RC CAR PROJECT REPORT

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Motivation and Problem Statement

For our project we were tasked with constructing a battery-powered car. This car came with several requirements and expectations for its performance that must be met. Being tested on the track, the car must be made to stay in a straight line and travel as much of one hundred meters as possible. Several other elements of the car includes charging the battery using solar energy, 3D printing one part. We were given the battery, solar panel, and a charger; the rest of the materials were purchased with a budget of $100.

We need to design and fabricate a cost-effective battery-powered car to cover a distance of one hundred meters, staying within three lanes on a track, as fast as possible, while being able to carry a load of one kilogram.

Project Management

We kept ourselves organized primarily using the Gantt chart (Appendix A). Kyle headed the organization skills as the Communication role. He delegated who was to do what for each meeting, which were held in Schlosser lobby. The rest of the roles are outlined in the Team Contract (Appendix B). For quick decisions we each talked about our ideas and compromised where necessary and finally had a vote to determine our plan of action. For larger decisions, especially those concerning different materials and concept choices we used Pugh charts (Appendix C). This plan was effective in making group decisions quickly.

Design Specifications

Our objective was to build an RC vehicle using solar panel to charge a battery pertaining to the problem statement detailed above.

Product Design Specifications include:
Cost: must be less than $100
Distance: must be able to travel 100m in a straight line
Speed: must be able to travel as quickly as possible
Load: must be able to carry up to 1000 gm

The most important PDS of our project are listed above. Our full PDS is in Appendix D. We decided on these constraints based on the Project Statement given to us (Appendix E). Pertaining vehicle speed, we did a Pugh table to compare which motor will suit for our project (Appendix C). To help keep the car straight we 3D printed rails to help align the car.

Concept Generation and Selection

Referring to our PDS we decided our materials attempting to minimize resistance, weight and price. We implemented Pugh Tables (Appendix B) to determine the best design. We decided on a car with 4-Wheels, a squared body and metal framing. Some of our alternative designs involved varying wheels, bodies and materials (Appendix F). These three decisions were made primarily on the basis of stability. These would allow our car to be strong, run straight as well as relatively light and inexpensive.

Detail Design

We used the pugh tables (Appendix C) to decide on our vehicle which includes four wheels. Our car was rear wheel drive, with the back axel having a gear wheel held in place by washers and fly nuts, which attaches to a pinion gear, which was screwed on the motor. The motor was connected to the battery, switch and variable resistor, which were all housed on the wooden support. We ran a wooden support between the 3D printed supports on the metal slotted flats. The wooden support will also have enough space to carry the weight requirements, which were be set and attached individually. Our planned car was under budget (Appendix G) and included room for adjustment after trial runs. Our alternative models are sketched in Appendix (F).

Fabrication

Before fabrication, we created a fabrication plan to implement in the shop (Appendix H). These were largely based off of our CAD designs (Appendix I). This started with us cutting our metal slotted flats, and threaded axles to size using the metal cutting bandsaw. We used a combination of a band saw

and a table saw to cut a piece of plywood to be our support wood. We drilled holes in the wood to thread zip ties through to hold our battery, switch and motor in place. The motor did not align with our spur gear so we used a lathe to remove some of our plywood and lower our motor to align to the spur gear. We 3D Printed rails that slid over our slotted flats and helped align the car. We put the axles through the holes in the slotted flats and positioned the wheels and spur gear into place. We used washers as well as either regular nuts or fly nuts to fasten the wheels, axle and gears into place.
Along with the washers and nuts we added caulk to the axles to present slipping.

Testing and Redesign

There are several possible ways to use MATLAB for this project. One way being, to write a program that measures charge level from battery voltage and then another being finding your adjusted time by running a program based on the scoring algorithm.
We learned from testing our prototype that it wasn't very effective power wise. We lost battery charge far quicker than we were able to recharge it. Because of this, we managed our battery level more closely. Also, we decreased the resistance of our resistor and put less weight on. Finally, we allotted more time for the charging of our battery.

Performance

Our project performed better than expected on race day. Our first run went 40+ meters but our adjusted time came out to be 342 seconds because of the lack of weight on our car. Our second run was not as good. We added 0.70 kilograms to our car, which caused the motor to slip off of the gear because our axle shifted. Our second time came out to be slightly over 2000 seconds because our car only traveled 7 meters with the increased weight.
Overall, our car had the fifth fastest time, out of eight groups, so we were considered on the slower side, but for the obstacles we encountered during testing, we consider it a huge success. The median time was 142 seconds, which was faster than ours, but not too much faster compared to several other groups. The mean time was heavily affected by outlier times, so hold little-to-no value to us as a comparison.

Reflection

There are numerous things that we learned as a group from this project. One of the most important lessons we learned from this project was the importance of not over testing. After we had finished our fabrication and everything was seemingly completed, we began several test runs. We kept changing the resistance and amount of weight that our car was carrying. This ultimately led to our resistor breaking in half, and our gears being chewed up because of the metal pinion gear spinning on the plastic gear on the axle.
There are a couple things we would have done differently if we could have done it over again. One would be to try and prevent the axles from sliding back and forth and the second would have been to not over test. This would have greatly improved the performance of our car and decreased wear and tear.
To future groups working on this project we advise that for the cars, the simpler the better. The more complicated the design, the more room for error. It is pivotal to research what you are doing exactly, and to know exactly what you want to. Also, have several design plans that are feasible in case one ends up not working out. Things that worked particularly well for our group were the wheels we used, because they were bigger and made for off road, so they had an immense amount of traction. Also our circuit worked very well after adding a slight resistance along with a switch.

References

RC Cars & Trucks, Radio Control Heli, Airplanes, Traxxas - RC Planet. (n.d.). Retrieved April 28, 2015, from http://www.rcplanet.com/

Project Statement, Dr.DeGoede, Kurt M, 2015, Blackboard

Serway, R. (1996). *Physics for scientists & engineers, with modern physics* (4th ed.). Philadelphia: Saunders College Pub.

Appendices

Appendix A: Gantt Chart
Appendix B: Team Contract
Appendix C: Pugh Charts
Appendix D: Product Design Specifications
Appendix E: Project Statement
Appendix F: Design Selections
Appendix G: Budget
Appendix H: Fabrication Plan
Appendix I: CAD Drawings