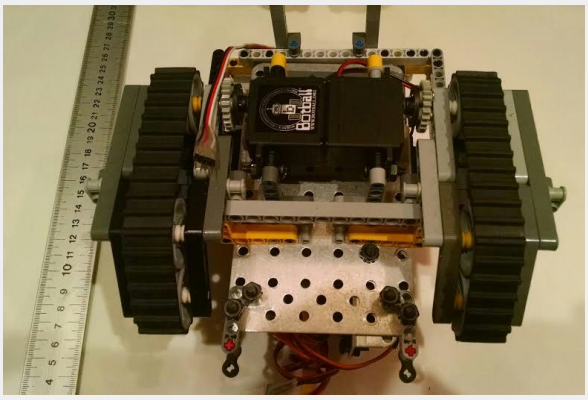
Explorer Post 1010
Botball Team 16-0162
Greater DC Region

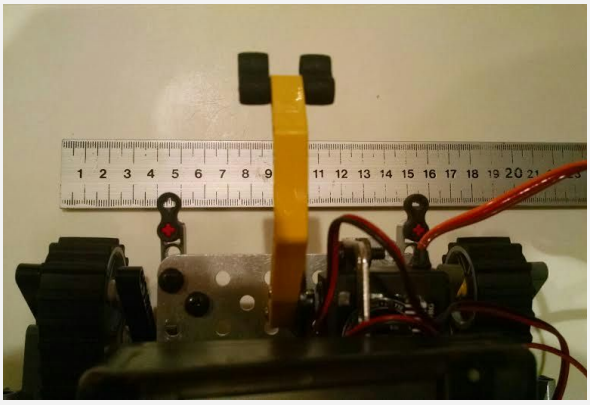
Period 2 Mechanical Design

Drive Train



- The drive train style shown on the left is a belted system with an upward slant on the forward facing side of the robot. The Tracks are powered by 2 competition standard motors. 1 for each side for independent control and turning.
- Our team decided to use tracks instead of normal wheels because it is much more difficult to climb over the PVC dividers with the wheels. Tracks makes this task much simpler, so we chose to sacrifice the speed we would get out of wheels for the reliability of tracks.

Effector

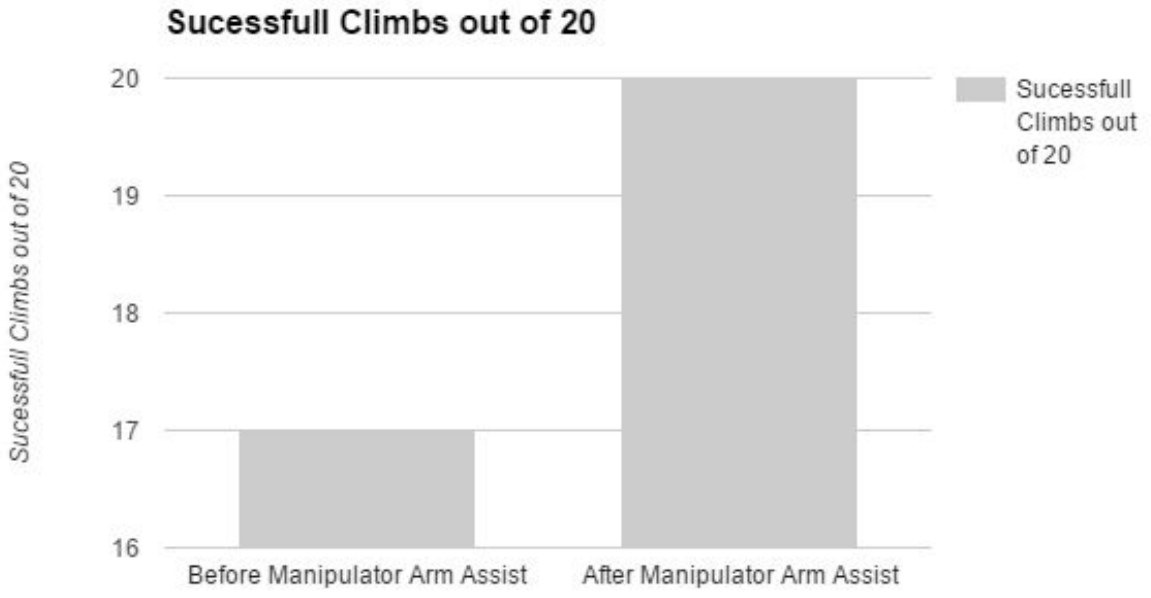


- The bin grabber consists of 2 main parts. The stationary bumpers, and the servo actuated gripper arm. Once in position, the servo arm closes over the potato bin, securing it tightly in place between the stationary bumpers and the gripper arm.
- Our goal for this design was to keep our mechanism for grabbing the potato bin as simple yet effective as possible. This meets those requirements with only 1 moving part, and a rock solid grip on the potato bin for safe transportation.

Sensor Mount

- The manipulator arm is a sturdy U-Shaped Lego structure stretching around the width of the robot, mounted on either side to 2 motors. This device assists in climbing the PVC dividers, and gripping and scoring the center game pieces (incomplete).
- A touch sensor was added in order to provide a feedback loop for the position of the manipulator arm. The sensor allows us to know the approximate position of the manipulator arm at any given time, allowing us to create programs that are more reliable and adaptive.

Data



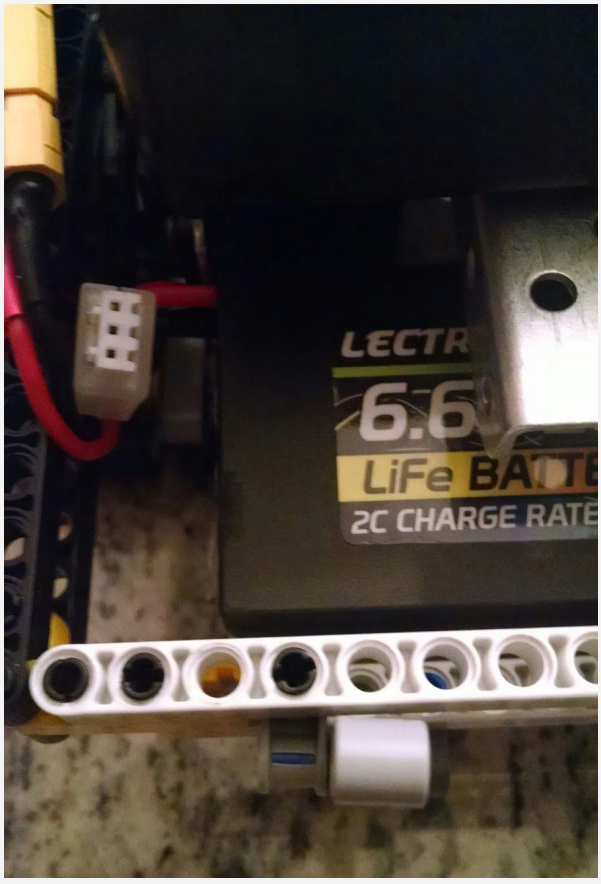
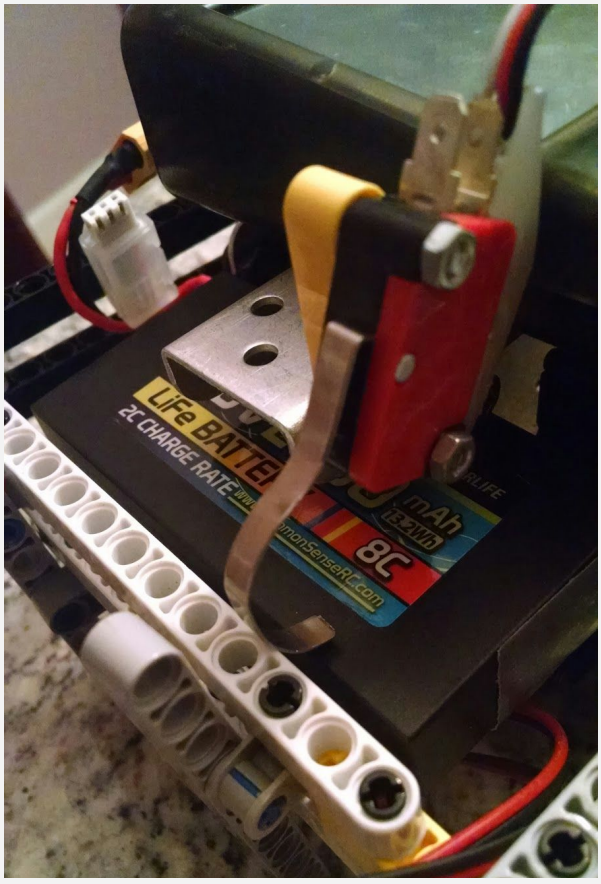
- This data was collected by running the simple PVC Vault Tester program with the robot positioned 1 inch from a PVC tube that is identical to the ones used in the construction of the field. The program will start, then the robot will attempt to jump over the PVC barrier. The program ends after 5 seconds regardless of whether or not the climb was successful. At that point a success/failure state is recorded.

Data Evaluation

- The purpose of this experiment was to test the reliability of the robot's ability to climb over the PVC barrier. This data shows that after programming the manipulator arm to assist in the climb, we get near 100% reliability, proving that the mechanism works so we can focus our efforts elsewhere.
- The data shows 1 very clear trend. Prior to manipulator arm assist the robot relied solely on its tracked drivetrain system to pull itself up and over the PVC barrier. This did not always work because sometimes the steep incline would cause the tracks to lose traction and slip, causing the robot to become stuck on the PVC tube. If this was a match, the robot would become completely useless for the entire round. A 3/20 chance of the robot scoring no points is unacceptable. After adding the manipulator arm assist the data clearly shows near perfect performance.

- To perform the assist, the manipulator arm pushes down on the ground, rearing up the back of the bot and putting more pressure on the tracks allowing them to regain traction and continue climbing the PVC. In order to actuate at the proper time for the climb changes had to be made to the manipulator arm. This changes allowed the arm to actuate only when the robot was starting to tilt upwards as the climb began. This prevents any issues that could arise due to inaccuracies in robot placement, and differing speeds due to battery power by making sure that the assist is based on location, not time.

Modified System

Before	After
	

- The design change represented here is the addition of a touch sensor for detecting a change in position of the manipulator arm. When the robot tilts as it climbs the PVC, the manipulator arm is pushed upwards, triggering the touch sensor and telling our program that it's time to push the manipulator arm downwards to allow the robot to climb the wall successfully.

- The decision to add this feature was made while watching test runs. During these runs we observed that the robot's climbing angle was far too steep for the tracks to get the necessary traction. We determined that the best solution was to use the manipulator arm to lift the rear end to correct the angle mid climb. We did not want to rely on timing, because using a simple timer to trigger it creates more opportunities for things to go wrong. We then decided on the touch sensor system and implemented it successfully.