Land Maverick

Department of Electrical & Computer Engineering and Computer Science

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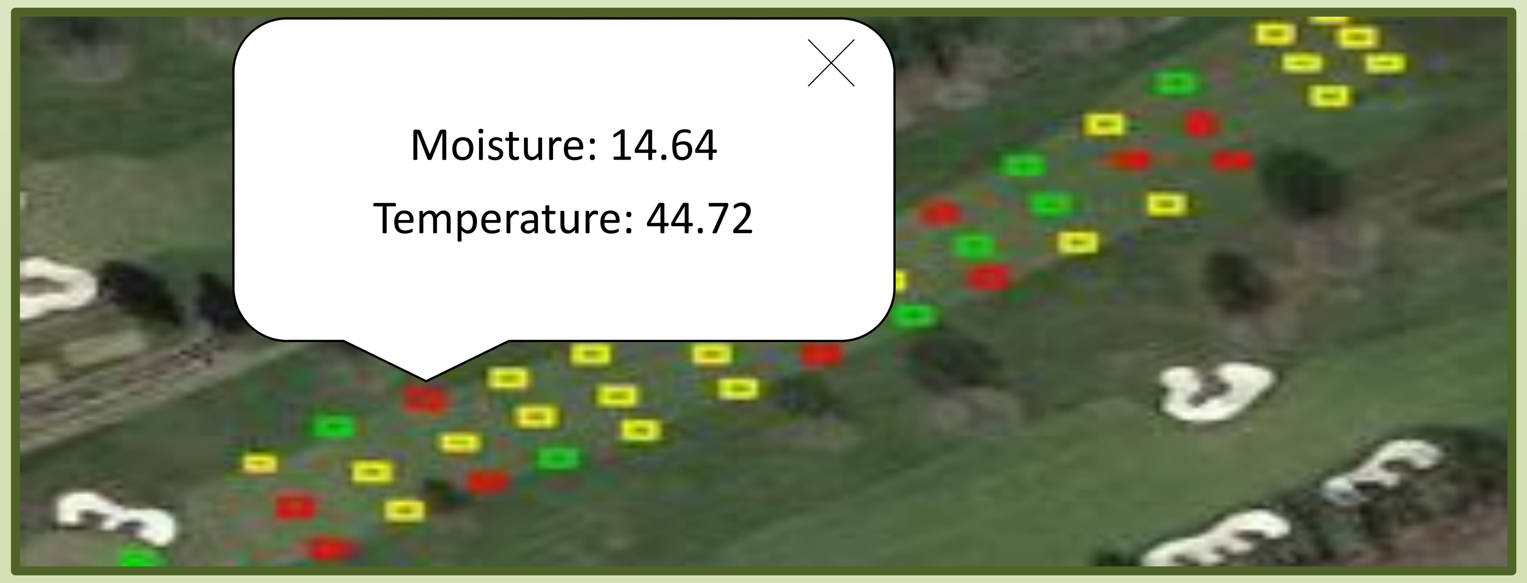
Faculty Advisor: Liberty Page **Industry Advisors**: Emily Yale, Larry Studwell

Introduction

The goal of the Land Maverick project is to replace the software of an existing robot so that it can be controlled by a remote as well as run autonomously. The purpose of this robot is to monitor the health of soil on large pieces of property, initially targeting golf courses, by using a navigation system and measuring sensors. The team is adding data collection software which will verify when the robot is stopped, deploy the measuring sensors, save the measurement data, and retract the measuring device. The data collection software will then communicate with the navigation software to resume traversal. The team created navigation software will use highly sophisticated algorithms (using a customer created algorithm) in order to traverse the course and reach the target sample spots. The team uses data from various detection sensors such as GPS, Infrared, and Time of Flight, will work alongside the traversing algorithms to ensure the robot avoids hazards such as sand traps and water sources. The data collection software will be written in Python and the navigation software will be written in C++ programming languages.

Goals

- Communication of motors and motor controllers from an on-board computer
- Communication of sampling sensors (soil, pH, temperature) from separate on-board computer
- Manual control using hand-held (PlayStation 3) controller
- Add functionality for basic vehicle navigation which includes turning X degrees, moving forward and moving backward X feet
- Relaying the information from the customer-designed A* Algorithm to the vehicle and determining direction and pathing
- Creating a semaphore that will allow the on-board computers to communicate during operation
- Installation and operation of object avoidance/detection for safe vehicle navigation
- Installation of GPS to determine real-time location compared to desired location
- Successful navigation of a course and on completion, returning to charge station
- Installation of all devices as well as sample device on vehicle
- When fully assembled, vehicle navigates course successfully taking care to avoid obstacles and obtaining samples then returning to charging station



Acknowledgements

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Staff Members: Mark Morton

Prototype

- 4 Motor Controllers
- 4 brushless electric motors
- 2 Raspberry Pi 3B+
- Soil Sensors (temperature, pH, and moisture)
- Remote controller
- Guidance sensors (ultrasonic, infrared, lidar)
- GPS
- Linear actuators
- Air compressor

Methods

- Took input from the course using the customer designed A* algorithm and fed it into the robot's navigation software that we created for robot navigation
- Developed a class to handle the navigation system which determines if the robot needs to turn, move forward, or reverse as well as calculates how far the robot must move.
- Programmed temperature, ph and soil moisture sensors to read and output data for recording and analyzing purposes.
- Installed an API for the GPS sensor to read latitude and longitude coordinates used for the robot's navigation.
- Created a semaphore for communication between processors for sampling and navigation in order to prevent damage done to components.

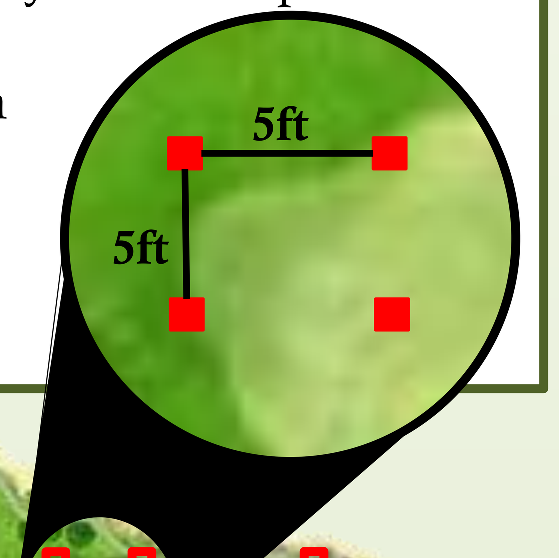
Design Process

Motor and motor controller communication	Completed
Various sampling sensor communication	Completed
Controller communication with assembled vehicle	Completed
Added functions for movement (forward, turn, reverse)	Completed
Reading the path calculated from A* and move depending on the calculation	Completed
Pi to pi communication for driving and sampling	Completed
Installing and operation of object detection/avoidance sensors	In Progress
Installation and operation of GPS	In Progress
Successful navigation of a course	In Progress
Installing sample sensors and sample actuation device on vehicle	In Progress
Successful navigation of a course, avoiding obstacles taking samples	In Progress

Key: Completed In Progress

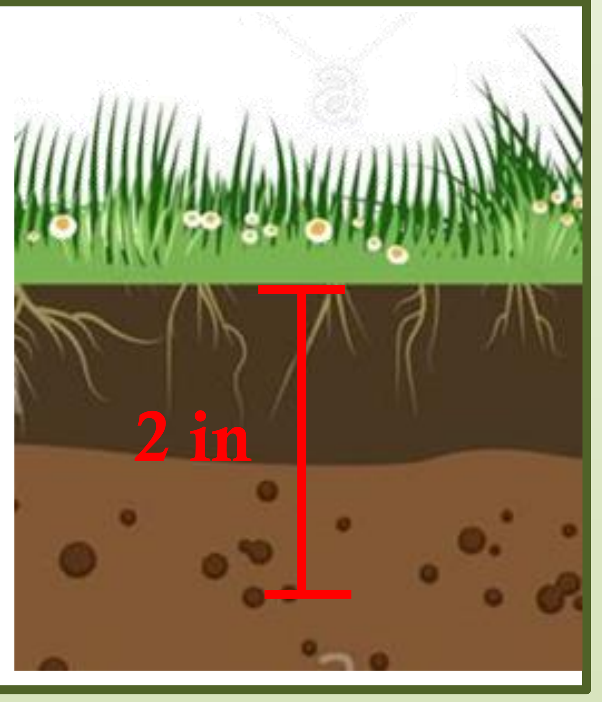
Navigation System

- Uses a customer created algorithm that uses the concept of A* to calculate the best path for the vehicle to take from one point to another
- The robot moves in five feet increments and uses GPS data to recalculate its position and next best path at each point
- The software must prioritize the incoming data from ultrasonic, infrared, and lidar sensors to ensure object avoidance is maintained
- The navigation system is run autonomously with the option to run with the use of a controller
- The angles calculated from the navigation algorithm are sent to a navigation class where the data is used to determine the necessary robot turn angle and move distance



Data Collection System

- Data collection system deploys when the navigation systems signals the vehicle is stopped
- Linear actuators deploy the sensors 2in into the soil
- A variety of sensors are used to take readings of the soil temperature, ph, and moisture
- The values are recorded and stored in structured format for front end systems and users to easily read



Conclusion

Land Maverick provides an automated robot that can traverses a golf course and determine the temperature, ph, and moisture of the soil. This product establishes a more efficient way to determine the proper maintenance plans for golf courses which prevents mistreatment of the soil and provides the potential to reduce maintenance costs.

References

- https://land-maverick.com/course-overview/