February 2016,Fort Collins, CO

FIRST team #4499

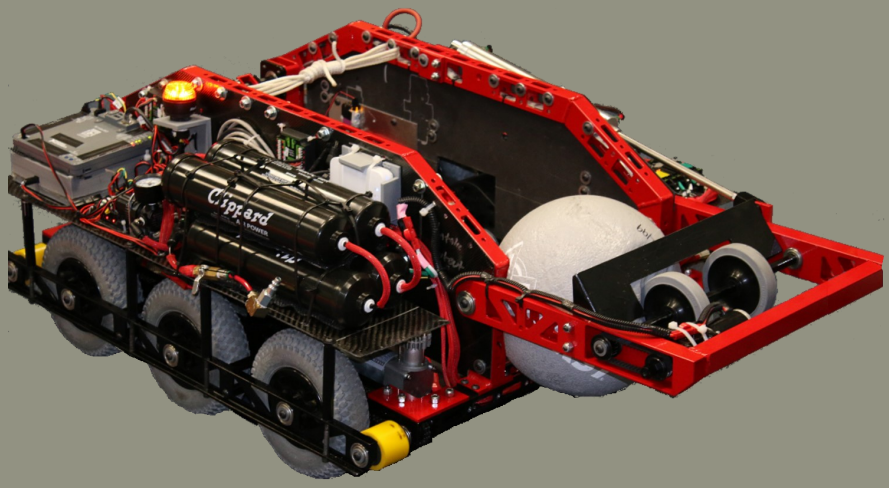
The Cyber Cycle

The Highlanders FRC

"The Cycle of Success"

Introducing.... Our robot for the 2015-2016 Season

Magnetar

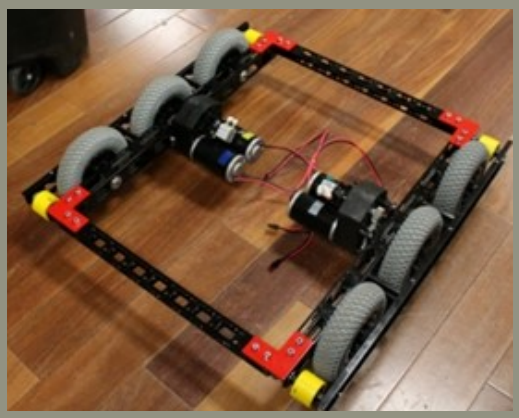


Magnetar is an amazing robot. Named, as with team tradition, after a celestial object (a star with a large magnetic field), the robot can do amazing things. Read on for the details of the robot and the process we went through to design, program and build it!

We are continuing to work, of course, preparing for our two tournaments. We are still working on a couple of things: bumpers (high priority because they are required to compete), a way to maintain control of the ball as we go over obstacles, plus a means of opening the portcullis and/or helping us over the cheval de frise (see-saw) barrier.

Our Chassis

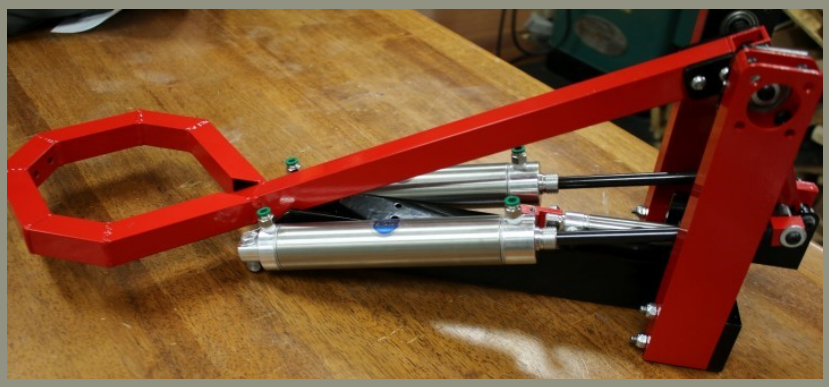
We started prototyping for Stronghold with a modified version of our 2014 chassis; tank drive with shiftable gearboxes driving 3 wheels on each side. We used belts again, as well, sticking with what we knew how to do well.



As we tried driving over obstacles, it quickly became apparent that our chassis needed adjustments. The three-wheel system was getting stuck going over the moat and could not scale the rock wall. We moved the three pneumatic wheels together on each side to remove the gap between them. We also raised our front beam and added smaller wheels at the front and back to help boost us over obstacles. We switched to a chain drive to prevent slipping under high torque and extended it to power the mini-wheels.

The modifications worked, and we are now able to drive over all of the obstacles with relative ease.

The Catapult



This design appealed to us because so many teams had used it so successfully in Aerial Assist. We started out trying to use pistons, but found they could be slow. We switched over to using springs (leftover from an old trampoline) and a lever arm to supply the force. To add more force, we tried combining springs and pistons, but found that the pistons actuated slowly, and our distance actually decreased. The design we have decided to use has pistons (no springs) and ballast tanks to supply the needed influx of air.

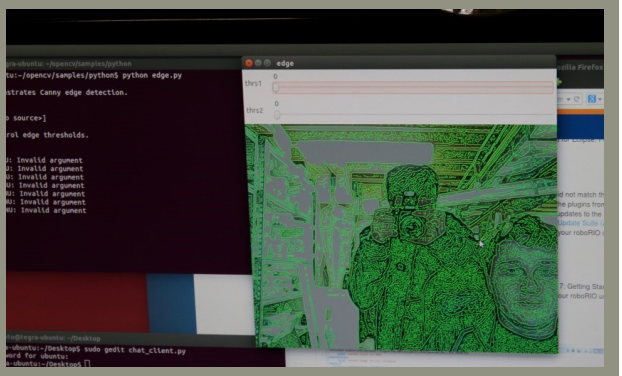
The latching mechanism for the catapult arm was another engineering design challenge. For safety reasons we needed something very secure to hold the arm even when the pistons were primed. We started with a gate latch, but found it had too much slop to be reliable. We designed a latch system in CAD and were able to mill it on the HAAS. It is able to latch reliably when the catapult is retracted, hold it securely when it is primed, and release it quickly when it is triggered.

Intake Mechanism

We were very comfortable with the design we had created, having two wheels on the axle to intake the balls. That changed, though, when we were at a late-build-season scrimmage and discovered that, in the heat of battle, balls would frequently get carried up and over the wheels, popping out the top of the robot and not into the catapult's basket. There were two other problems with the intake/catapult interaction: the ball wasn't be held well, and so would sometimes bounce out of the basket as we went over defenses, and we had no way to get it out of the basket and back to the intake to put it into the low goal on the castle.

We devised a shield mechanism to prevent the ball from flipping over the top of the intake, but bagged the robot without any mechanism to keep positive control of the ball or to push it out of the catapult for the low goal.

Programming and Vision



For programming, we are using Java this year in order to be flexible and enable us to use the WPI lib.

Unlike previous years this year's game field is often equipped with numerous obstructions that block the drivers' line of sight to the robot. Therefore we worked to create a system that would maximize the efficiency of cameras on board the robot. We developed a more comprehensive vision system based upon an on-board Nvidia Jetson TK1. The Jetson does high speed vision processing on the reflective tape on the castle. The vision code is written in python using opencv. The Jetson also hosts a web server and continuously serves the image data from 3 cameras to the driver station. The advantage of this system is that it can transfer 3 different video feeds with minimal latency. The web server is hosted using python flask and is also capable of rapidly calibrating the vision code using a series of sliders programmed into the web-page.

But Our Biggest News?.... We Made it to Bag & Tag!

Thank you so much to our parents, coaches and mentors...for all of the food, inspiration, direction, and even more food!

Please watch us at both our upcoming tournaments:

Flagstaff, March 10-12

Denver CO, March 24-27

Watch us online at **www.thebluealliance.com**

And a special thank you to our sponsors...

We couldn't do this without you!

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