*Technical Design Report*

The Technical Design Report is your chance to show off your project. Explain what you have done this quarter and why it’s impressive. A working project is more important than a well written report, keep your writing brief and to the point.

Your Technical Design Report should at least include the following:

* Explain the changes your design has gone through since the Preliminary Project
* Design and why you made those changes:

Since the preliminary project design the stair climbing robot has changed significantly. The design that incorporated two independent pairs of rhomboid tank treads was reconsidered due to time and material restraints. Ultimately, the group decided that this design would most likely be too costly and complicated. From there the mechanical team split into two different groups. One of these groups designed a robot that utilized a single pair of large trapezoidal tank treads, with two motors powering each tread. The second team designed a robot that utilized six independently powered and controlled wheels attached to stilts that separate them from the chassis. Two pairs of wheels would be connected together at the front of the robot and would be attached to the chassis via an axle that allowed the wheels to rotate around the surface of the stairs. The rear pair of wheels were rigidly attached to the chassis. When each design had been completed we analyzed them as a team to determine which to pursue. Though it was difficult to tell which would perform better at climbing stairs, our team decided that the production of treads for the tank design would be prohibitively time consuming compared to the wheeled design. In addition, the tracked design would require more power and more weight than the wheeled design, ultimately deciding the wheeled design would lead to a better outcome.

Having agreed upon the wheeled design it was prototyped and tested it. During the design iterations several important changes were made. Our first prototype did not have sufficient power to climb the stairs. To remedy this we first replaced our initial small 9 volt DC motors with similar but much more powerful ones. These new motors were 12 volts and ran at 30 RPM or 100 RPM. Secondly, the second prototype chassis was constructed out of acrylic, as opposed to the wood in the first design. This was done to save weight and reduce the amount of torque needed to pull the robot up the stairs. In our third design iteration we added braces to the two forward axles to reduce flexing that caused the wheels to lock up. In addition, after several of our axles snapped we designed new stronger axles that were able to withstand the stress of going up stairs. Springs were also attached to the front-most section of the robot to pull up the robot after the front wheels ran into a flight of stairs. These major changes are what have allowed the robot to improve from being unable to even move up a slight ramp to reliably climbing stairs.

* Include new models and technical drawings

Sections of Chassis (Caelen’s files)

New Acryllic cutouts

* Describe the process you went through in building your projects
* Include process pictures if you have them
* Pictures of completed project

Briefly (1 - 2 paragraphs) describe some of the challenges you faced in the design and building process, and how you overcame these challenges.

Some of the primary challenges we faced during the creation of the robot arose due to monetary and time constraints. In the process of designing our robot we considered multiple designs that incorporated a continuous track or tread. The most time efficient way of creating such a robot would have been to purchase a manufactured tread or belt, 3D printed tracks would have taken too long to print and assemble. Unfortunately we could find no belts of appropriate specifications that would left room in our budget for other important components. Had we the time to print all the necessary track or the money to purchase tread we could have more seriously considered using a tracked robot. Other obstacles also increased the challenge that time posed. One example of this was our reliance on the Dabble Lab. Several times throughout our build process equipment failure meant we would lose a day of work time. Conflicting schedules meant we could often only meet a couple times in a week, meaning a delay of just a day could put us more than half a week behind.

Overcoming these challenges meant adapting our design methods and time management. During our initial design phase we had to take a close look at the feasibility of each proposed design. While the tracked design certainly had its benefits over some of the others, ultimately we determined it to be an unrealistic design path. For all it’s pros it was simply to time consuming to pursue. To save resources and time we stopped our prototyping of tracked designs and put all our effort into producing a functioning prototype that used wheels. Doing this allowed us to fast track our primary design while minimizing waste on designs we couldn’t reasonable build. Time management was also vital in keeping our team on track to complete the robot within the set time constraints. We began to anticipate the possibility of equipment failure. When we planned work sessions we would often set a backup time in the event we couldn’t use the required equipment for progress. We also extended the length of our work sessions to make up for time we had lost previously and to negate the effect of future delays. By proactively responding to these obstacles we have been able to complete our robot on time and within budget.