GUYER HIGH SCHOOL

STEAM TEAM

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Boosting Engineering Science and Technology Robotics Competition • Current Events 2018 • Guyer High School STEAM Team •

BEST

Guyer Gyre Cleanup

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1.0 TEAM MEMBERS

Miguel A. Benitez	Chief Executive Officer
Cooper J. Vennell	Chief Operations Officer
Rachel N. Hughes	Chief Financial Officer
Jean Kim	Secretary
Ibi Eni	Chief Engineer
Turner Russell	Chairman of the Board
Sarah Spivey	Marketing Manager
Lindsay Sciarrino	Board Member
James Ferguson	Board Member
ZJ Jones	Board Member
Harrison Daniels	Board Member
Ben Little	Board Member
Matthew Bedford	Board Member
Jawad Rao	Board Member
Claire Sopiarz	Board Member
Christopher Zan Schoolcraft	Board Member
Urjitha Vardhineni	Board Member
Omarion Barraza	Board Member
Joshua Fisher	Board Member
Jack Johann	Board Member
Ceanna Cooksey	Graphic Designer
Gabriel Lee	Audio/Visual Technician

2.0 OVERVIEW

This notebook is an accurate documentation of the past month and a half of our work on our robot. From the preliminary process of brainstorming to the final adjustments and fine tuning, we all learned something new. The process of the build was filled with many victories with an equal amount of unforeseen ordeals and general frustration (some of which could not be documented for they could be deemed as too inappropriate). The series of sketches and collective man-hours between us all went towards the completion of this robot.

3.0 DESIGN PROCESS

3.1 Problem Recognition and Analysis

In order to begin the process of brainstorming and design for the robot, we needed to analyze the game objectives and the field in order to determine the overall design of the robot going forward into the brainstorming and the actual build of the robot. Upon our analysis of the game, we came to the realization that the robot would need to perform two main tasks: traverse forwards and backwards on a wooden rail as well as grab items varying in distance.

3.2 Game Strategy

In this upcoming competition, our team will focus on first collecting the turtles to maximize our point total and then we will go for the larger items in our gyres so we can pad our numbers and get rid of the pieces that will be in the way when we go for the practice golf balls. If and when we complete our main objectives, we will switch to our alternative objectives which are shelving the items that we pick up from the gyres and push off the duck so that we can collaborate with the other competitors to figure out which current we are on and get the bonus 150 points.

3.3 Brainstorming and Preliminary Designs

Now with the main design goals created, the brainstorming process could now begin. With these objectives, we determined that the robot would need to be made up of three main components: an arm, a chassis/traversal system, and a claw.

3.31 Chassis

Since the robot itself was constrained to a 2’ by 2’ cube, we knew the base of the robot would also need to be considerably smaller than this maximum limit in order to work once other components like the arm and electronics were added. Another consideration for the base was to ensure that it would be able to balance on the beam with minimal to no tilt or flex. Using a square board would be geometrically sound and having it sit directly on the platform would allow it to balance relatively well since the centroid is located at the center of the object.

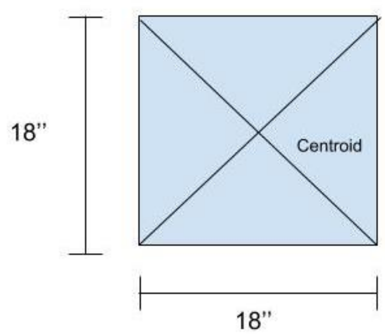


Figure 1. Shown is the geometric centroid of a square when considering the balance point of the robot’s base.

However, using a base with these dimensions limits the reach of the arm and requires all items to be balanced accordingly to prevent the robot from tipping. A method to circumvent this flaw is to use a similar design with a cut out that will shift the centroid to a new location: one closer to the top left corner of the chassis.

With a centroid in this area it allows for the base to be offset allowing for most of the main components and additional parts to be placed on the main body of the chassis while the arm should be extended out from the main square decreasing the distance that it would need to reach in order to grab items from afar.

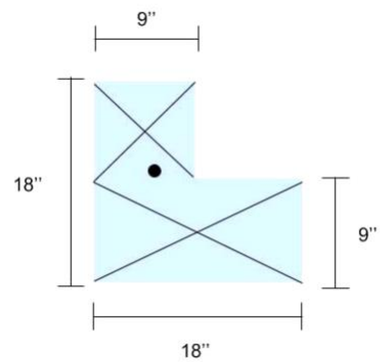


Figure 2. Shown is the geometric centroid of a composite figure when considering the balance point of a modified version of the robot's base.

The design implemented to move the robot across the rail was to use a box that hugged the rail with space for a tread/wheel system either on top or on the bottom of the box. The idea of a locking box hinge was proposed but was later change for an open bottom with PVC connectors and pipes to slide in and lock the bottom of the box to keep the robot on the rail. The open bottom was implemented to reduce the weight of the robot as well as to be able to easily access or modify other parts of the base.

<u>3.32 Arm</u>

The arm underwent multiple preliminary designs before one was finalized for construction. One of the main criteria for the arm was that it needed to reach almost 3 feet at the farthest point and also needed the ability to raise and lower from a fixed point. Two designs were proposed, the first being a simple rail-telescoping system. This design featured multiple methods of lowering depending on which way would be the most efficient. The problem with this design is that it would not be able to reach the needed distance in order to grab game pieces. This problem, combined with its inability to contract in an effective manner, disqualified the design for this arm.

Another flaw of this design is that it was designed as a third class lever, the weakest lever type. While third class levers tend to be extremely accurate, they still lack the strength needed to grab heavier game items.

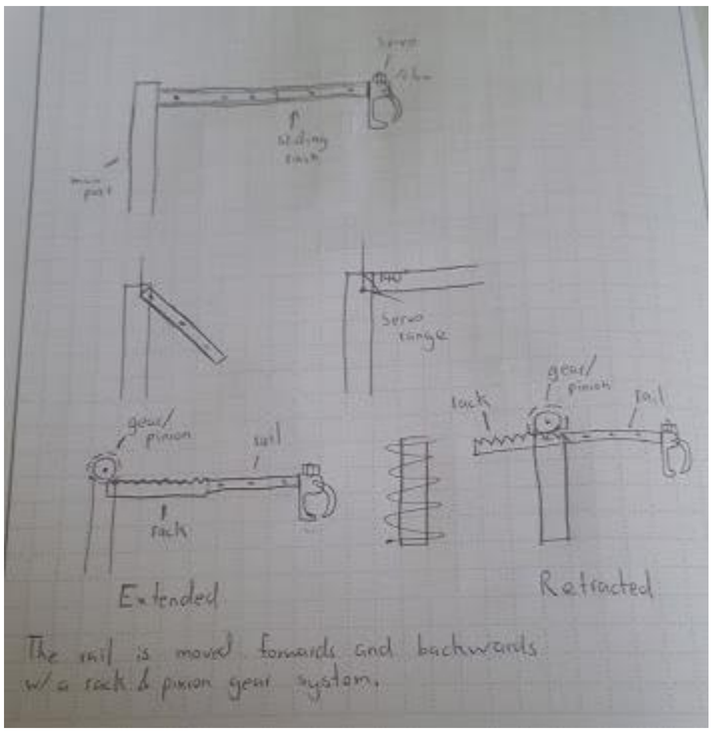


Figure 3. Shown is the sketch of the first attempted design for the arm.
Its short reach and weak lever type made it a poor choice.

The second arm design was kept for most of the brainstorming process. This new design was much more complicated in design and contained multiple members and moving parts in order to fulfill the needs of the game. Unfortunately, one thing we have overlooked in the design of the arm was the 8-inch height limit of what was allowed to be over the rail (the current). This essentially rendered the new designed useless as it required a taller height in order to work efficiently.

The third Arm design had a few different iterations, but the same premise. This arm took the telescoping capabilities of the last arm but added a closed loop chain system to extend and retract the arm effectively. In addition, a rotating base plate would be created in order to allow the arm to rotate a full 360 degrees of motion.

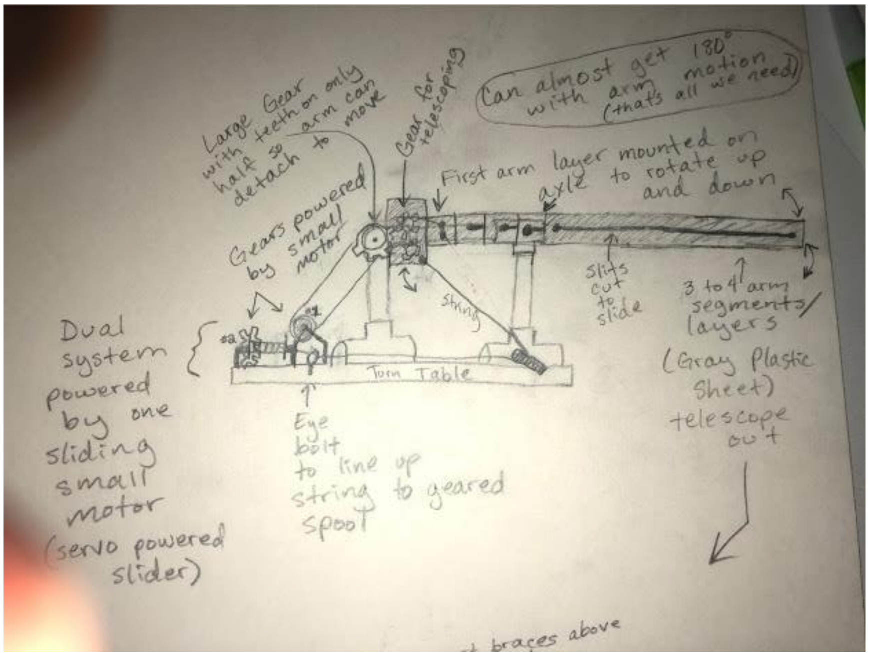


Figure 4. Shown is the sketch of the second attempted design for the arm. Its shorter height and more effective telescoping method made it preferable to the first design.

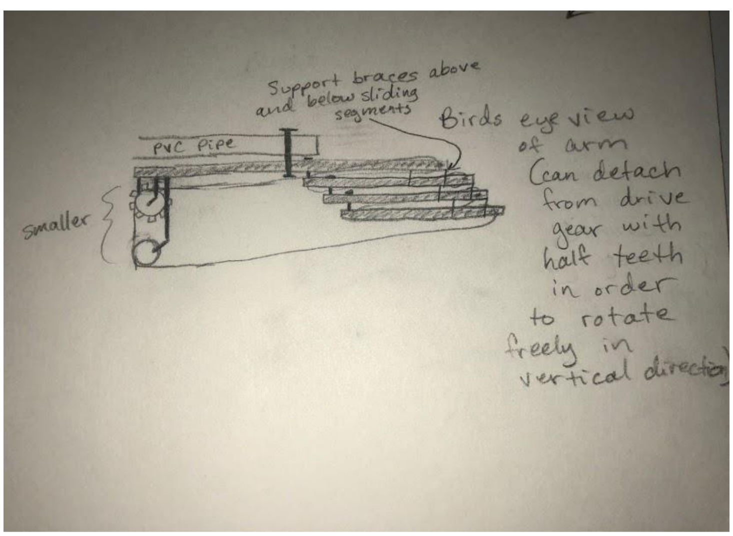


Figure 5. Shown is a bird's eye view of the second attempted design for the arm shown in Figure 4. This view highlights the idea of the closed loop chain system.

3.33 Claw

The claw of the arm had two main iterations. The first was a basic design made up of four different pieces that were a quick mockup as a proof of concept in order to grab larger items. The claw itself was made up of three parts, one of which was stationary. Problems later arose when the laser-cut foam board prototype was made. The glaring flaw in the claw was the robot's inability to grab smaller objects. The idea of adding a mesh was then considered but was later declined and another model was opted for.

This new design was modeled after most claw machine games and large-scale commercial fishing nets. The claw is made up four distinct claw fingers, each connected to a circular apparatus and jointed at a pivot point to allow the claw to move freely. Around each claw finger is a series of rubber bands to create the aforementioned mesh. Only one claw finger will be activated by a servo. By having one of the fingers move, it will then move the others in one continuous motion allowing for the claw to grab things of varying sizes and diameters.

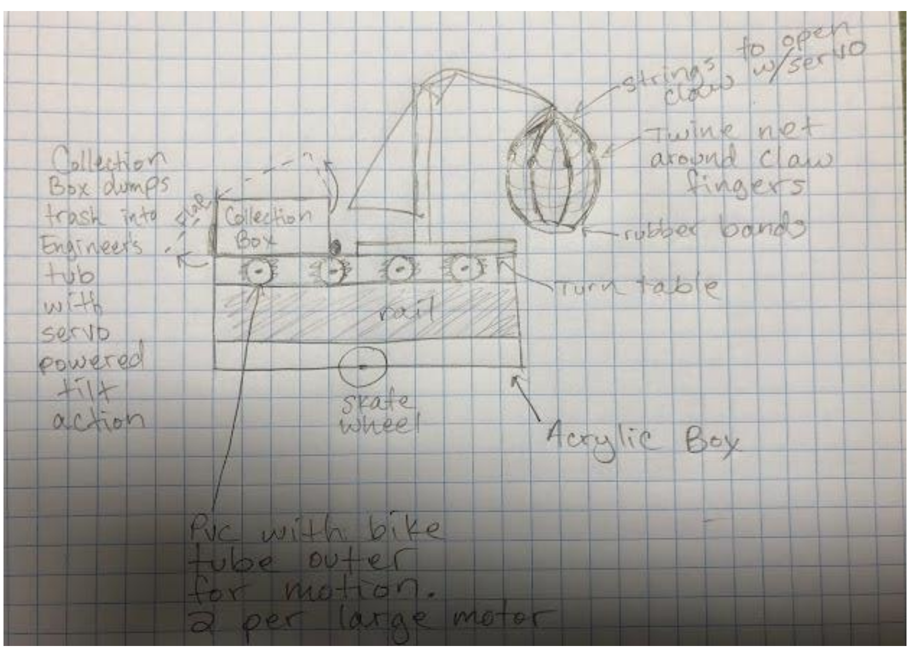


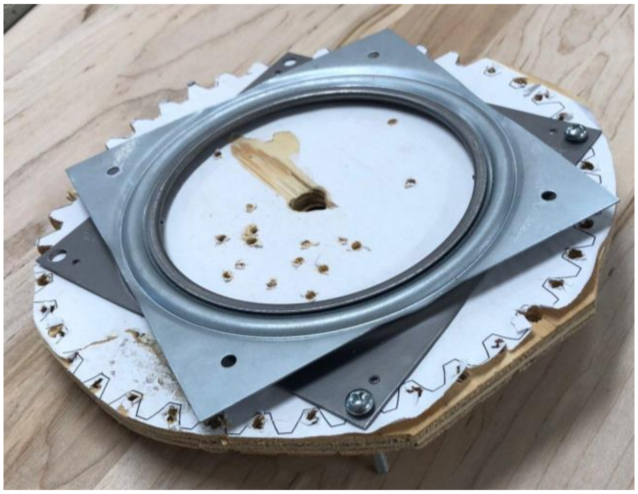
Figure 6. Shown is a side view of the first proposed box design with an arm that is too tall to fit in the 8 inch restriction above the rail. The claw in this sketch is the second consideration modeled after toy grabbing game machines.

3.4 Prototypes and Proof of Concepts

Many of the individual aspects of the robots were modeled and prototyped before exact dimensions were assigned and the construction of the robot began. The purpose of the prototypes and models was to allow us to test what designs would be effective in order to help finalize the design and look at what problems would occur during the final build process.

3.41 Turntable

The first prototype built was the turntable base that the arm would be built upon. Doing so was rather easy, as a piece of scrap wood was bolted to the ball bearing disk as well as a gear affixed to its center for another gear to interlock with it perpendicularly. This second gear was then affixed to a drill to simulate the motion of the motor. Unfortunately, the gear rotated by the motor did not interlock with the gear in the center of the turntable as anticipated, but the paddle rotated significantly more when the gear was placed on the outside edge of the scrap wood. Due to the simplicity of the design, no further testing was needed, only a few changes in the design of the base that will allow a gear to catch on to it from the outer edge.



Figures 7 and 8. Shown on the left is the top side of the turntable prototype with the center gear which was later deemed unnecessary. Shown on the right is the bottom side of the turntable with the ball bearing disk, one of the consumable kit parts.

3.42 Arm

The arm itself went through the most prototyping than any other part of the robot due to how important it was to the completion of the game. The first few iterations of the arm were made of cardboard of two different sizes. The first was a smaller fully functioning arm that operated with the single pull of a string extending the cardboard into three distinct members. The second was a to scale model used for reference to construct the arm.

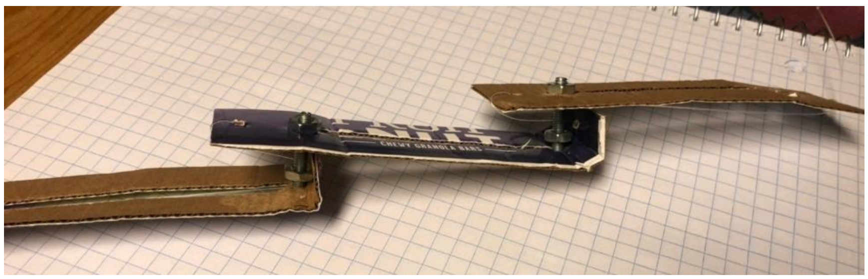


Figure 9. Shown is the first prototype of the telescoping arm made of 6 inch by 2 inch pieces of cardboard, screws, nuts, and fishing line.

Figure 10. Shown is a full sized (but not completed) prototype of the telescoping arm made of cardboard, metal tape, screws, nuts, and twine.

The third prototype was designed to be a to scale functioning model intended to be the final arm made of the provided plexiglass. This arm proved the concept was feasible and saw the elimination of the third member for the apparatus as it was seen as a bit excessive. The plexiglass was chosen initially due to how light it was when compared to other build materials like wood. What we ended up gaining in lightness we ended up losing in rigidity since plexiglass has low elasticity modulus (the measure of a material’s ability to undergo stress before deformation). The secondary problem discovered found in this design was the high degree of precision and accuracy needed in order for the arm to slide out efficiently. A degree that we could not create in our shop given the tools we have and the time constraint we were under.

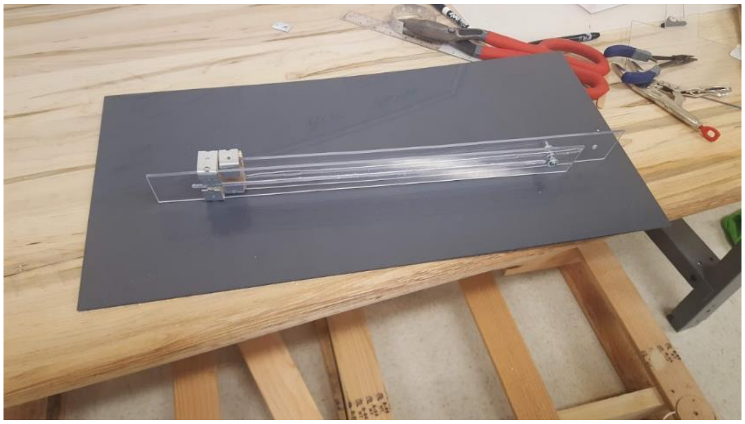
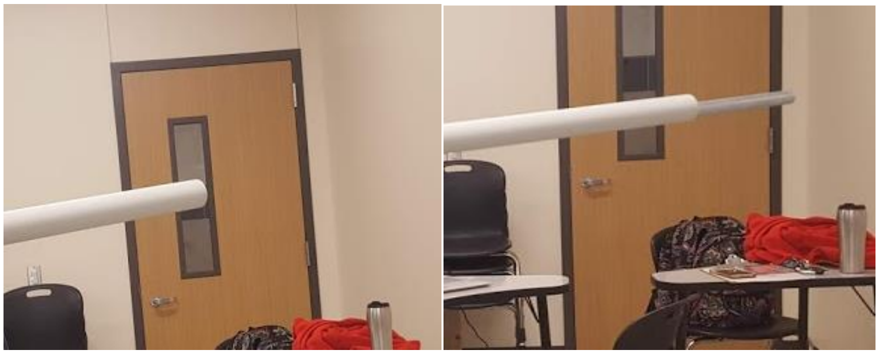


Figure 11. Shown is the plexiglass version of the telescoping arm meant to be the final useable part. However, it was redesigned due to its material weakness.

Now knowing the problems of using a flexible material like plexiglass in long strips, a quick prototype was designed and sketched using the same basic principles but with a more rigid material. The new design utilizes two pipes of different sizes concealed within each other in order to mimic the telescoping motion of the last prototype but with less accuracy needed retaining both rigidity and weight by using hard tubing. The tubing is able to evenly distribute the force of both itself and the load of the arm due to it having a much greater surface area than the plexiglass due to its circular shape.



Figures 12 and 13. Shown is the final design idea for the telescoping arm in the retracted position (left) and extended position (right).

3.43 Claw

Using the quick brainstorming design discused in 3.33, a prototype was laser cut and assembled out of foam board in multiple layers. The design itself yielded an effective claw that would have worked, but it was unable to hold large objects or grab multiple objects in a downward orientation. This then prompted the shift toward a new larger claw that had the ability to grab multiple items, all operated with a flick of a servo. The idea of a holding box was tossed around at this point but was scrapped due to the additional space and weight it would add to the robot and the claw's potential difficulty in extreme repeated use.

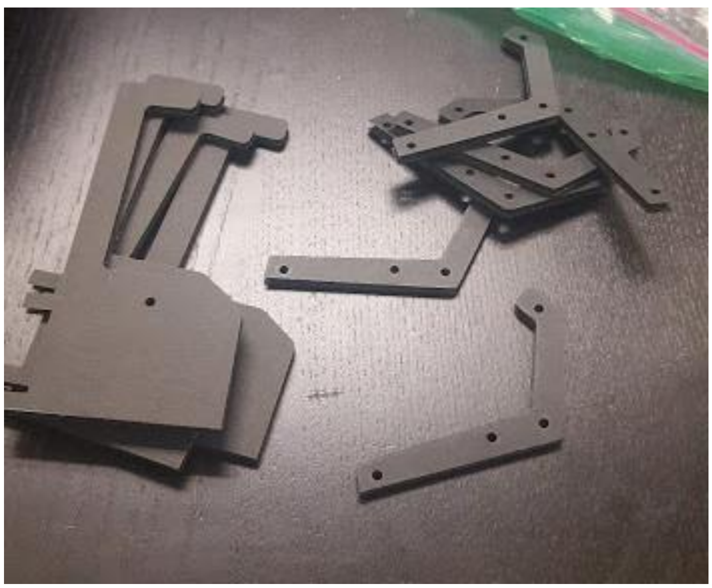


Figure 14. Shown is the first attempted claw prototyped out of foam board. Though it could be useful for smaller applications where precision is needed, it was not an efficient choice for the game strategy we had in mind with grabbing multiple objects at once.

4.0 BUILD PROCESS

4.1 Safety

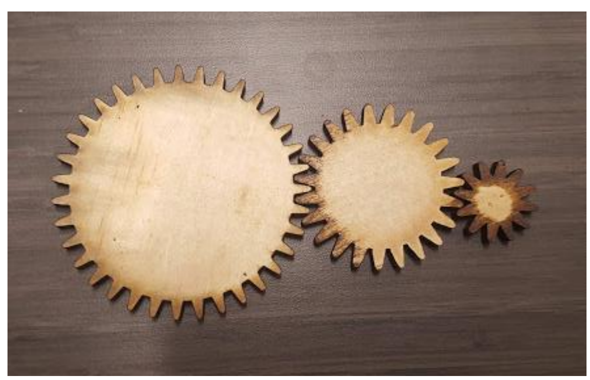
While we were building, we kept the safety of our members as our top priority especially with a large number of new members in the club this year. We were always under the supervision of Mrs. Matamoros when operating the power tools. When using the scroll saw, miter saw, jigsaw, or Dremel we always wore safety gloves, safety goggles, and earmuffs. Additionally, we have established a buddy system which requires at least two personnel to operate any of these large pieces of equipment. When drilling, we used clamps or a vice to make drilling easier, safer, and more precise. The scroll saw requires a safety key to turn on which we kept locked in a cabinet when not in use. This provides a safe environment for the students and provides forgiveness to mistakes for members unfamiliar with constructing a robot. Furthermore, the robotics team at Guyer High School keeps a first aid kit and fire extinguisher in convenient locations for emergencies.

4.2 Building the Robot

Once all the designs were finalized, the prototypes were tested, and all team members had been trained accordingly in safety, we began building the actual robot for the competition. This was one of the more difficult parts of the competition due to the complexity of our design invoked by the difficulty of the game (more difficult than any year in which we have previously competed). The robot also required a high degree of precision and intricacy to ensure each part functioned as needed which we tried to offset with simplicity in other parts of our design. Despite this, there were still problems we encountered and needed to surpass in order to complete the task at hand in time for the competition.

4.21 Gears

The gears were one of the easier items to design and cut since we had access to a laser cutter at the Advanced Technology Complex. The gears themselves were designed in Autodesk Inventor in two different waves. The first set of gears had much more rounded teeth but meshed too well causing them to lock up. The first wave of gears also did not scale well to smaller sizes as the entire CAD model was simply scaled down by ⅓ and ⅔ models and lasered. This made it to where gears of different sizes could not mesh together and synchronize. Sizing the gears incorrectly caused the smaller gears to be extremely brittle as the number of teeth did not change. The new gears designed in the second wave had more pointed teeth and better spacing between them. These new gears were sized accordingly when they were scaled down to smaller sizes as the teeth retained the same size but changed in number as the inner diameter of the base decreased creating nine different gear ratio combination if each ratio consisted of two gears. Granted there were some issues with the cutting of the new gears as the laser had some pass thru and lens focusing errors, but they were easily resolved after only a few hours of troubleshooting.



Figures 15 and 16. Shown are failed gears due to a scaling error (left) and the corrected gears with more pointed teeth which were utilized for various tasks on the robot.

4.22 Arm

The claw's base was constructed on top of the turntable as directed using PVC t-joints to provide a sturdy and light frame PVC for the base and the arm. Mentioned earlier, the first attempt at the arm was made up of plexiglass which lacked any sort of structural support to lift both the load of the game and support its own weight. The new arm with the PVC and aluminum rod is designed to circumvent this flaw and carry much heavier loads.

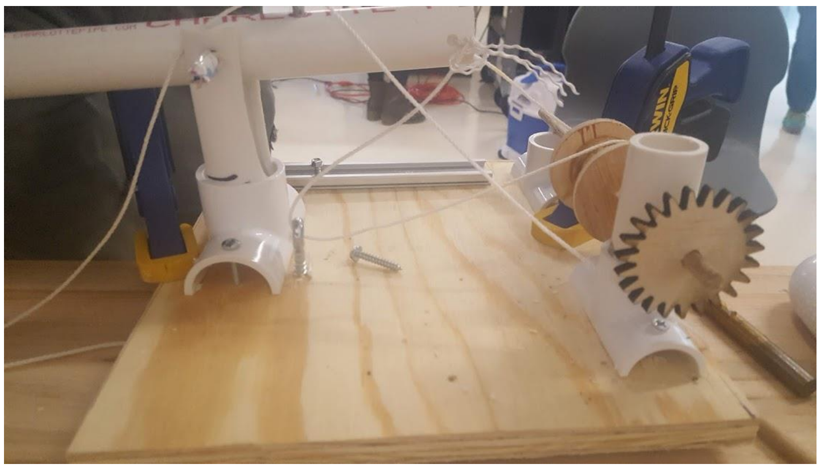


Figure 17. Shown is the base of the arm with a PVC t-joint cut in order to be mounted flush on the turntable.

Earlier iterations of this arm had a spring attachment that was later improved on with a wooden spool and string to extend the arm forwards and back with ease. The method to raise the arm is to use the same motor but on a shifting slider in order to switch between lateral and elevation arm movements to maximize the efficiency of the last motor. With the addition of the sliding motor and the elevation system, the platform for the arm needed to be much larger than anticipated when compared to the original design. Later on, pegs and rounded corners were added to make it so that the motor could effectively rotate the platform.

4.23 Claw

The claw itself was constructed in five unique parts. The first being the circular hinge and the other four being the individual members that move to grab the various game pieces.


Figure 18. Shown is the mounting plate of the claw (left) and the fingers of the claw (right) which were attached to the plate using paper clip circular hinges.

The individual members each will be surrounded in string/rubber band mesh, forming the net at 4 distinct spots on each claw piece. Surrounding the mesh will be a secondary mesh of rubber bands keeping the claw under tension. The top claw where the members each meet will have a string attached to a servo moving all four “fingers” independently of the string. Furthermore, the Claw utilizes one servo to simultaneously move four “finger” components, attached to the base.

To make the net surrounding the claw, we researched some Do-It-Yourself nets and then knitted one out of twine using various knots. We also utilized strategically placed rubber bands to give it some extra elasticity. The net provides two benefits. Firstly, the nets allow for more items to be gripped by the claw from the gyros. Secondly, the net provides an insurance that the game pieces which are grabbed do not slip out of the grip. Therefore, the net is an innovative, instrumental part of the claw itself.

4.24 Chassis

Construction on the chassis started with the box that would support the main base as well as sit on the rail in order for the robot to move. First, the side and top panels were glued to each other before the corner brackets were mounted once the glue had dried. After this, the main L shaped panel was cut out and glued to the box. The wheel holes were then marked so that multiple pilot holes could be made to cut them out. At this point, we had realized that L panel was beginning to bow needed a new application of wood glue and additional screws to secure it in place.

In the movement box, 3 holes were cut on each side to allow for 3 short PVC tubes to be inserted as a lock the box in place when affixed to the current/traversal beam with relative ease. The wheels were later affixed to the motor using an aluminum rod and a modified L bracket. The wheels themselves had two small of a diameter to catch the beam. The wheels were then modified to accommodate using an irregular shape akin to that of a 4 toothed gear with a rubberized covering which allowed the wheels to grip the wheels and move on our sample rail.

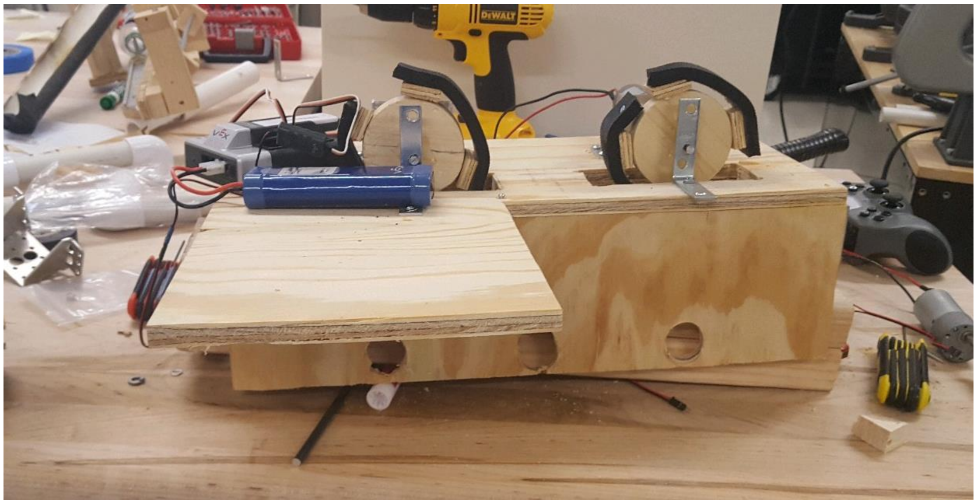


Figure 19. Shown is the box chassis with the wheels mounted on the top side and the side platform for the rotating, telescoping arm.

5.0 PROGRAMMING PROCESS

5.1 Software and Code

Most of the software for the robot was performed on Simulink, with early and preliminary concepts demonstrated being demonstrated with a preliminary concept code in RobotC. The software overall was one of the simpler parts of the robot to work on as most of the adjustments were done by changing a numerical value by a few points rather than making any significant physical changes to the build process.

5.2 Pseudo Code

Before code was actually written, a pseudo code was outlined based on the motorized components and how they functioned as a system. Writing began by assigning each motor to each part of the robot that needed to move. Once this was done and each part received its respective motorized component (Servo and/or Motor), we then discussed and documented the method in which it would have to move. Most of the motors needed to use a continuous drive motion in a positive and negative direction for the turntable, arm extension, and movement. Servo systems found in the claw, motor slide system, and movement locks needed to work with simple control flick staring them in their -90 position and moving them to their +90 position in order to obtain the full 180 degrees of motion they are capable of as it will be necessary to convert the rotational motion provided by the servos into linear motion.

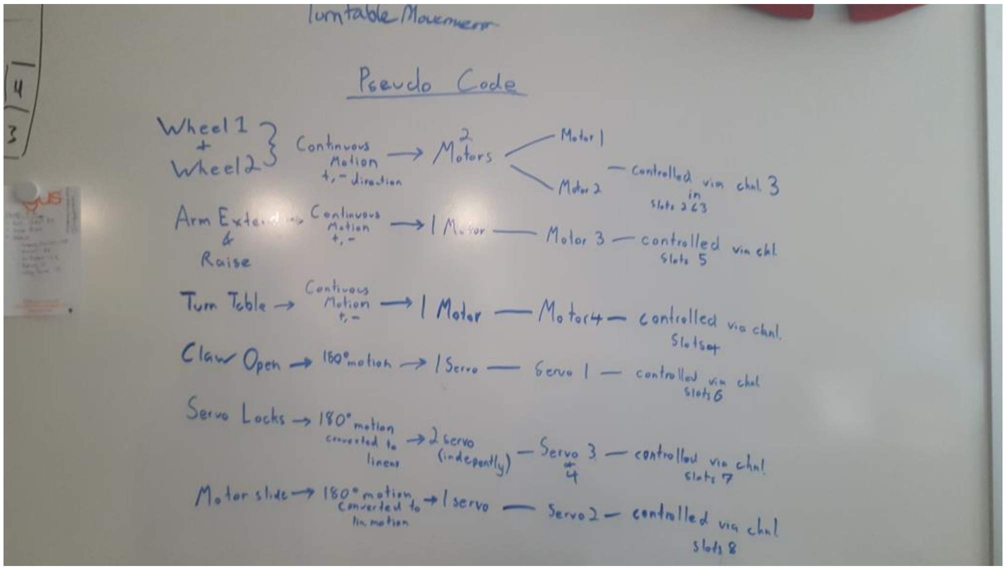


Figure 20. Shown is the pseudo code for the robot's programming needs. This was essentially the basic outline of the robot's motion components to make the programming process smoother.

5.3 Preliminary Code and Early Versions

Once the pseudo code was complete, it was then tested and drafted with a simple movement code written in RobotC to help visualize and understand the channels and later transferred into a Simulink model where it contained more of the complex systems and aspects of the code. The preliminary snippets primarily allowed for movement in the testing phase of the wheels and the turntable.

```
#pragma config(Motor,  port2,           LeftDrive,     tmotorVex393_MC29, openLoop)
#pragma config(Motor,  port3,           RightDrive,    tmotorVex393_MC29, openLoop, reversed)
#pragma config(Motor,  port4,           Arm,           tmotorVex393_MC29, openLoop)
#pragma config(Motor,  port5,           ClawServo,     tmotorServoStandard, openLoop, reversed)
//*!!Code automatically generated by 'ROBOTC' configuration wizard               !!*//

task main()
{
  while(1==1)
  {
    //drive code
    motor[LeftDrive] = vexRT[Ch3] / 1; //left wheel drive in channel 3
    motor[RightDrive] = vexRT[Ch2] / 1; //right wheel drive in channel 2

    //arm code
    if (vexRT[Btn6U] == 1) //moves arm upwards w/ RB
    {
      motor[Arm] = -127;
    }
    else if (vexRT[Btn6D] == 1)//moves arm downwards with RT
    {
      motor[Arm] = 50;
    }
    else
    {
      motor[Arm] = 0; //arm remains at rest with no input
    }
```

Figure 21. Shown is the preliminary code done in RobotC before final transfer to Simulink. This was necessary to verify the motors and servos were working correctly.

5.4 Final Code

The final Simulink model was reached after the robot's physical completion allowed for testing aspects other than movement, such as arm and claw mobility. The final few versions of the model were where things such as the mapping of controller inputs to output ports on the robot were changed and modified.

The original code simply connected the input devices on the controller to motors and servos on our robot, without any processing of the input data. The joystick analogs 2 and 3 (the up and down analogs) were each connected to a drive motor, and two of our servos were connected to the up and down buttons of channels 7 and 8. There was little else in the original implementation save for a few comments to explain the code.

As the design and progress of our robot continued, the code was added to and optimized to accommodate for changes in design and physical conveniences in our robot. As the controls for our robot were moved around and modified, certain structures were necessitated to allow for things such as motor control via two button instead of a joystick analog, servo control without the servo being controlled automatically reverting to its natural state after the release of a button, and being able to view simulated values (motor speed, servo speed, etc) on our robot

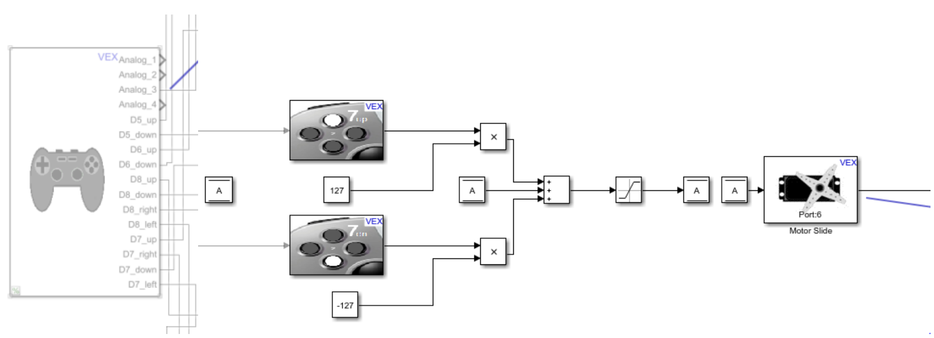


Figure 22. Shown is a sample of the Simulink code used to control the servo that operated the claw's opening and closing motion.

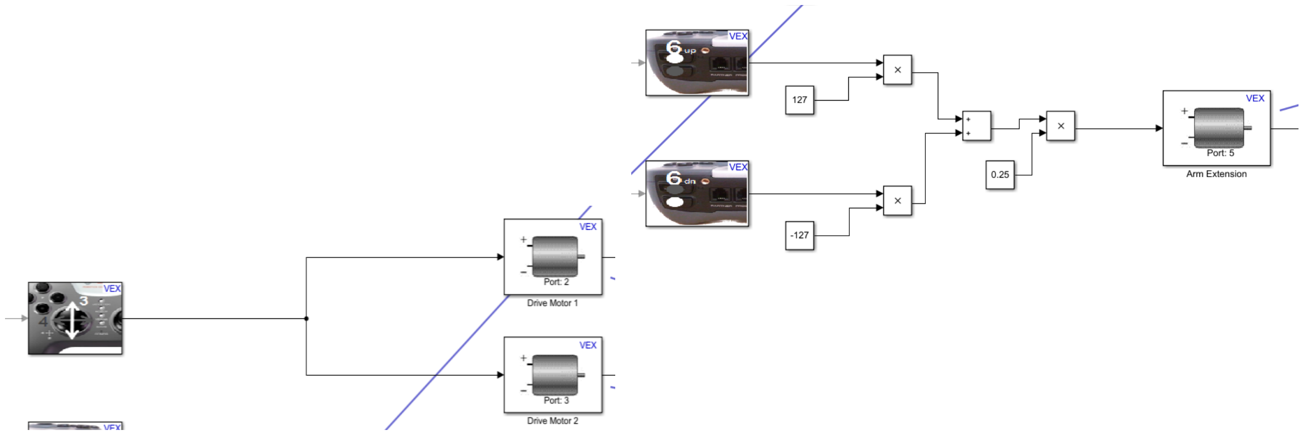


Figure 23. Programming structures implemented in our software.

Eventually our final model was complete and consisted of structures that allow for all of the aforementioned features and was also subject to late speed and motor control configurations (such as slowing down certain motors and allowing both motors to be controlled by a single vertical joystick analog) during the final testing and optimization phase.

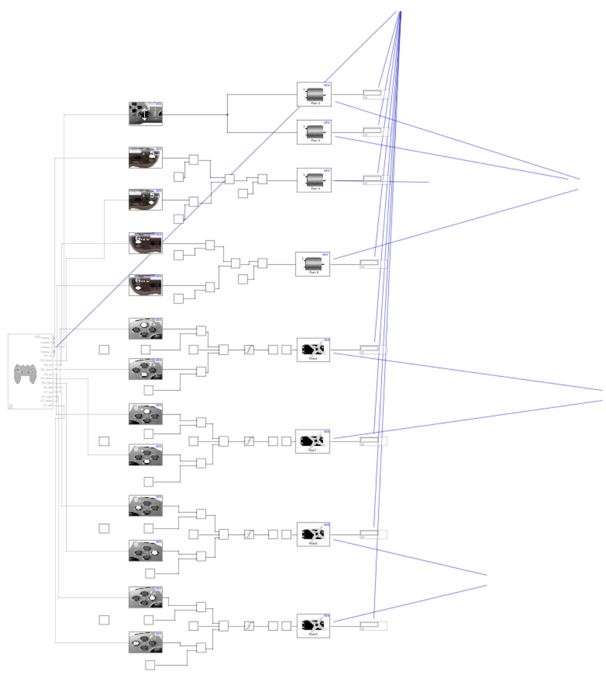


Figure 24. Final programming model used during competition.

6.0 MODIFICATIONS AND ADDITIONAL CHANGES

Following our district competition we realized there were a series of alterations that needed to be made to the design to aid us in ou progression towards the state competition. Most of these modifications occurred within the turntable, gear system, movement, and the claw

6.1 Turntable

The turntable, all things considered, worked remarkably well. It was able to rotate the arm and claw mechanisms very well. However, given the length of the arm and the imbalance that the claw added to the whole device, it worked too well in a manner of speaking. It was very unwieldy, throwing the arm and claw in the direction that it was turning, loosening everything in the process. It turned too fast, making the device hard to manage. To counter this, we will be slowing the speed of the motor in the code itself, as well as adding a potentiometer to help manage the speed of the motor.

6.2 Claw

The claw was the part of the robot that took the most man power to create, this lead to a device that was far too complicated to actually function properly. The device used a single servo attached to strings which we looped through the fingers of the claw, once the servo turned it was supposed to pull on the fingers, opening them up so we could grab the garbage in the gyres. This only worked about 60% of the time, this was before we attached it to the arm. When it was attached to the arm it only worked about 40% of the time. To fix this we will be abandoning our previous design and going with our original design which is a scoop. Our mentality for the new claw is that simplicity equals efficiency.

6.3 Gear Trains

While the gears of the robot meshed moderately well within the system, the process of making them lead to them being difficult to use. We used a laser cutter to precisely cut the gears out of ¼ inch wood. However the laser cutter hadn't been cleaned in a while, this lead to the laser being ineffective at cutting the wood. This meant that the laser wouldn't always cut all the way through the wood, we would try to cut it again with no progress. This lead to the sides of the gears being cauterised, and slippery. The gears would mesh well but they would often slip instead of turning.

Moving further we have decided to use simple gear train systems that will have a higher likelihood of meshing and working in less dynamic systems rather than having anywhere from three to four driven gears functioning off of one drive gear.

6.4 Movement

Initially the wheels were mounted on an aluminum rod that was secured with an epoxy to keep it rotating in place with the motor and the axle. While this worked for our first few tests, we later discovered that it was unable to hold when traversing the beam with the full weight of the robot for the full length of the round. Upon realization we attempted to fix this with even more epoxy which was met with lackluster results, as the additional epoxy was unable cling to the material that made up the wheels and the axle.

A secondary approach was made last minute with the robot with a wooden block and a piece of threaded rod in order tighten the wheels to the axle which worked slightly better, but still retained the same problem. Keeping this concept in mind, we decided to switch from the wooden block to a block of aluminum that holds the axle in place with a set screw to ensure that the wheels move with the axle.

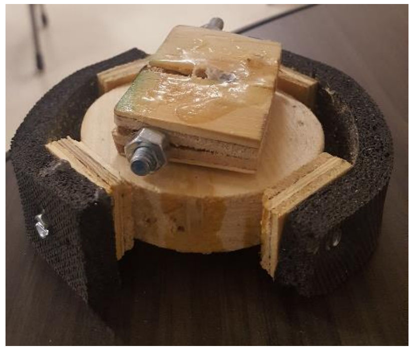


Figure 25. Shown is the unfortunate wheel that caused problems as it would not adhere to the motor driven axle.

7.0 RESEARCH PAPER

The influence of synthetic polymer, also known as plastic, has revolutionized industries worldwide since its invention in 1907 by Belgium-born New Yorker Leo Baekeland. In fact, the first polymer was called Bakelite, named after the inventor himself. Baekeland’s invention has invaded every aspect of human life. Escaping the impact of plastic and its subsequent technological influences on today’s products is a nearly impossible feat. Plastic has experienced extreme proliferation ever since its invention due to its convenience and relative abundance. In 1950, a staggering 1.5 million tons of plastic were produced, and in 2015, the number increased tremendously to a colossal 320 million tons.[4] Products such as Tupperware, plastic bottles, and Ziploc bags contribute to these growing numbers with their dramatically increased use in the past few decades. These innovative products have all been hailed for their usefulness, but the focus on their positive aspects caused people to ignore the intense negative impacts that they have on the environment for many years. Not until the 1960s did people start to seriously consider the concerning impact of plastic on the environment. Many individuals and groups protested, specifically deriding the indifference of plastic companies coupled with organized boycotts on plastic products. However, their efforts were discouragingly insignificant compared to the sheer size and growth of the plastic industry. The largest petrochemical companies worldwide have sales in the billions of dollars annually, but conservation is a priority for only a handful of those companies such as LyondellBasell Industries, headquartered in Houston, TX.[6] Unfortunately for the United States, our efforts at conservation pale in comparison to those of European countries such as Switzerland, Austria, and Germany who are successful in recovering over 95% of their post-consumer plastic waste.[7] More rigorous efforts at recovering recyclable materials must be made to prevent future generations from carrying a burden that is too large to rectify.

The difference in scale between plastic production and conservation efforts was truly discovered in 1997, when the Great Pacific Garbage Patch was discovered by Captain Charles Moore.[5] Thirteen years later, both the Atlantic Ocean Garbage Patch and the North Atlantic Garbage Patch were also discovered. These patches are disturbing culminations of decades of ignorance and indifference. Contrary to the prevailing public belief that the garbage patches are floating islands composed of trash, the ocean garbage patches are actually gyres or areas of revolving ocean currents that contain microplastics unable to be seen by the naked eye. An estimated 80,000 tons of plastic material reside in the Great Pacific Garbage Patch alone, covering approximately 1.6 million square kilometers.[4] In the ocean, more resilient and buoyant plastics travel along the surface of the waters for a longer period of time. Once the plastic finally enters the gyre, the destructive material is unable to escape the confines of the gyre. The plastic continues to float within the area of the gyre and degrade from the effects of the sun, water currents, and marine animals until they become microplastics.[3] With their deadly concoctions of toxic sludge and microplastics, the great garbage patches throughout the world are wreaking havoc on ocean environments and are demanding solutions from scientists.

Animals experience the majority of the negative impacts that the garbage patches create. The marine animals are deceived by the vibrant colors of the plastic and mistake them for food. These fatal consumptions lead to greatly decreased marine populations. Beached sperm whales have stomachs filled to capacity with plastic waste, and lifeless sea turtles float with more polymer than body weight. While many believe that these negative aspects affect the animal populations solely, the consequences actually also affect the health of humans. When fish consume the microplastics suspended in water, those same microplastics will enter human bodies when the fish are caught and consumed. Not only does ocean pollution affect the health of humans, it also leads to major economic problems. Countries have to spend exorbitant amounts of money in order to fund water cleanups and help to cover the damage done to fisheries. An estimation made by the NOAA's Office of Response and Restoration reported that it would cost between $122 million and $489 million in one year to clean up less than one percent of the North Pacific Ocean, not including labor and equipment costs.[1] In response, our competition, Current Events, touches on these issues and gives robotics teams the chance to formulate solutions that would decrease the costs. The game's idea of being able to take plastic out of the ocean and build artificial reefs with it can lead to more interest and further research and solutions to the problem. Even in a stimulated field, young minds are learning about ocean plastic and are able to understand the problems within our environment, while working towards ridding the ocean of plastic waste. Our solution is long term, effective, and favorable to the environment and health.

Many conservation efforts and companies around the world are working to find a reliable way of removing plastic from the oceans while also reducing costs. Some are also primarily devoted to raising awareness of the pollution issue. The Ocean Cleanup, a company based in the Netherlands, has made great strides in solving this issue. Their current plans are to use a floating collector that travels with wind and ocean currents to gather plastics or a net that can move plastics into a smaller area for collection. They have prompted extensive research on the subject and are serving as an example for companies to discover ways to contribute to the solution in creative and cost-effective ways.[4] With the combined efforts of conservation companies around the world, it may be possible to eliminate plastic debris from the world's oceans in the next few decades.

7.1 Works Cited

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8.0 APPENDIX

8.1 Best National Registry Proof

eventbrite

Order #853560419

BEST Robotics National Registry

Teacher Registration

None

Saturday, September 1, 2018 at 8:00 AM - Friday, November 30, 2018 at 8:00 AM (CDT)

Free Order

Order Information

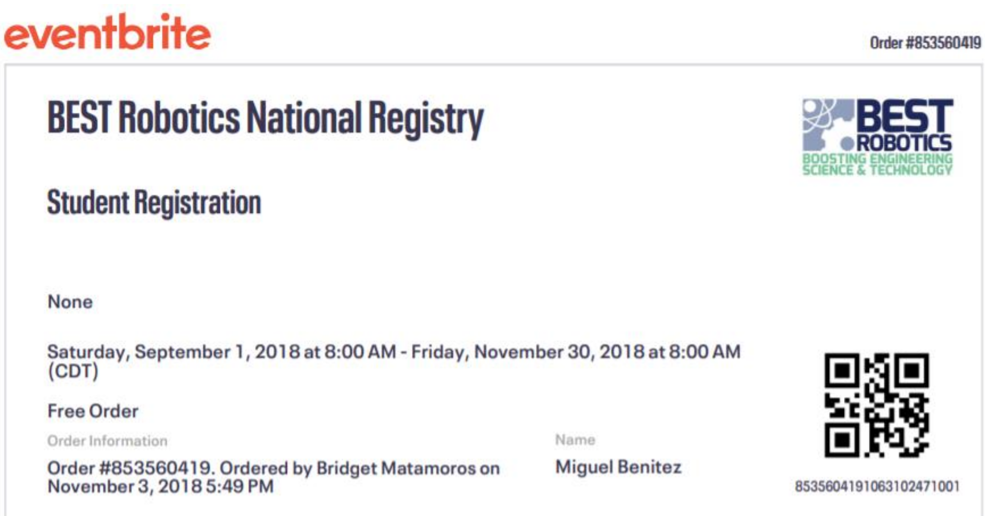
Order #853560419. Ordered by Bridget Matamoros on November 3, 2018 5:49 PM

Name

Bridget Matamoros

8535604191063102469001

This is the sponsor’s registration information for the BEST Robotics National Registry which she completed for the whole team since she had the list of members and access to their demographic and contact information.



eventbrite

Order #853560419

BEST Robotics National Registry

Student Registration

None

Saturday, September 1, 2018 at 8:00 AM - Friday, November 30, 2018 at 8:00 AM (CDT)

Free Order

Order Information

Order #853560419. Ordered by Bridget Matamoros on November 3, 2018 5:49 PM

Name

Miguel Benitez

8535604191063102471001

This is the Robotics Team President’s registration information as an example. Each of the 20 students on the team was registered in a similar manner, but the entirety of the registrations cannot be included because it would span 20 more pages.

8.2 Robotics Team Meeting Log

Date	Day	Time	Focus
05 September 2018	Wednesday	4:10 - 5:30 pm	Brainstorming
12 September 2018	Wednesday	4:10 - 5:30 pm	Brainstorming
15 September 2018	Saturday	10:00 am - 2:00 pm	Analyzing BEST Problem
19 September 2018	Wednesday	4:10 - 5:30 pm	Analyzing BEST Problem
22 September 2018	Saturday	10:00 am - 2:00 pm	Developing Marketing Materials and Journeying the Engineering Process
26 September 2018	Wednesday	4:10 - 5:30 pm	Engineering Process
29 September 2018	Saturday	10:00 am - 2:00 pm	Building the Robot / Marketing
03 October 2018	Wednesday	4:10 - 5:30 pm	Building the Robot / Marketing
06 October 2018	Saturday	10:00 am - 3:00 pm	Building the Robot / Marketing
10 October 2018	Wednesday	4:10 - 5:30 pm	Building the Robot / Marketing
11 October 2018	Thursday	4:10 - 5:30 pm	Building the Robot / Marketing
13 October 2018	Saturday	10:00 am - 3:00 pm	Building the Robot / Marketing
16 October 2018	Tuesday	4:10 - 5:30 pm	Building the Robot / Marketing
17 October 2018	Wednesday	4:10 - 6:00 pm	Preparation for Competition
18 October 2018	Thursday	4:10 - 6:00 pm	Preparation for Competition

19 October 2018	Friday	8:50 am - 8:30 pm	Preparation and Competition
20 October 2018	Saturday	7:00 am - 4:00 pm	Competition
24 October 2018	Wednesday	4:10 - 5:30 pm	Analyzing Competition Results
27 October 2018	Saturday	10:00 am - 3:00 pm	Building the Robot / Marketing
31 October 2018	Wednesday	4:10 - 5:30 pm	Building the Robot / Marketing
03 November 2018	Saturday	10:00 am - 3:00 pm	Building the Robot / Marketing