

Indoor Positioning System for Inventory Management

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1 Project Description

We propose a system for keeping track of the physical location of an outlet or grocery store's inventory and to allow that information to be utilized by consumers and the store itself.

For consumers, we plan to create a mobile application that will point them toward the location of the item they seek and potentially find the shortest path to acquire the items in their 'shopping list'.

Stores currently employ devices physically attached to a number of expensive products, such as high-end clothing, alcohol, and razor blades. These devices already contain RFID modules in order to alert the store if the stolen good passes through the exit. Our system would replace this as well as provide the store with real-time information on the location of their goods. For inexpensive goods whose cost does not justify security measures, the device could be placed on relevant shelving.

This system consists of the following components:

- A large number of small, inexpensive modules that can be attached to the objects
- A 'central hub' that serves as the location anchor of our system. This consists of a single processing unit and at least 4 nodes arrayed across a ceiling in a known configuration. This anchor constantly pings the modules and then uses trilateration to keep track of the coordinates of the modules with respect to itself
- A simple, mobile application that allows the shopper to acquire the coordinates of the modules

The modules are to be designed so that they are easy to mass produce to ensure that the system is scalable. A store employee attaches the module to a product or location of interest and then associates that module with the relevant item in a database of items that store sells. The mapping of these "labels" to the coordinates of the object is stored by the central hub. The shopper's mobile application can then access the coordinates of any of the given modules via the central hub's software interface.

2 Implementation Plan

Below is a proposed plan for the project's implementation.

2.1 Stage 0

Early Deadline: Beginning of August

Expected Deadline: Beginning of September

Late Deadline: Week 0 of Fall 2018 quarter

- Develop an algorithm to determine the position of the modules. This should include robust error handling
- Determine the physical mechanism that ascertains the modules' distances from the central hub (i.e. communication protocol and hardware used)
- Determine the specification of the central hub and module hardware
- Determine the method of communication between the central hub and the user's devices (i.e. Raspberry Pi, etc.)

2.2 Stage 1

Early Deadline: Week 0 of Fall 2018 quarter

Expected Deadline: Before fall design review

Late Deadline: End of winter break

- Write the program that determines a module's position using the algorithm determined in Stage 0. The input to the program at this stage is simply generated test data
- Design the central hub and module hardware
- Write a software interface so that the position of a module can be acquired from the central hub, assuming it has already been correctly calculated

2.3 Stage 2

Early Deadline: Before fall design review

Expected Deadline: End of winter break

Late Deadline: Before winter design review

- Manufacture the central hub with an acceptable number of modules
- Integrate the software written in stage 1 with the assembled hardware
- Test the system with the modules

2.4 Stage 3

Early Deadline: End of winter break

Expected Deadline: Mid winter quarter

Late Deadline: Before winter design review

- Devise a method to associate a building's drawn physical layout with our system
- Create the mobile application
- Integrate the system with a database and test for full functionality
- Test the system with the modules

2.5 Stage 4

Early Deadline: End of winter quarter

Expected Deadline: Before winter design review

Late Deadline: N/A

- Plan and construct what will be presented at winter design review.