Senior Design Proposal

The Caddiellac

"In the pursuit of perfection on the course, your clubs should follow your lead"

Introduction

The proposed senior design project incorporates the design, testing, and construction of a robotic golf caddie. From the idea suggested in class, the project is appealing and achievable for senior electrical engineers and allows the team to utilize the knowledge and skills acquired the past four years at the University of Notre Dame. The group consists of Ryan Bernhold, Matthew Deporre, Rachel Drumm, and Colleen Tigani.

Problem Description

When golfing, there are two major issues that one has to deal with. The golfer has to have access to a large selection of heavy golf clubs at any given time on the course. Additionally, golf courses are expansive and transporting these clubs is tiresome. Currently, there are three ways that this problem can be resolved: the clubs can either be carried around by hand, the golfer can rent a golf cart or a pull cart, or hire a caddie for the day. To carry the clubs by hand is cumbersome and tiring for the golfer. The latter two options become expensive for regular golfers. There is a need for a method of transporting clubs which relieves the golfer from carrying them from stroke to stroke, and also eliminates the necessity of renting an expensive piece of equipment or hiring someone to walk with you.

Proposed Solution

A proposed solution is to build a motorized cart that follows behind the golfer based on position tracking. The cart will resemble a typical pull cart, and will have an accompanying handheld controller. This controller will be held by the golfer and will provide location data to the cart so it knows where to go. Additionally, the controller will have a limited user interface. The user will be able to turn the follow capability on and off from the controller. This allows the golfer to take a swing, or use the restroom with out his golf bag getting in the way. Additionally, the controller will have basic drive controls to override the follow system. This way, if the cart gets in a

tight spot, the user can control it back on track. The robotic cart will be able to accommodate the golfers personal golf bag in a secure manner.

Demonstrated Features

The final prototype will demonstrate the following features:

Self-driving: The caddie will be fully automated, with its own power source and four wheels which will give it the ability to traverse the golf course. The caddie will have a low center of gravity and four wide-set wheels to ensure proper balance even on small hills, and the torque necessary to drive with a heavy load.

Golfer Detection and Following: The caddie will have the ability to detect the location of the golfer, based off a signal that is sent from a remote stored on the golfer's person. It will adjust itself accordingly, and follow the golfer along the course.

Remote Control: The remote allows the user to control the start and stop of the caddie while also providing an option to manually override the caddie's direction. This remote can be clipped to the belt loop of the golfer for ease of access.

User-Friendly Design: To accommodate the golfer, the caddie's design allows easy access to clubs while still stable and sturdy enough to successfully navigate the terrain of a golf course.

Potential Additional Features: (depending on funds available and feasibility)

- **Speed Adjustment**: The caddie will be able to adjust its speed based on the golfer, whether it be a remote option, an automatic adjustment, or a dial on the caddie.
- **Object Detection System:** A system to detect any abnormalities in the path of the caddie such as sand traps, trees, or other golfers.

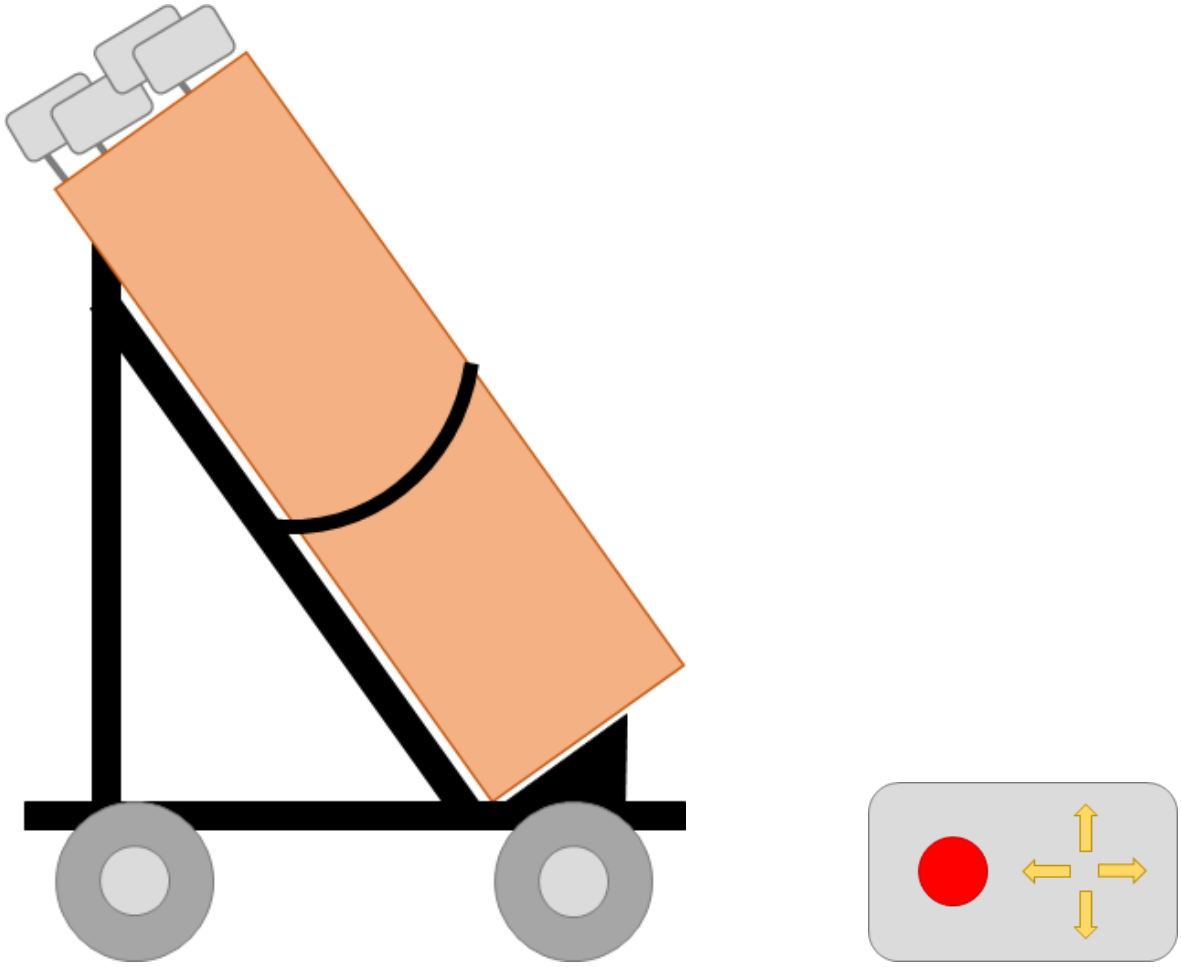

Figure 1. Automated Golf Caddie Prototype: Cart and Remote Control

Available Technologies

There are many available technologies for this project.

Self Driving:

- DC 12 volt motors [CIM 2.5” DC Brushed Motor PM25R-45F-1003]
- Gearbox [AndyMark Tough Box]
- Relay Board [Songle 8 Channel Relay Module B0057OC5WK]

Golfer Detection and Following

- Wireless Transmitter and Receivers (below)
- GPS position tracking (possible)
- Bluetooth Communication (possible)
- LED visual tracking (possible)

Remote Control

- Wireless Transmitter [Sparkfun RF Link Transmitter - 315MHz WRL-10535]

- Wireless Receiver [Sparkfun RF Link Receiver - 4800bps (315MHz) WRL-10533]

Potential Additional Features (Speed Adjustment)

- Motor Driver [L298 2A 6V-50V Compact Dual Motor Driver RB-Sbo-24]

Engineering Content

In order to design, build and test the motorized golf cart, a variety of engineering principles will need to be demonstrated. The cart will include a significant amount of both hardware and software interface. Setting up the microcontroller on the circuit board will consist of a lot of programming and I/O formatting in order to interface properly. The microcontroller will need to be able to handle multiple programs and contain several multi-purpose I/O pins for us to interface it with the motors, relay board, and remote control in the proposed design. In addition to the software requirements, there will be a great amount of mechanical and hardware interfacing--including soldering parts together on the circuit board, wiring the relay board, and constructing the drivetrain and framework of the cart.

One of the major challenges to be faced with this proposed project is the implementation of a tracking capability. Engineering a low-power robust way to follow the golfer will be a critical task to be completed. Additionally, constraints such as the cart not moving as the golfer approaches to get a club, battery life, and diversity of terrain all prove to complicate the project.

There are many possible ways to implement a golfer tracking system. One such way, as we have used for available technologies, is to use a triangulation of a signal. This signal could be a wireless signal from a controller the user holds. There are other possible ways to achieve the same result. The caddie could have a camera that tracks a special LED arrangement that the user could wear. Other technologies that could be utilized to have a golfer tracking system would be GPS checkpoints, Bluetooth communication, or other vision based tracking options such as thermal tracking.

Along with designing a tracking and wireless communication portion of the project, a versatile cart design will also have to be engineered. With the variety of slopes, terrain, and surfaces the cart will endure, special engineering considerations need to be made.

Conclusions

Overall, the Caddiellac is a viable/marketable product due to its pre-defined market and consumers. Although this would be a more expensive option than simply carrying one's clubs along the golf course, it provides the golfer with a more enjoyable golfing experience. This product could be marketed to golf courses, who could rent them to golfers as a less costly alternative to hiring a caddie for the afternoon. It could also be marketed to people who golf frequently and would use the product often. This product will ultimately provide a new and marketable service to the golfing industry.