CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

David A. Zarrin

Project Number

31435

Project Title

Never Lost Again: Designing a Novel Precision Indoor Navigation System

Abstract

Objectives/Goals

The social impact of precision indoor navigation will be significant in the coming decade. Hospital visitors frequently have difficulty finding one's doctor or locating a patient's room in a large medical facility. Shoppers walk into malls wishing to locate a specific store, a particular aisle in a department store, or even a specific item on a shelf. People spend valuable time looking for a specific conference room, a particular booth in a trade-show, a ride in an amusement park, or a known piece of art in a museum. These are all applications of precision indoor navigation systems. Previous attempts in creating indoor navigation resulted in 10-15 meter accuracy. My hypothesis is that it is possible to build a low-cost, indoor navigation with accuracy of few centimeters.

Methods/Materials

I plan to build several prototypes using radio-sonic, WiFi RSSI, and a novel technique using radio oscillation. I plan to:

1) Build a prototype of an indoor navigation based on ultrasound and radio sensors. The prototype software will use the radio sensors to trigger an ultrasound ping which is received in multiple known locations. The target location will then be calculated based on triangulation and displayed on screen.

2)Use WiFi RSSI technology and develop a mathematical algorithm that can match the RSSI RF signature of a location in a building with a known database of RSSI signatures using a derivative of Maximum Likelihood Probability correlation. I will test the software prototype at Good Samaritan Hospital and an office building with WiFi.

3) Use radio oscillation to calculate the target position. Previous attempts in using radios for sub-meter indoor positioning system have required super-fast electronics and that made the solution not viable for low-cost or indoor commercial use. I plan to build a prototype to prove a new and novel solution.

Results

I built and measured the accuracy of several prototypes. The radio sonic offered an accuracy of down to 2cm, but required multiple sensors. The WiFi RSSI proved to be the most economical with an accuracy of 5 meters. The radio oscillation prototype provided a robust method for building indoor navigation with sub decimeter accuracy.

Conclusions/Discussion

These experiments demonstrated that the radio oscillation provides a robust, low cost, and patentable method for building an indoor navigation system with an impressive accuracy of down to 10 centimeters.

Summary Statement

A Novel Precision Low-cost Indoor Navigation System with Centimeter Accuracy

Help Received

Received research tips from an MIT math professor, my adviser, and C programming assistance from my sibling.