Final Project Report – Team Two

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Executive Summary

To better understand the intricacies of the design process, our team has been tasked to create a simple robot intended to solve a specific purpose, while following a list of guidelines and specifications. Over the course of four weeks our team has researched previous attempts at solving this problem, we have brainstormed our own ideas and tried to synthesize them with the knowledge gained from research, finally settling on a few designs we deemed feasible. These designs range from simple cars with switches that make the car go in reverse, slightly more complicated designs that involve a heavy reliance on an accurate and reproducible "return structure" principle, while also considering more daring options such as a grappling hook. Ultimately, after testing during and outside of class, our team decided on a switching principle mentioned as the "Wall Reverse Car" model, as it was determined to have the best chance at winning the race, while remaining under the specified $30 budget.

Introduction

The objective of this project is to design and create a machine that can go from A to B and then return to A in a short amount of time, while staying within a budget of $30 and accommodating a few standardized design specifications. This project has been developed over the last four weeks, from culminating and formulating ideas, to then building the final design. The group wanted to design and make a machine that completed this task in the shortest amount of time, while also achieving the most simplistic design.

Background

This project, and projects similar, are common throughout many collegiate institutions to test engineering student's abilities. The University of Texas at Austin has an advanced version of

this project, but the underlying principles and goals are closely tied. Elements such as designing a robot that moves forward and backward and creating some type of interface to control the motors are imperative for a working model, all while effectively communicating and working as a team (Volvano & Gerstlauer, 2023, p. 1). By looking at this example, our team is exposed to a more complex version of our project, that provides a few extra points that are helpful to consider for our design methodology and execution.

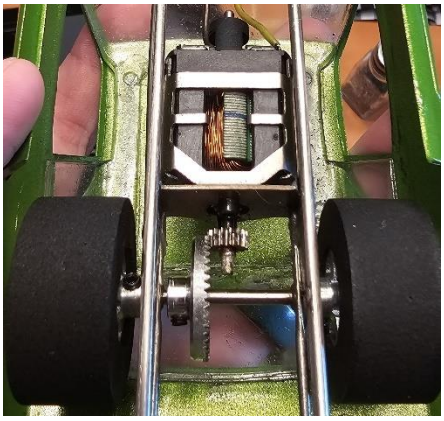

Figure 1. Motor & Gear Example

Another inspiration for the design of our project is the niche hobby of slot car racing. The overall goal of these vehicles is dissimilar to our intentions, however, several design elements such as gear ratios and motor placement provided excellent starting points for our team to brainstorm and develop ideas. Slot car parts can be purchased online for easy access, but they are also pricey, raising a budget concern that needs to be considered later during the evaluation process.

The final area of inspiration our team searched for pertains to the return structure. This aspect of the project was not necessary, however, in attempting to keep our vehicle simple, the process of "returning" could be handled by something other than the vehicle. A simple ramp may be effective in meeting this requirement. Ramps like those from Mario Kart's Rainbow Road show the twisty nature of what our group imagined, and with a little modification, a ramp like this may suit our needs after further evaluation. While there is plenty of information to take inspiration from, our team will

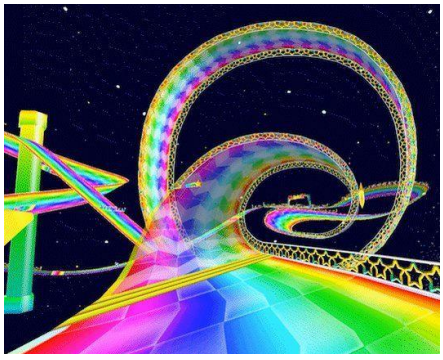

Figure 2. Ramp Example

ultimately have to begin testing and evaluating the ideas we have, to determine the most effective design choices.

Alternative Designs

There were many different designs the group came up with over the time working on this project. These designs are shown below with a brief explanation.

“Forward Flipping Car”

- This would involve having a car thin enough where the “car” can flip upside down with a reverse structure to then return.

“Grappling Hook”

- The “Grappling Hook” was a design to use string to shoot and hook on a return structure. Then using the potential energy of a winding gear box to then return.

“Sideways Flipping Car”

- The “Sideways Flipping Car” design is very similar to the “Forward Flipping Car” but flipping from left to right instead of forward to backwards. This is explained in greater detail in the *Evaluation of Alternatives.*

“Wall Reverse Car”

- This design is to have a “button” or “pressure plate” at the end of a car to then switch the direction of travel with the use of the return structure.

Evaluation of Alternatives

Each one of these designs has pros and cons. The evaluation of different designs is very important to have a final design that best fits the objective.

“Forward Flipping Car”

- The forward flipping car was our most promising design in the beginning of the design process. It was simple, efficient, and seemed reliable. The major issue we ran into early on was that the wheels would be spinning the wrong way if the car didn't reverse. This led us to scrap the idea.

"Grappling Hook"

- The "Grappling Hook" was a fun idea for a more complex way to solve an otherwise easy task. The complexity of this idea would lead to complications with our experience in programming, circuits, and projectiles. The cost of this "Grappling Hook" design is unknown but would be very hard to mass produce for under $30 each.

"Sideways Flipping Car"

- This design was our solution to the "Forward Flipping Car" failure. This design is simplistic and fast. One of the major problems with this design is its reliability.

"Wall Reverse Car"

- The "Wall Reverse Car" is very simple and reliable. One of the biggest drawbacks of this design is the speed. We believe the circuits would weigh it down and our little experience in circuits could lead to unreliability.

Final Design

The final design we decided on was the "Wall Reverse Car." The team chose this design for its simplicity and speed. The main issue with the design is the inability to keep the momentum we build up, but with enough precision and tweaking, we believe that we can make it hasty enough before the presentation. The estimated cost of the materials and parts used for the project car is $21.09, for more details (see Appendix A).

References

Valvano, J. W., & Gerstlauer, A. (2023, March 27). *Lab 7 Formula0001 Racing Robot*. The University of Texas at Austin. https://users.ece.utexas.edu/~gerstl/ece445m_s23/labs/Lab07.pdf

Appendix A

Total Budget		$30
"Wall Reverse Car"		
PLA		
Battery Tray		
Frame		
Wheels		$3.12
2mm Metal Rods (10p=$7.79)		$0.78
3 Position 2 Poll Switch (10p=$7.09)		$0.71
Gear 1		$7.99
Gear 2		$5.99
Popsicle Sticks		$1.25
Return Structure		$5.00
Wire ($5)		$0.50
Budget Used	84.47%	$25.34
Budget Remaining	15.53%	$4.66

Figure A1.