motors when we are trying to align with the goal. The auto adjustments seemed to be coming along quite well and Ian seemed very positive about the progress made.

Wednesday February 6

After hours and hours of testing the robot in its current state over the last few days, we came to the conclusion that the feeder needed a redesign. We wanted the ability to park at the feeder station and shoot from there, meaning the tray had to be angled in a way that the shooter faced the goal while the tray faced the feeder slot. We decided that this option was a priority, so the tray was sent back to the drawing board. This problem really conflicted with our textbook strategy, where rapid-fire is necessary.

Another interesting occurrence in our lab was the 5.5-axis part being made on our 3-axis CNC router. The part, made in two major steps took one hour to make. Luckily, or unluckily, the part was deemed unnecessary the very next day. Nevertheless, the final product was very impressive.



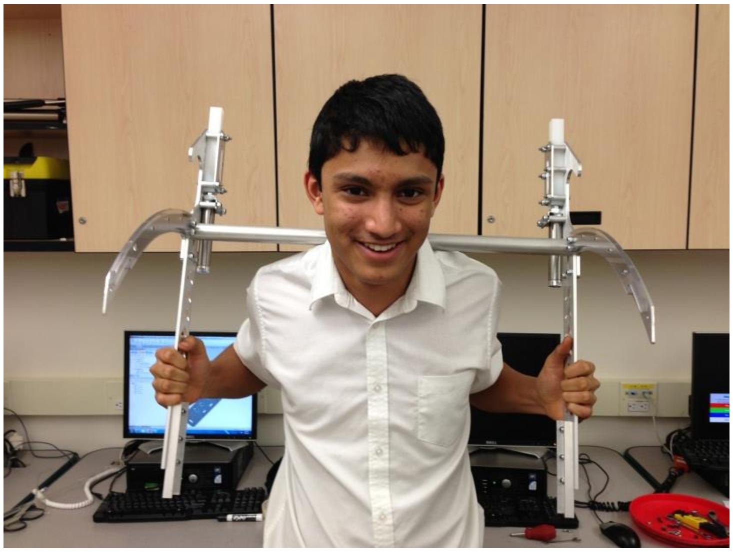
Thursday February 7

Jonathan finished editing the CAD model of the feeder. As well, the programmers were testing the rapid-fire shots from behind the pyramid. These shots had a high accuracy. The approach that the programmers took to speed up the recovery time

was that after a shot is fired they would spike the speed of the shooter so that it will recover much faster. With the PID values, they are able to quickly stabilize the shooter once it reaches the appropriate speed. Design and Manufacturing continued to machine hanging mechanism parts.

Friday February 8

Today was a very important day for the development of our robot. From dawn until nightfall, parts were machined right here in the Tech Lab. Our hanger, a key part of the robot, is nearing completion. Starting with the passive hooks, a large part of the hanging mechanism was constructed. We are making great progress at this stage of build season. If we continue with this momentum, we will have our world-class robot completed in time for Stop Build Day.



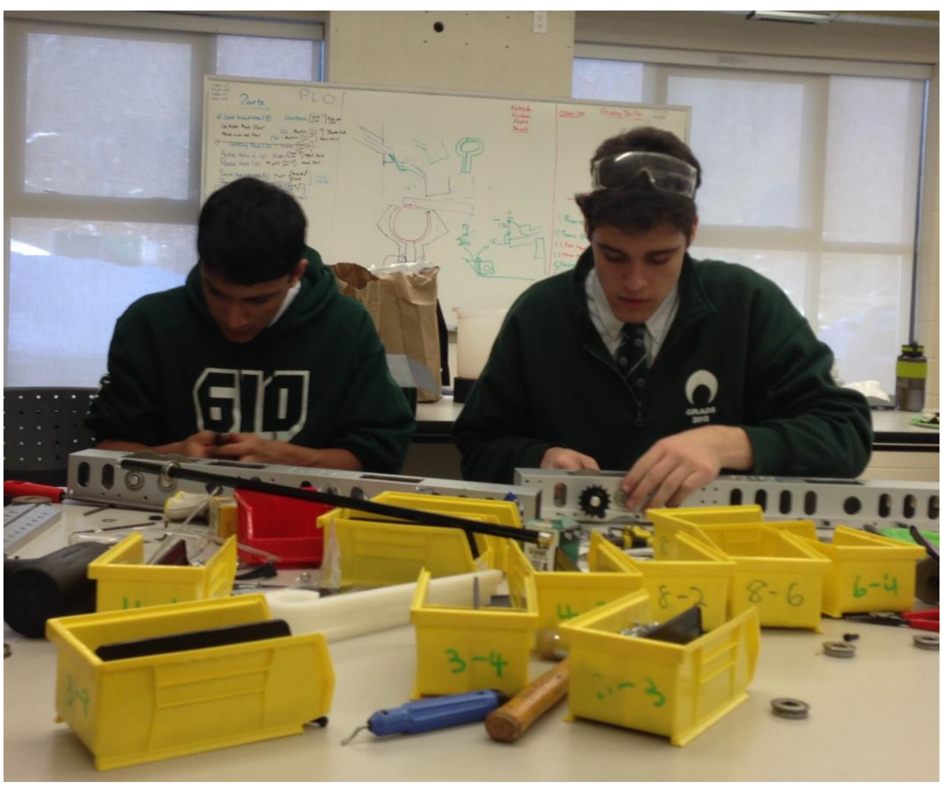
Week 6

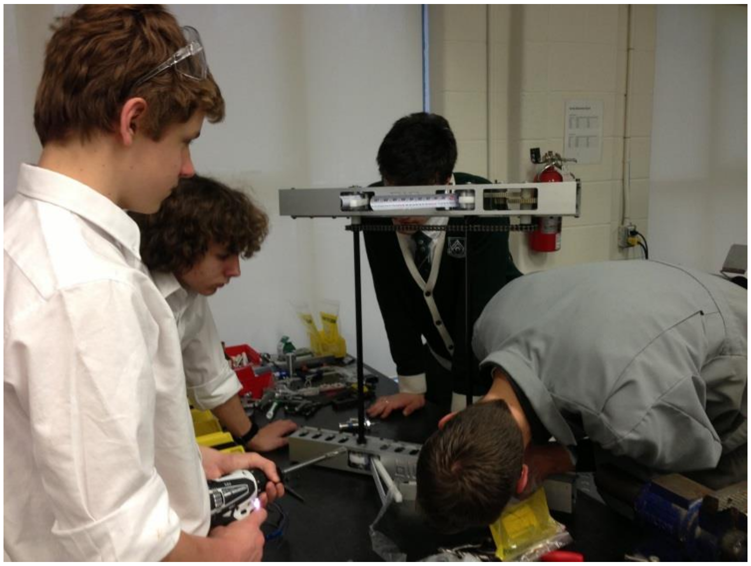
Saturday February 9

Today was the beginning of the end. Design and Manufacturing finished making all of the parts for the hanging mechanism and began assembly. The team hoped to build both modules today, although the assembly was taking longer than expected. Some of the spacers we made weren't quite the right length, which caused some delay. In Hyland Hall, our main practice and testing area, the programmers continued to work tirelessly away at tuning the shooter.

Monday February 11

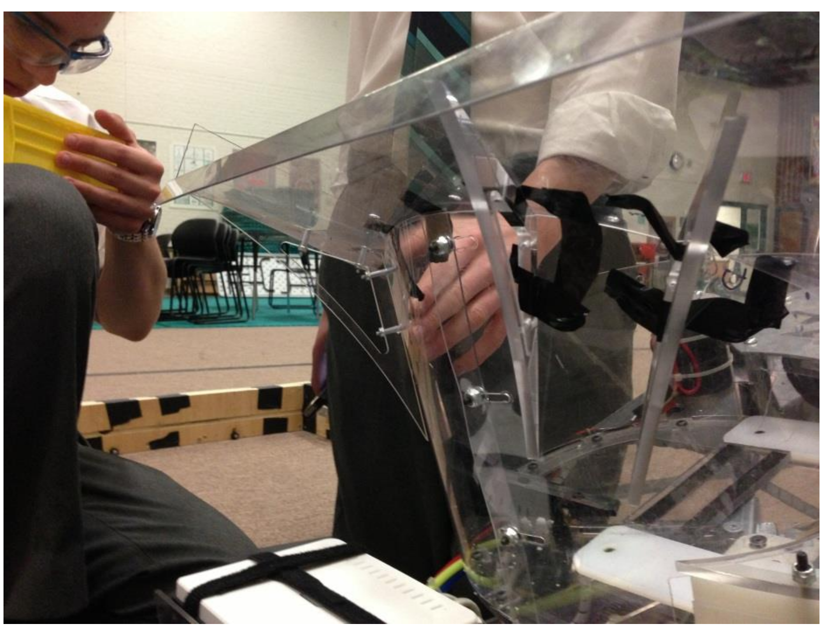
Today we had parent teacher interviews, so a select few students came in to work on the final part of our robot, the hanger. We were able to assemble much of it today and it is almost ready to be mounted on our robot. The hanger uses measuring tape to lift active hooks, so seeing if it will work will be extremely nerve-wracking. We have faith in our assistant head of Design, Taran Ravindran, and we think his mechanism will do the trick. With this hanger being mounted sometime in the next few days, we will judge just how well the robot will perform this year.





Tuesday February 12

The passive hooks and their base were mounted onto the drivetrain. Later in the night the drivers attempted the first climb, but only to the first level. There was good news and bad news from this trial. The good news is that going from one level to another was going very well, however the bad was that the fixed hooks were having trouble grasping onto the bar when we raised them to grab the bar on the first level. The gearbox and raising and lowering section of the hangers is close to being finished. Once this sub-system is complete the team can begin full time. The strategy division finalized the drills they want to run the drive team through this weekend; every aspect of the game will be covered to ensure the drive team is prepared. We also added supports to the feeder to make it more stable.



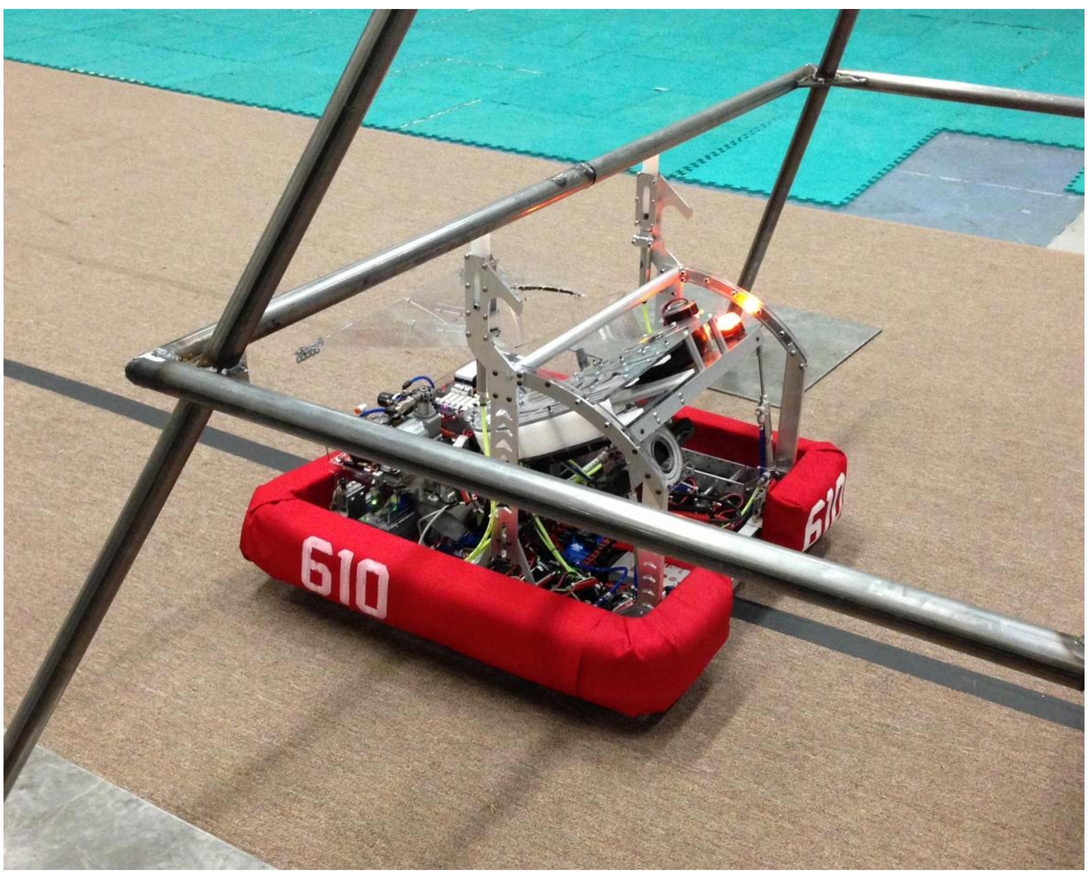
Wednesday February 13

Today we had a meeting discussing the following items:

1. Our 30-point hanger was having issues with twisting tape that made it difficult to position the passive hooks, so we had to redesign our hanger. We decided to make a simpler 10-point hanging mechanism for our first regional, BAE Systems Granite State Regional in Manchester, New Hampshire.
2. The feeder, at this stage, was not able to fulfill an essential part of our textbook strategy, shooting discs while parked at the feeder station. This called for a modification to the shooter. We decided we would design a flip up mechanism that extended to allow discs to be fed from the optimal angle.
3. The Design team was divided into sub-teams that would work on designs for a pneumatic hanger and a wedge-style hanger. The 30-point hanger would continue development, but would not be implemented onto the robot until after BAE.

The designers went back to the drawing board and SolidWorks, and began designing these hangers.

Meanwhile, the drive team was doing what they do best, practicing driving the robot. They were running cycles – going to the feeder and firing discs in quick succession. This driver training will help us immensely during the regular season.



Friday February 15

Today the pneumatic 10-point hang mechanisms were finished and assembled. In the morning the drivers were working on their cycles, which consist of driving to the feeder station, driving to the back of the pyramid, aligning, and shooting 4 discs. The robot was running relatively well, although the drivetrain was having a bit of trouble towards the end of morning. During lunch the new hanging mechanism was mounted and a fold out tray for full court shots was mounted. Energy Systems then hooked up pneumatics to both components. In the afternoon, the team did the first 10-point hang with our new hooks and fixed the problem with the drivetrain. For the rest of the afternoon and evening the team continued to practice cycling.

Week 7

Saturday February 16

The day started off in the field house, with drivers practicing on the mock field we made. We invited local teams, such as 907, 1241, and 3396, to practice with us. This is advantageous to all teams participating, as they can gain insights from other teams, become comfortable with driving, and work together to fix any issues that may arise. Around midday, we encountered a few problems such as a hook on our hanger breaking and some Jaguars that needed to be reconfigured. Both of these problems were solved within 20 minutes and we were on our way. We will spend the next few days the same way, with driver training and troubleshooting.

Sunday February 17

Today was a robot maintenance day for the team. The team made new hooks. This time, however, we used thicker aluminum to ensure they would not bend again. Ryan Tam, a member of Design and Manufacturing, also made extension side pieces for his hanging mechanism to make sure the air cylinder would not be able to move. As well, Jake, head of Strategy and an avid designer, designed what we hope will be the final version of the fold out tray for the feeder. This tray will allow us to attempt full court shots. One of the damaged wheels on our drivetrain was replaced and Austin, head of Design and Manufacturing, added grease to the drivetrain. The team hopes to be practicing by tomorrow.

Monday, February 18

Today was dedicated to practicing with our near-completed robot, Taz. We continued to practice "cycles," driving back and forth between the feeder station and pyramid and scoring discs in quick succession. Throughout the day, minor problems arose, but they were quickly fixed. Near the end of the day, we carried out a mock inspection of the robot, which resulted in a few bumper and air tank errors. We plan to fix that tomorrow.

Tuesday February 19

Today the team had our robot showcase. For the event we invited parents, sponsors and other community figures in our Centre for Creative Learning, the school's theatre. It was a very enjoyable night showcasing what 6 weeks of hard work looks like in its final fabricated form.
After our showcase we took our robot back to the Tech Lab where we bagged and tagged our robot, finishing up a difficult but rewarding Build Season.

BAE Granite State Regional

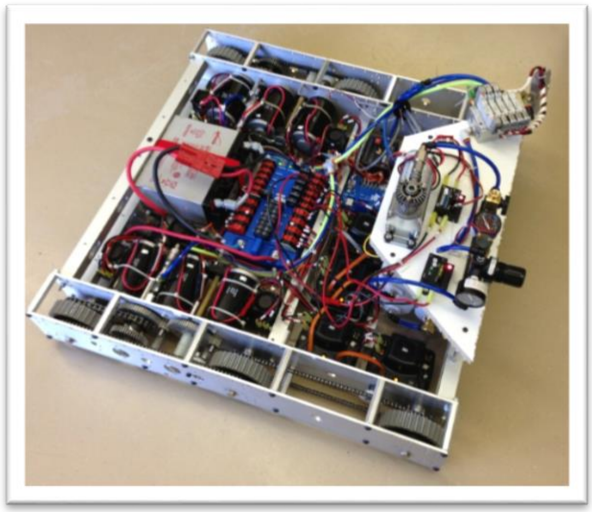
This season Team 610 travelled to New Hampshire to compete in the Granite State Regional. After being the very first team to pass inspection, we spent the Thursday on the field practicing our cycles, full-court shots, and autonomous programs. We made some minor tweaks to our robot, and were ready for qualification matches. The next day we went 7-0, and were able to meet and help some terrific teams throughout the day. We were also awarded the Delphi Excellence in Engineering Award. The event was extremely well organized and the arena hosted a textbook FIRST environment. We finished the qualification rounds with a 9-1 record, seeding first. Team 610 formed an alliance with teams 4124 and 3609, partners that were instrumental in our eventual victory. After 6 thrilling elimination matches, with scores averaging 134 points per match, we earned the blue banner. Team 610 would like to thank all the FIRST organizers for making the event possible, and all the teams that made us feel welcome.

Robot Specs

The Tasmanian Devil
“Taz”

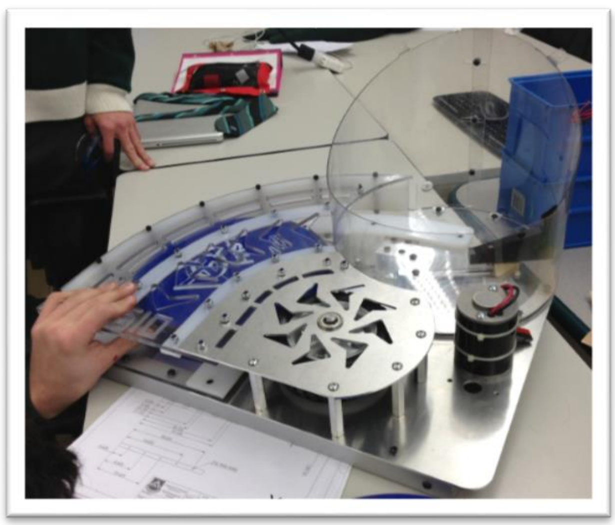
Major Systems

Drivetrain
Designed By: Ryan Tam 11



- Six wheel drive
- 4” AndyMark HiGrip Wheels
- 6 CIMs geared 5:1 with 8:5 sprocket reduction for over all of 8:1
- Top speed ≃9ft/s
- Acceleration ≃6ft/s^2
- Optimized for moving between Pyramid and Feeder station (36ft) apx. 4 seconds
- 2 sets of #25 chain + 1 set of #35 for Power Takeoff
- Custom Aluminum Chassis & Gear Box
- Max Pushing force ≃130lb
- Stall torque ≃100N*m
- Power Takeoff (removed post BAE)
- 0.1” rocker
- Weight ≃ 50lbs

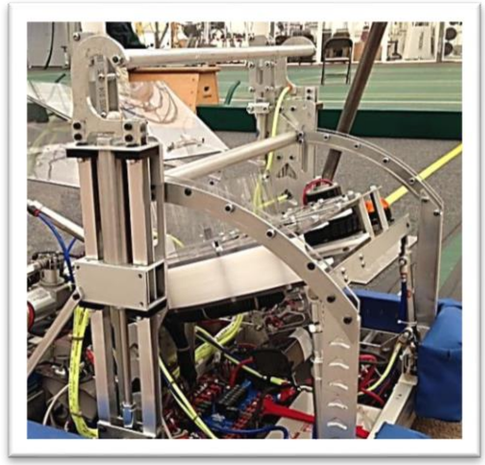
Shooter
Designed By: Austin Bianchini 12



- 0.25” Lexan polycarbonate & 1/8 Aluminum housing
- Powered by 1 Mini CIM motor
- Driven by timing belt
- ¼ circle shooter design
- 0.5” disc compression
- 6” pneumatic wheel
- Recovery time < 1.2 s
- Pneumatically fed

Hanger
Designed By: Ryan Tam 11

- Two dual acting 5" stroke pistons
  - 1.25" bore
  - 100 lbs. lifting force each @ 60psi
- 2 hooks positioned above center of gravity to prevent swinging
- Machined from 6061 Aluminum
- Sub second hang + alignment time



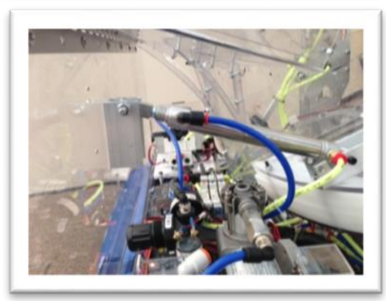
Sub–Systems

Feeder
Designers: Jonathan Lau 11; Jamie Rose 11

- 1/16" Lexan polycarbonate construction
- Pneumatic indexer
- Delrin "doorstop" prevents discs from jamming

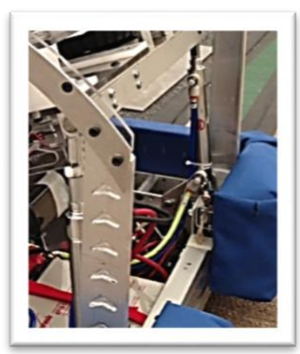
Flip-out Tray
Designers: Jake Fisher 11; Ryan Tam 11; Taran Ravindran 11

- 1/8" Lexan polycarbonate construction
- One dual acting 4" stroke piston to retract and extend



Variable Shooter Mount
Designed By: Ryan Tam 11

- Two dual acting 4" stroke pistons
- 15 degree & 30 degrees



Additional Info

- Encoder on drivetrain for accurate autonomous movement
- Optical sensor on shooter to control rpm ("custom" encoder)
- Microsoft Kinect for automated infrared goal tracking
- 3 layer electrical panel
- Onboard compressor + 4 clipper air tanks
- 2 pneumatically actuated "bunny ears" pop out as hard stops for Pyramid alignment
- **Possible ground intake system with improved autonomous**

Taz's Scouting Information

Autonomous

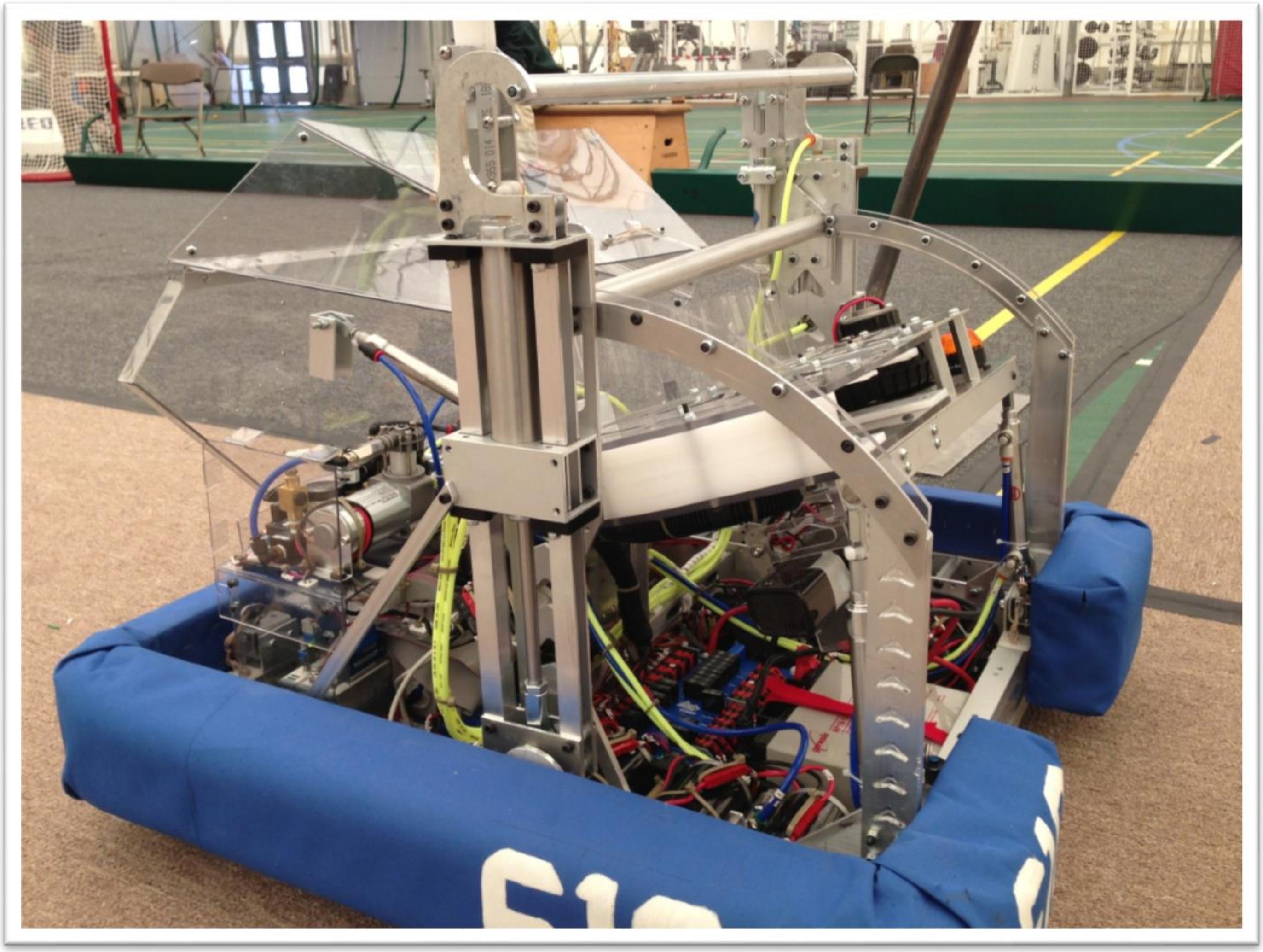
- Positioned behind the pyramid, centred
- Can also be positioned at side of pyramid
- Possible 5-7 disc autonomous (**ground intake pending**)
- Scores 3 discs in 3pt goal - >90% accuracy (3 seconds)

Teleoperated

- Shoots from behind the pyramid, centred
- >90% shooting accuracy in the 3pt goal
- Can drive to feeder station, load 4 discs, drive to pyramid, and shoot them in under 16 seconds

End-game

- Level one hang in 3 seconds
- Can shoot discs while hanging at the back of pyramid
- ~75% shooting accuracy while hanging from level one



Textbook Strategy

The following is the strategy we created at the beginning of the build season. Firstly, we outlined what we needed and wanted on the robot. With that, we were able to create a complete second-by-second breakdown of our strategy for a match.

Autonomous

- Centre behind pyramid all 3 shoot up at top
  - If possible, pick up discs from centre line or under pyramid
- Go to alliance station
- Get load of 4
- Cycle... back and forth
  - if we can... floor pick-up
- Grab 4-6 of special disks
- 30-45 sec
  - Go climb and hang
  - Dump the 4-6 in pyramid

Requirements

- Fast drivetrain
- 10 traversals in 1 minute (36 feet, start, stop, under 5 seconds)
- Capacity of 4
- High Hang (from outside)
- Shooter
- Loading 4 into pyramid goal
- Shoot 4 frisbees in 5 seconds
- Intake System (able to get frisbees from intake slot)
- 75% accurate shooter
- Shoot through pyramid/and 60" robot

Wants

- Dumper Capacity of 6
- Adjustable shooter
- Floor pickup
- Shoot middle
- Shooting from feeding station
- 50% shooting from feeding station on 3 point goal
- 75% shooting from feeding station on 2 point goal
- 30 second end game (allowing 4 cycles)

Optimize distance from feeder distance to back of pyramid (36 ft)!

Textbook Strategy:

Version 1: Cycles Strategy

Autonomous

0 - 7 sec: Shoot 3 preloads into top goal (18 points)

Tele-Operated

15 - 21: Drive to feeder slot
21 - 23: Load the robot with 4 frisbees
23 - 29: Drive to shooting spot at pyramid
29 - 35: Shoot frisbees into top goal (27 points)
35 - 95: Repeat 3 more times (54 points)
95 - 101: Drive to feeder station
101 - 104: Load 4 alliance frisbees into robot
104 - 110: Drive to pyramid
110 - 135: High hang (84 points)
132 - 135: Dump alliance frisbees into pyramid goal (104 points)

Version 2: Hail Mary

Autonomous

0 - 7 sec: Shoot 3 preloads into top goal (18 points)

Tele-Operated

15 - 25: Drive to feeder slot and line up
25 - 90: Shoot all 45 frisbees at top goal (87 points)
90- 93: Load 4 alliance frisbees into robot
93-100: Drive to pyramid
100 - 135: High hang (117 points)
132 - 135: Dump alliance frisbees into pyramid goal (137 points)