The Craft Academy Robotics Project

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Abstract

Starting a team to build and compete in the FIRST Tech Challenge with two months to build a fully functioning robot that could be programmed and driven to complete the object with a teammate robot. Learning how the creative and engineering processes combine while also learning how to adapt to failure and overcome adversity. Reaching out to the community and getting it involved with STEM and the FIRST Robotics Community.

Introduction

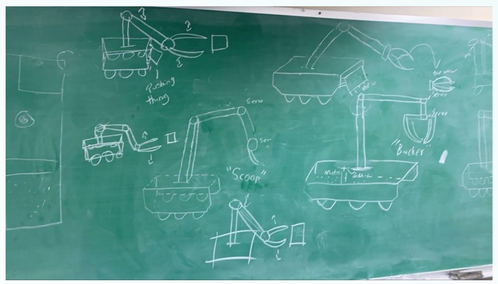
To begin, the team's research project consisted of a robot that could compete on a 12-foot by 12-foot playing field alongside 3 other robots. The robot had to fit within an 18in-by-18in limit, it could be made of a variety of materials and motors specified in the game manual to help it achieve the most amount of points possible. There are many ways to earn points in Freight Frenzy divided into 3 sections, Autonomous, Tele-Operation or "Op" for short, and End-Game: In the Autonomous section, the match starts with a 30-second Autonomous Period where Robots are operated only via pre-programmed instructions. Teams are not allowed to control Robot behavior with the Driver Station or any other actions. The Control Hub is placed in a hands-off location during said Autonomous Period so that it is evident that there is no human control of Robots. The robots can obtain points by parking in the Alliance storage unit, parking in the closest to the robot's alliance, moving freight into the shipping hubs, or alliance specific storage unit, with an additional bonus of using a camera to recognize and move a rubber duck or Team Shipping Element to a randomized part of the shipping hub. During the Tele-Op part, teams can score points by going over or around the PVC barrier to obtain whiffle balls or different weighted plastic cubes and placing them in either the Alliance Shipping Hub or Shared Shipping Hub. Finally, in End-Game, Teams can put the custom capping element on the Alliance Shipping Hub, spin the Carrousel to get up to 10 ducks, or park in a Warehouse.

Materials

- AndyMark 6-Wheel TileRunner Chassis
- C-Channel Steel Support Beams
- 80/20 Support Beams
- REV Control System and Motors
- 3D Printed PLA Filament Claws
- Surgical Tubing

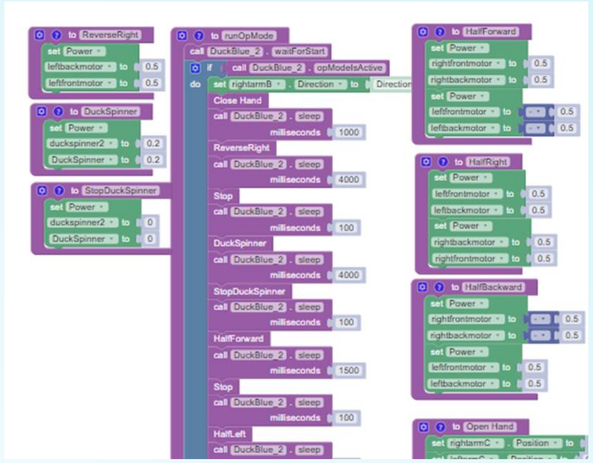
Methodology

After a slow start in Mid-December (when the game dropped in September), the team finally got to work on the chassis. The chassis was picked out by Shawn, the team captain, because of its easy constructability and easy maneuverability because the team is all new to FIRST Tech Challenge. Additionally, the chassis was more suited for the playing field because of its tank-like design allowing it to go over the obstacles. Due to the high zinc content in the axles, the chassis would often break down causing us to be vigilant in noticing problems and being quick to repair the robot. After the team finished the chassis, they began to work on the arm. The first arm design was a chain and sprocket, but the chain length was too small. The next design was with a gear ratio, surgical tubing, and a 3D printed claw. Both the gears and the surgical tube were meant to keep the arm from slamming into the ground and damaging the claw as well as easy arm control. With a completed robot, all it needed was a name. After much discussion, the team decided on the name "Hugh G." Because of the robot's large size, barely being able to fit within the 18in-by-18in limit, the team thought it was a perfect name.



For the design process, we went through many iterations. Some include have an arm mounted in the center with a claw on the end to pick up the Freight. We also had some trouble with the Carousell. We first decided on a small motor mounted on the side with a small rubber wheel, but we found that the motor did not have enough torque and the wheel was too squishy to spin. Upon further discussion, the engineering team decided on what you see now, a Hugh G robot.

Because of how new our team was, we only had one programmer. As a first-year programmer, Daniel decided to use block coding because it was the easiest to learn and apply in the short time span. There was a lot of trial and error in both the autonomous and manual parts of the game. One of the biggest challenges was the inconstancy of the physical parts on the robot, as the code was fine-tuned for high precision. When the axle was stripped or a bearing was slightly out of place, the code would be inconsistent.



Finally, the PR team. The PR team played an essential role, from outreach to uniform design to the engineering notebook. They covered all communications, including designing and ordering uniforms and logos, communicating with other teams during competitions, working with the other team members to get accurate information for the engineering notebook, taking photographs throughout the entire season, and running a team Instagram page. The engineering notebook is an important part of the First Tech Challenge competitions, it is meant to document everything the team did like the design process and results, as well as team member descriptions and motivations.

Results

The team competed in 2 tournaments, one in Murfreesboro, TN, and Murray, KY. After all their hard work, the team placed 16 out of 25 in the Tennessee competition, and 7 out of 16. The team then got picked for the Kentucky semi-finals and got nominated for the Connect Award (the Connect Award was given to teams that showed exceptional community outreach and initiated positive outreach with outer teams at the Kentucky competition) for their presentation to the Judges and our Engineering Notebook.

Conclusion

All in all, the team learned a great deal about teamwork, responsibility, team development, diligence, time management, and outreach within the community. As well as more technical things such as CAD design, the engineering process, coding, and problem-solving. It was a positive and enjoyable experience for all. The team plans to participate in more FIRST Robotics competitions in the future with the incoming underclassmen.