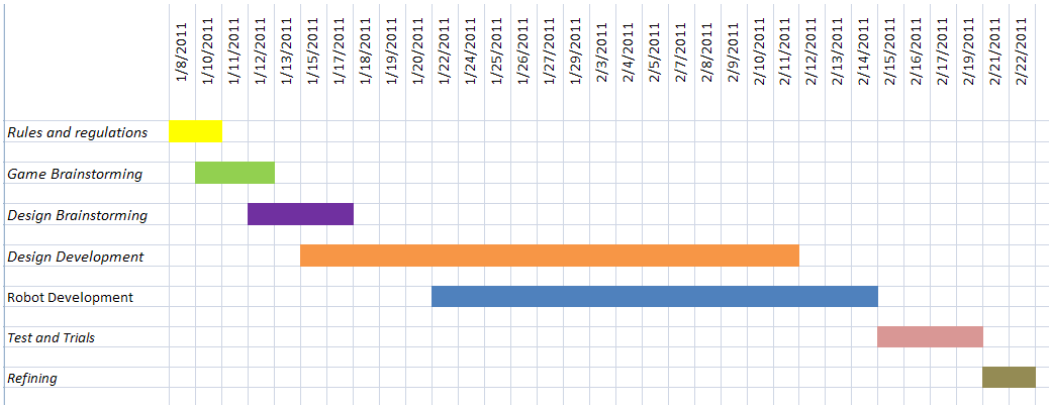
Team 1764 Design Process and Sketches

Team 1764's Design Process

1. Rules and Regulations
2. Game Brainstorming
3. Design Brainstorming
4. Design Development
5. Project Development
6. Test and Trials
7. Refining

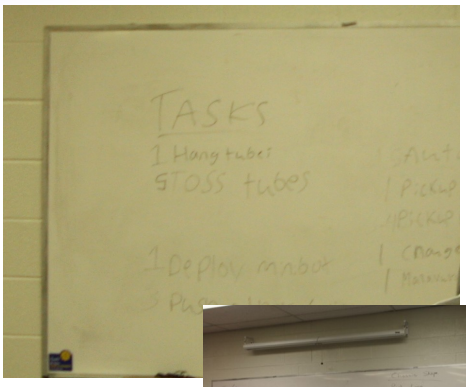
Design Process Gantt Chart



Rules and Regulations

This step began with kickoff, where we all gathered around the live broadcast learned about the 2010-2011 FRC game, Logomotion. Once the password was revealed, we broke into groups and read the rule book for Logomotion. While the rest of the team read the rules the Chief Positions and Head Coach went into a room and made a short test covering the manual. To ensure that the entire team had an understanding of the 2010-2011 game each individual was required to get an 80% or higher on the test before we could move on to the next step of the design process.

Game Brainstorming

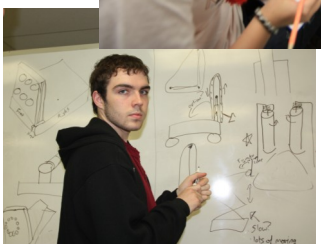


We started this step by determining a strategy for this year's game. To begin, we brainstormed as many strategies as we could think of. Some examples of these strategies included only offense and excellent game piece manipulation, only defense with excellent minibot, only defense with excellent drive system, etc. Once we had a list of strategies we started to narrow it down. To begin, we eliminated any strategies that were not plausible or not possible. We then made a list of tasks that could be completed by the 2010-2011 robot. This list included maneuverability, manipulation of game pieces, use of minibot, game piece manipulation on multiple levels, autonomous mode, etc. We ranked each system with a numeric value that represented the importance of each task. The numeric rank was determined by discussion of the task in question and then a vote on the level of importance. Once we decided on our priorities for the robot's abilities we were able to narrow the list considerably. We then discussed each one of the remaining strategies, weighed pros and cons, plausibility, and time constraints. Then, through a vote, we decided on a strategy, mainly offense with game manipulation and a minibot. By looking at the strategy we had chosen and the numerical value of each task we developed a design statement.

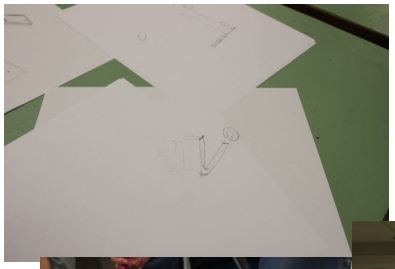
2010-2011 Design Statement

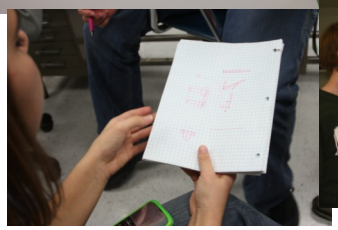
To design and build a robot to compete in the 2011 FIRST Robotics Competition game Logomotion, that is easily maneuverable, can lift and place game pieces onto the upper two tiers of pegs, and deploy a minibot that can quickly climb a 10 foot pole.

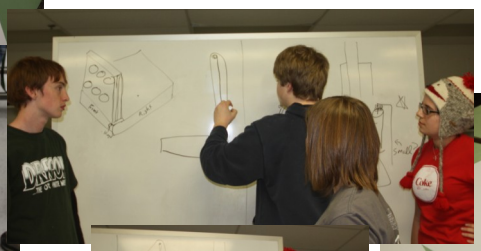
Design Brainstorming

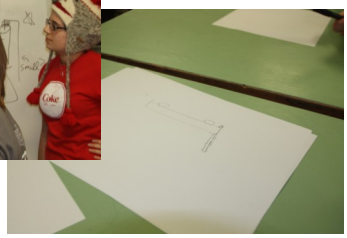


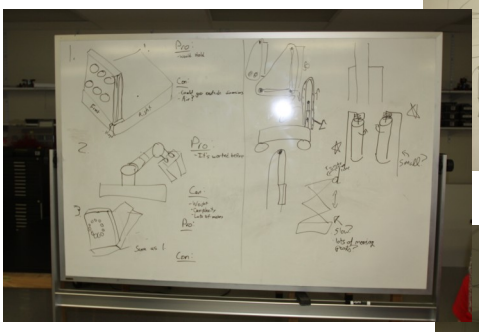
This step began by having a giant brainstorming session on all of the possible systems that would allow our robot to fulfill the needs of the design prompt. Brainstorming began with individuals sketching ideas and quickly moved on to a group discussion around a white board. The robot was divided into 6 main systems; frame, lifter, grabber, deployment, minibot, and drive train. After all of the ideas had been looked at as a group we began narrowing down the list. We quickly eliminated all ideas that were impractical and then set up a chart of the left over ideas. Each remaining idea was discussed and then given a numeric value based on the number of people who thought it was the best design to achieve the tasks set forth by the design prompt. Once narrowed each system was individually examined and a design was chosen, providing us with a design solution.





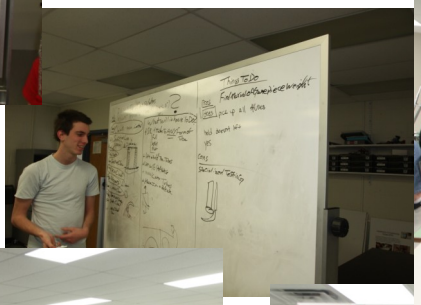


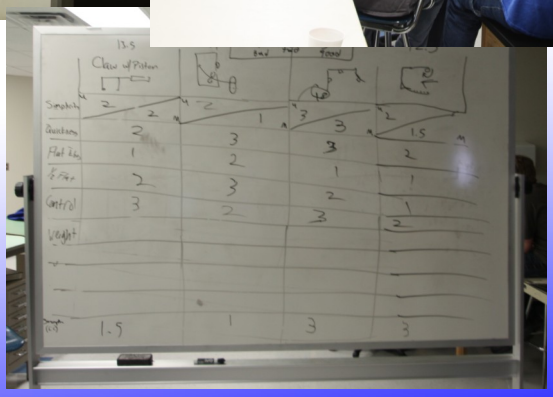




Design Brainstorming

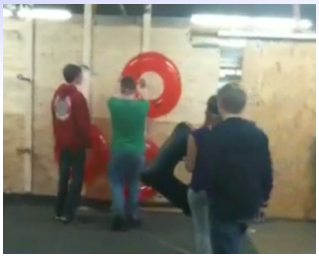
Design Narrowing





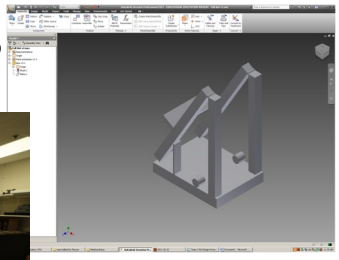
Frame/Drive Train Brainstorming

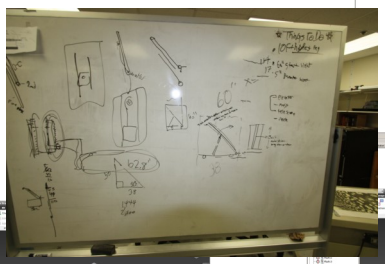
The drive train design was chosen by running mock rounds of Logomotion using people rather than robots. Each person was given specific instructions on the way they could move and the rounds were video taped. The system that performed the best was chosen for the drive system and the frame system was chosen to best fit the drive system.

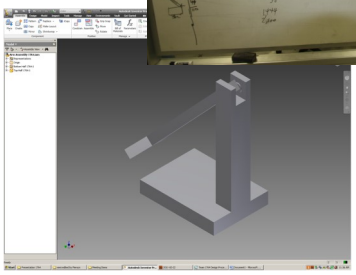


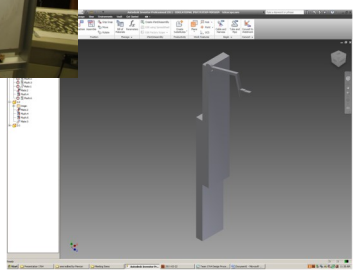
Lifter Brainstorming

The lifter ideas were narrowed to 3 designs. A basic virtual model of each design was made to better determine which system to use.



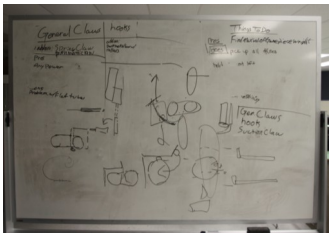




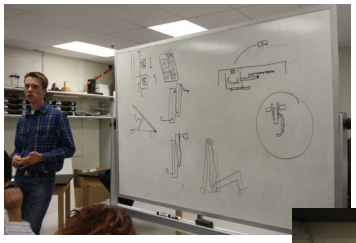


Grabber Brainstorming

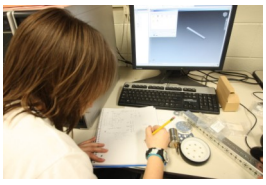
The grabber design was chosen to best fit the lifter system that was chosen. Basic tests were run to ensure that suction cups were a good option for grabbing game pieces.

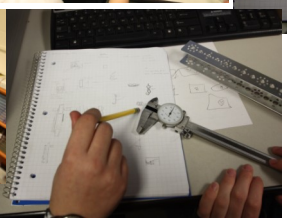


Minibot/Deployment Brainstorming



Virtual models of different minibot designs were made in Autodesk Inventor based on sketches. Based on testing minibot designs were modified to include multiple wheels rather than one and other design changes.





2010-2011 Design Solution

Maneuverability – Use of mecanum wheels allows for the robot to strafe left and right, greatly increasing our maneuverability compared to previous experiences using a tank drive system.

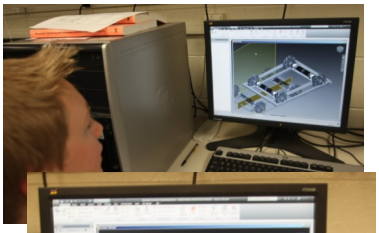
Lifter/Grabber System – Use of pneumatics suction cups allows for a firm grip on the game pieces and the rack and pinion system along two masts allows for the game pieces to be placed on multiple levels.

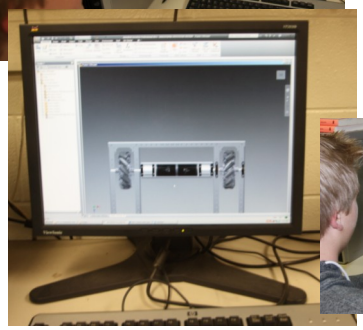
Minibot/Deployment System – Use of both permitted motors, a light weight design, and surgical tubing allow for quick attachment and ascension of the 10 foot pole.

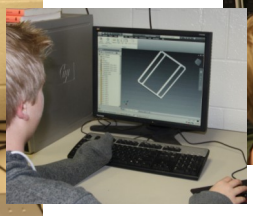
Design Development

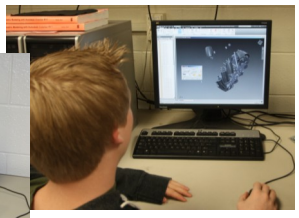
During this step we took the chosen designs from the last step and made accurate virtual models of them using components made in years past or acquired from free online libraries. We designed the systems in 6 different parts; frame, electronics board, lifter, grabber, deployment, and minibot. Through this system we worked out the details that were not specified in the basic design such as dimensions and component placement, found and corrected several mistakes and problems in the design, and designed specialty parts for the robot using the sheet metal parts file in Autodesk Inventor.

Frame System Development





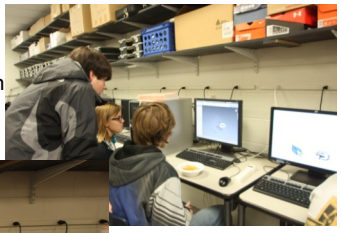


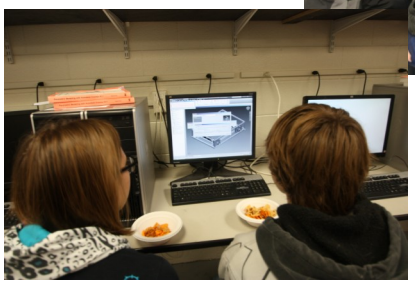


A virtual model of the frame system was made on which to base the rest of the systems. This system included chassis, drive train, and an upper frame.

Electronics Board Development

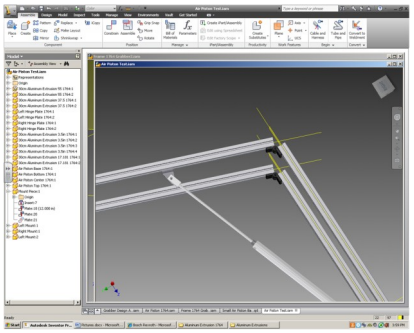
The Electronics Lead worked with the CAD team to place electronic components on the electronics board that sits in the frame system.

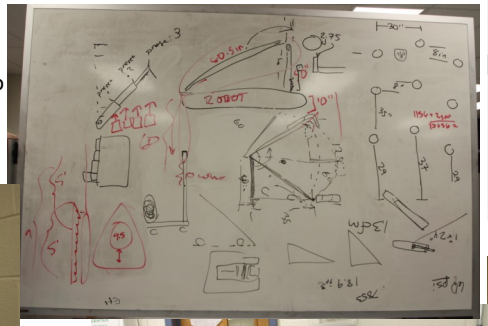


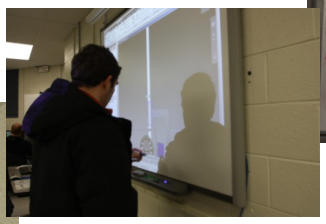


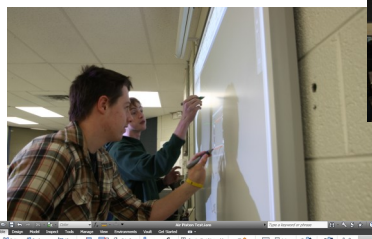
Lifter System Development

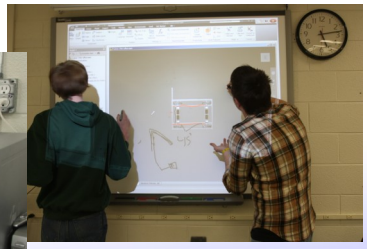
The CAD Team worked with a mentor, a Chief Position, and various members of other teams to develop the structural system of the lifter. They then worked to discover the best placement of a pneumatics actuator to fold half of the lifter to a predetermined raised and lowered position. They worked through these systems utilizing a SMART Board giving them the unique ability to sketch on the CAD drawing.

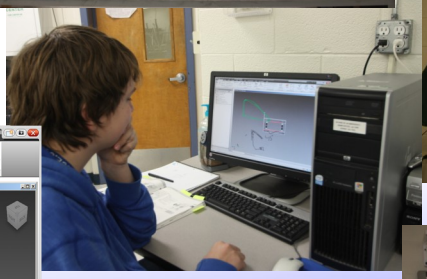


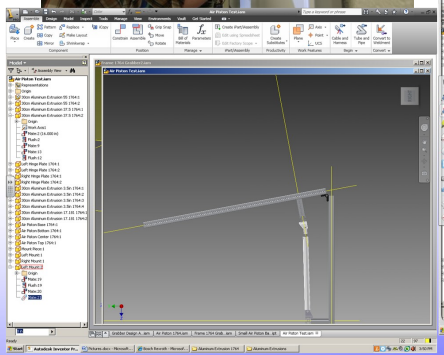


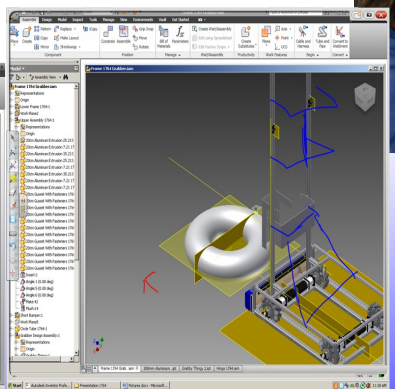


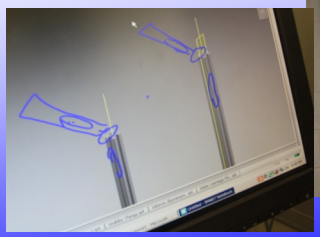


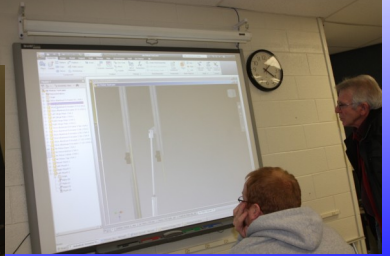






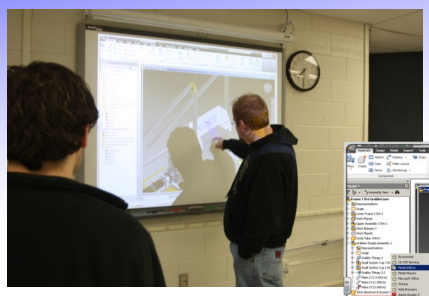


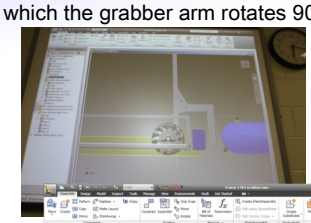


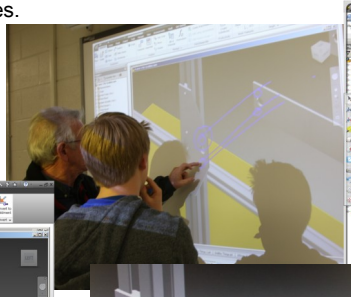


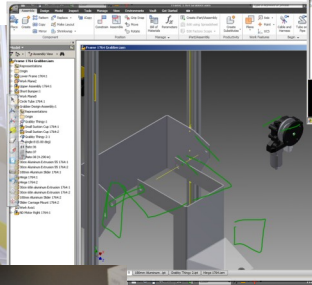
Grabber System Development

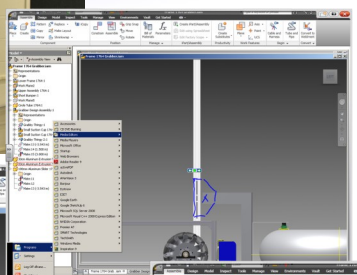
A team similar to the one that developed the lifter system worked to develop the grabber system. They created the carriage that would ride the rack and pinion set in the lifter and the arm that positioned the pneumatics suction cups to best grab the game pieces. They also developed the drive system for the rack and pinion system and the means by which the grabber arm rotates 90 degrees.

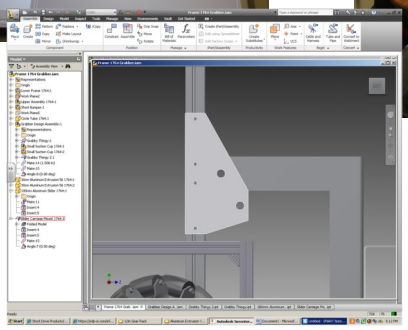


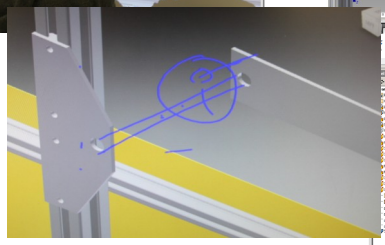


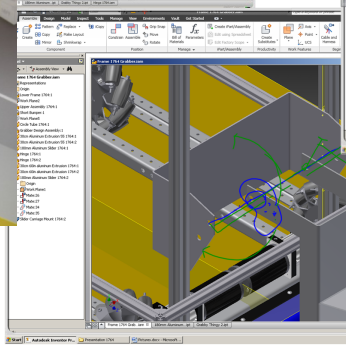


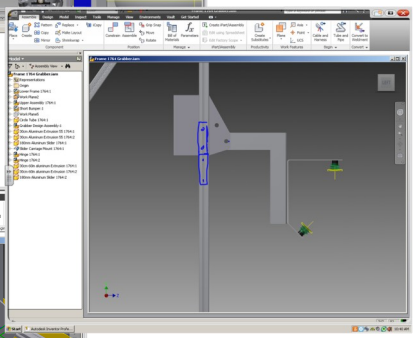


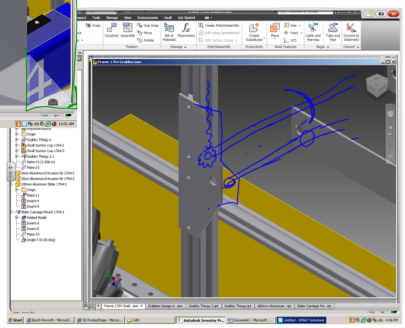






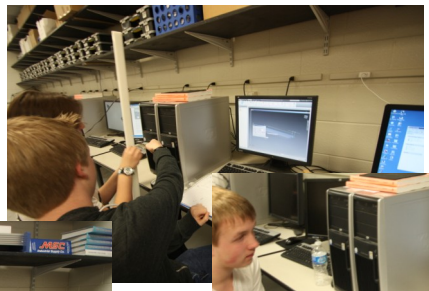


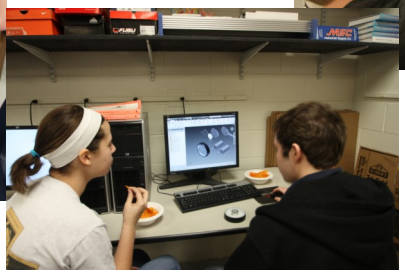


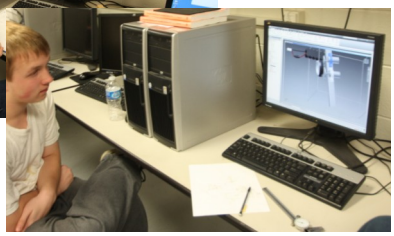


Minibot/Deployment System Development

The minibot was developed virtually. The deployment was then developed virtually based on this virtual minibot.

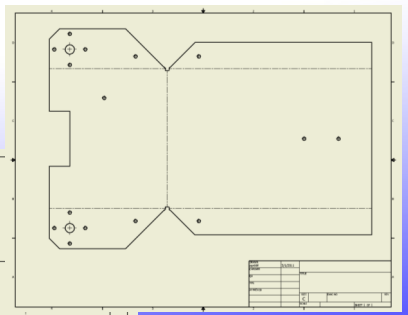


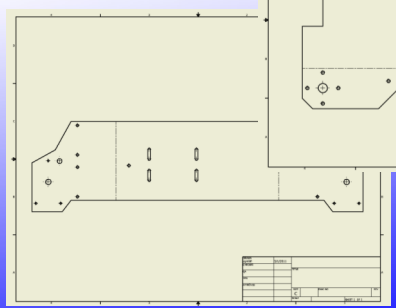




Specialty Part Development

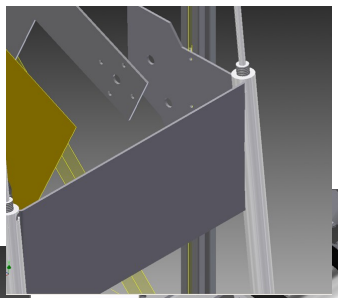
Multiple parts were developed to fit perfectly between nonadjustable components. Each of these pieces was put into a title block, dimensioned and then made by the Build Team. The slider carriage, grabber arm, pneumatics bracket were all created virtually.

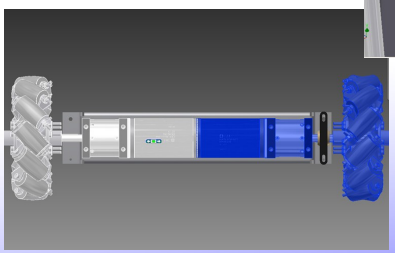


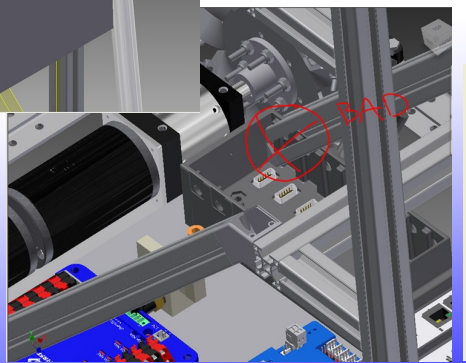


Error Analysis

Multiple special errors were discovered in the virtual model of the robot. Each one was able to be fixed through virtual manipulation of part placement.

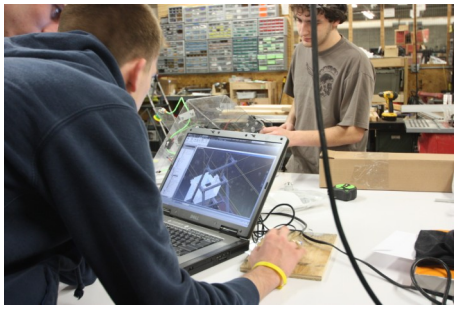




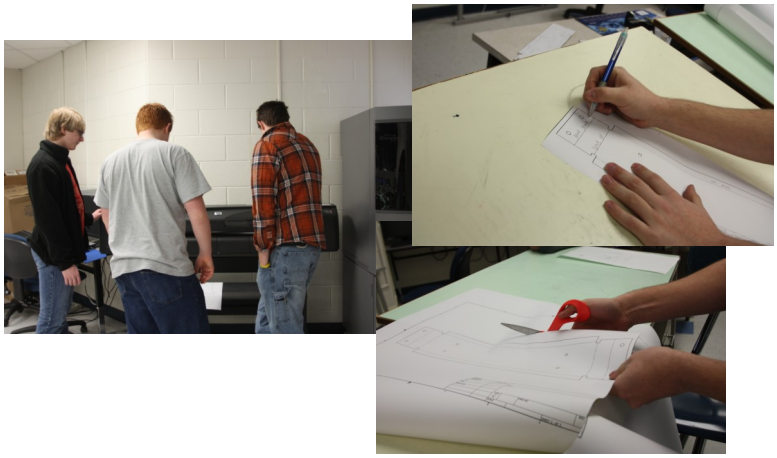


Project Development

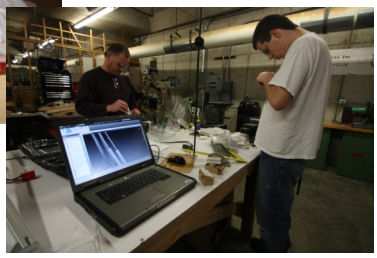
During this step the Build Team assembled the robot to the specifications set by the virtual model. This step took place at the same time as the previous step. Each system, when the virtual model was finished, was made into actuality by cutting parts to specified dimensions, placing components as shown in the virtual model, and making specialty parts designed during the previous step.



Specialty Part Development



Robot Development



Test and Trials

Once completed the robot was tested for any major system failures. None were found. The rest of the build season was used for training a new driver for 2010-2011 competition and continual testing of all systems, an event that in years past would not have happened due to lack of time associated with use of an alternate design process.

Refining

Throughout the previous step components were tweaked to maximize the robot ’s fulfillment of the design statement that was developed in the second step.