Senior Design Proposal

Park of the Covenant

Introduction

Finding space in a parking garage can be both time consuming and frustrating. It's easy to spend several minutes driving through parking garages looking for an open space. This wastes both time and gas. While time may seem trivial, both the parking garage and users lose money from this problem. The total gas usage during this time for all drivers is very high.

Problem Statement

A more organized and modern parking system could help eliminate these easily avoidable problems. The solution to the problem is to create a smart parking lot. This means that the user, in this case the driver, will need to be given information about where there are open spots in the lot so that they can quickly navigate to those spaces. We need a way to sense where there are open spots, and then display that information to the user.

Proposed Solution

We plan on creating a smart parking lot by placing sensors in each of the parking spots which can sense if the space is occupied. These sensors will then be networked to a central device, most likely a board, which will compute how many open spots there are and where they are located.

Lastly, we need some way to display the information to the driver to make the information useful. Our plan is to put a display at the front of the parking lot shows a map of the parking lot and highlights the open spots. We also would like to create a smartphone application which could display to the driver where the open spots in the parking lot are. This would entail uploading the data to a service which could then send that data to a smartphone application which we would write. The driver could then see where exactly the open spots are in relation to themselves, and would not need to waste time searching for an unoccupied spot.

Demonstrated Features

The features we will demonstrate in our final presentation include:

Sensors: Some sort of light or audio sensors will be placed strategically in a parking garage and will be able to determine when a parking space is occupied or empty. We will show how we determined the optimal placement of the sensors, and how these sensors are physically installed in the parking garage.

Networking and Power: The sensors will need to be networked together so that our project can scale to large parking areas. Sensor data will need to be sent to our microcontroller but we will demonstrate how a large number of sensors can communicate with a microcontroller that has a limited number of input pins. Power will also be needed for the sensors, and this will ideally be supplied through the network cable.

Parking Lot Display: Our microcontroller program will interpret the data from the network of sensors and output a display that will show a map of the parking garage and which spaces are occupied or empty. This display would be located near the entrance of the parking garage to assist drivers in finding a space. We will also demonstrate the speed at which the display updates as the status of a parking space changes.

Mobile Application: The display of the parking garage will also be made available to smart phone users. This will be accomplished by creating an app. We will likely need to make some changes to how the map is displayed so that it appears pleasant on a smart phone. That is, the displayed map of the parking garage on a smart phone will be different from the displayed map at the entrance of the parking garage.

Available Technologies

For our solution we will need to design the sensor module for each parking spot that would have the capability to determine whether or not a car is in the space. There are a wide range of technologies available for such requirements, such as light or ultrasonic sensors under the car, pressure or electromagnetic sensors in the ground, or RFID or GPS to track specific car locations. All of these input signals would then need to be sent to a central hub. We believe the easiest approach would be to wire each signal, because this would also help facilitate powering the sensors. This data would need to be processed by a microcontroller and displayed. The display could either be an LCD screen, or a simple grid of lights to represent the spaces. A smartphone app could also be used to display open spots or directions to the nearest space. Such an app could be programmed on either Android or iOS.

Engineering Content

Our engineering content can be divided into 3 major functional blocks. Sensing, Networking and Displaying.

Sensing involves using a sensor to detect car presence in each spot. Challenges in this block include finding an appropriate sensor technology, learning how to interface that with our microcontroller, and making sure this sensor physically can hold up to the stresses found in a typical parking garage environment.

Networking includes finding a way to link the discrete sensors together in order to calculate things like the capacity of the garage, how many spaces are open, and which sensors are in specific physical locations. Also Included in this block is finding a way to send information from the microcontroller to the mobile application mentioned below.

Displaying involves communicating this information to the customer, giving a “heat map” of open spots in the garage, and possibly directing them to those spots. This functional block can be expanded upon with a mobile application that users can access at any time to check spot availability, using data sent via WIFI from the microcontroller.

To test the final prototype, we have come up with a few options. The first one that comes to mind is using one of the parking lots on campus and a network of possibly 4-8 sensors along with the mobile application. Another idea is to build a scale model, using RC cars or an equivalent. This may be a good idea for our presentation, and have a video demonstration of the testing in the actual parking lot.

Conclusion

With our finished prototype, we hope to have created a viable system that is both cheap and effective to install in existing parking lots and garages. This system will both reduce driver frustration and allow garages to operate with greater efficiency, which makes our product an attractive option on the market.

By the end of the year, our prototype should show the following: proof of concept, reliability of the complete system, and display technology that is effective and user friendly. We believe this is an in depth and interesting project that will fully engage our team's engineering abilities throughout the year.