BEACON BASED INDOOR NAVIGATION

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OUTLINE

- Introduction
- Project Plan
- Progress of the Project
  - Collaborative Study
  - Group Member 1
  - Group Member 2
- Conclusion
- Tura Engineering
- Future Work
PROJECT AIM

- Localize a moving object using stationary sensor beacons.
Localization is the answer of the robot’s question which is «where I am?».
The distance from each stationary sensor beacon will be evaluated using time-of-flight calculations.

INTRODUCTION

INFORMATION ABOUT THE PROJECT

- Localization is the answer of the robot’s question which is «where I am?».
- The distance from each stationary sensor beacon will be evaluated using time-of-flight calculations.
INTRODUCTION

THE OUTPUTS OF PROJECT

- The coordinates of the moving object with respect to a reference frame.
# PROJECT PLAN

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PROJECT PLAN

Studies on Multiple Sensors
- December - January

Analyze Beacon Signals
- January - February

Coding of Localization Algorithm
- March - April

Displaying Results on the LCD and Tests
- April - June
PROGRESS OF THE PROJECT

- Literature review
  - SLAM (Simultaneous localization and mapping), indoor/outdoor localization.
  - Time of flight and Trilateration Method.
  - Analyzing the beacon signals

- Determination of equipment list
- Implementation of Time of Flight Method
- Determination of sensor types
COLLABORATIVE STUDY

Determination of Equipment List

- Arduino Prototyping platform
- Ultrasonic Sensors
- LCD Screen

- Batteries, cables, and connector elements
Implementation of the “Time of Flight Method”

- Sensor measures the time of flight.
- Distance = [Time X Speed of the Sound (344 m/s)] / 2

Let’s show Arduino implementation...
Trilateration Method

- To determine the position trilateration will be used
- To calculate Heron’s Equation and trigonometry will help, if coordinates of (2) is (0,0) then robot’s position become (h,y)

\[ Sp = \frac{S + d1 + d2}{2} \]

\[ Area = \sqrt{Sp \times (Sp - S) \times (Sp - d1) \times (Sp - d2)} \]

\[ h = \frac{Area}{\frac{S}{2}} \]

\[ y = \sqrt{d1^2 - h^2} \]

Heron’s equations \(( Sp = \text{semi-perimeter})\)
Determination of Number of Beacons

- Two beacons are sufficient for calculating (x,y) position.

- To increase the accuracy of the system we may increase the number of beacons.

- This will allow us to cope with the obstacles in the environment.

- Error margin
Why ultrasonic sensor is used?

- GPS is not suitable for indoor.
- Fine grained infrared sensors are good but they are very expensive.
- Reflect easily from hard objects
- Cheap sensors and easy to apply
- Margin is approximate 3cm.
Analysis of Beacon Signals

One clock signal will be sent from base station

Last 4 bits of the clock signal will be “busy bits”.

Beacons will send back the clock signal changing the busy bits according to their identifiers.
The platform will take this signal and control last 4 bit System will decide on which beacon the signal is coming from.
State-of-the-art localization algorithms are reviewed.

For doing this project, we need

- Ultrasonic Time of Flight Calculation for distance
- Trilateration Method for localization
- Analysis of Beacon Signals
Tura Engineering was founded in 2011.

Their major works are
- Mechanical design,
- Robotics
- Multi-physics analysis

Nowadays, they are making
- Autonomous lawn mower
- Autonomous cleaner robot

They will implement our project to cleaner robot.
FUTURE PLANS

Coming soon

- Coordinates on LCD
- Coding of Localization Algorithm
- Studies on Multiple Sensors
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