RFID Handheld Navigation Device
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Background and Intent
Following signs and walking around a new building is something many people take for granted. Those who are visually impaired can have difficulty finding their way through a new building, and cannot easily rely on signs. Thus, Impinj tasked us with creating a handheld navigation device to assist the visually impaired in this process.

Requirements
- Use Impinj RFID tags and RS1000 integrated reader module.
- Use the Raspberry Pi system.
- Determine user’s location and path to destination.
- Use text-to-speech to direct the user towards their destination.
- Develop a case to hold the device.

Our Solution
Navigation Concept (Tag setup pictured)
RFID tags are placed along the walls at chest height. The device reads the nearest tag to determine what “node module” it is currently in. Dijkstra’s algorithm is used to calculate the path to the destination. Directions and orientation are determined based on the user’s previous, current, and next node. This is done with the dot and cross products. In giving directions, the device also calculates the number of steps the user should take.

Architecture

Hardware
- Raspberry Pi 3 B+.
- Impinj RS1000 integrated reader module.
- PiJuice power system
- Adafruit Mini External USB Stereo Speaker.
- Breadboard and simple push buttons
- Antenna

Software
- Graphviz, Dijkstar, pytttsx3, networkx, protobuf, pyserial, google, mock, mysql, eSpeak, and python2.7

Results
- Meets all priority level 1 functional requirements and most non-functional requirements.
- Storage for a large tag database (over 20 million)
- Over three hours of battery life.
- It works well, though some test situations do not consistently perform.
- Overall, valuable in building navigation.

Future Work
- More functional and durable case.
- User-friendly way to map out and implement new environment.
- Easier updates of database.
- More clear text-to-speech voice.

Glossary
RFID: Radio Frequency Identification.
Dijkstra’s Algorithm: Algorithm that calculates the shortest path between two graph nodes.

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Team Themis