Creating a Semi-Autonomous Mobile Work Platform

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Abstract

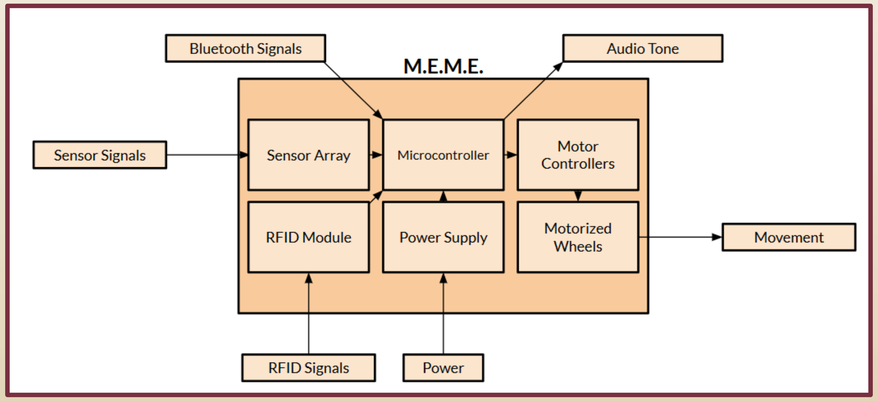
With an increase in industrialization dominating the modern era, the mechanization of the workforce has become a progressively prominent feature of the contemporary working environment. Menial tasks often executed by blue-collar workers have been replaced with the mechanical performance of pseudo-intelligent apparatus that not only create a more efficient and durable system but also increase regulation and facilitate a more effective work environment. Ultimately, these machines are implemented to bolster productivity in the working environment, and to relieve the physical restrictions associated with human performance and capacity.

This project presents the design and plan of a mechanical transportation prototype with semi-autonomous features to be implemented in an industrial environment. The platform aims to implement autonomous navigation, to allow for the user to both guide and ping the platform as it carries a large load and navigates the workspace. As a result, larger cargo can be transported in a timely manner while reducing physical strain on workers, surpassing the limits of human capacity and increasing the efficiency of the workspace. Relying on a combination of sensors for communication and navigation, the platform includes ultrasonic and infrared sensors to produce a system that provides both autonomous and manually controlled services. A combination of infrared and ultrasonic sensors, as well as manual control by way of Bluetooth, are implemented to allow the user to guide the platform at their own personal discretion.

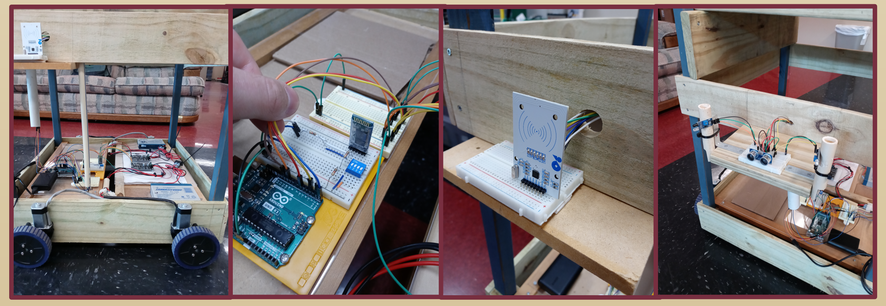
Objectives

- Create a rudimentary platform to perform a test routine
- Achieve Manual Control via Bluetooth
- Improve power economy to boost and lengthen performance
- Upgrade the chassis to see the effects of performance under weighted conditions
- Implement an RFID security measure
- Integrate code to utilize both manual control and RFID security feature
- Introduce a new and more robust microcontroller to accommodate the sensor array
- Add and test sensors for semi-autonomous functionality

Functional Design



Major Components



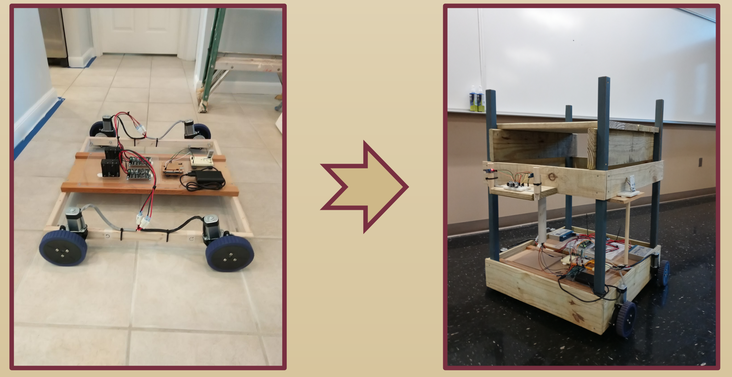
From left to right:

- The Main Body of Electronics – Comprised of the microcontroller, Bluetooth module, two motor controllers, four powered wheels, two 12V 2.8Amp Hour Batteries, and 5V Power Bank
- The Bluetooth module – Allows for manual control via a phone app
- The RFID module – Allows for the use of a key card or fab to authenticate before use
- The Sensor Array – Comprised of an ultrasonic rangefinder and two infrared sensors

Discussion

The Mobile Equipment and Materials Escort (M.E.M.E.) was originally intended to utilize an active RFID tag and reader coupled with a LIDAR to track an individual through an environment but due to budgetary constraints the functionality was revised to its current state. The overall purpose of the project has not changed, to develop a mobile work platform, but the means of execution have adapted to the various setbacks encountered during the testing and design phases. Another phased out feature was the incorporation of RFID beacons that could summon the platform to them without the need for an individual to lead the M.E.M.E. to its destination.

Several upgrades have been discussed but not implemented such as modular storage, omnidirectional wheels, all-terrain capabilities, and a more material appropriate chassis. The all wooden chassis is one of the most notable features of the M.E.M.E. and is a result of the ease of access to the materials needed to create it. Ideally the chassis would be made of a lighter material such as carbon fiber or aluminum, but once again the cheapest alternative won out and wood was used.



Results

- Can operate reliably for around an hour with constant use
- Guaranteed to transport up to 50 pounds of materials and equipment
- Manual controls through Bluetooth using a phone app
- Sensor implementation for tracking and following proof of concept
- Rudimentary RFID implementation for added security feature
- Low profile turning for reduced physical presence within a workspace