THE UNIVERSITY OF ALABAMA AT BIRMINGHAM
School of Electrical and Computer Engineering

Smart Shopping

Optimizing retail using IoT connected devices

Department of Electrical and Computer Engineering EE499

Connor McGarty Jeremy Milam Jake Watters Jon Yim

Mentored by Dr. Leon Jololian

Problem Statement: The Retail Environment

- Online shopping and delivery services are increasing in use
- Retail is on the cusp of traditional shopping methods and technological integration
- Current solutions:
  - Ask an employee
  - Query a store's online database, item by item to get a general location
  - Wander through store checking every aisle

Presented by Jeremy Milam

Our Idea:

Tracking Indoor Position of Individuals to Provide Location-based Services

Services:

- Live indoor mapping
- Turn-by-turn navigation

Applications:

- Retail consumers
- Warehouse and distribution
- Delivery services
- Large complex settings – Hospitals, Universities, Museums, Malls

Presented by Jeremy Milam

Design Requirements

Requirements

- User locations
- Product locations
- CRUD operation on user lists
- Dynamic navigation
- Path optimization
- User interface

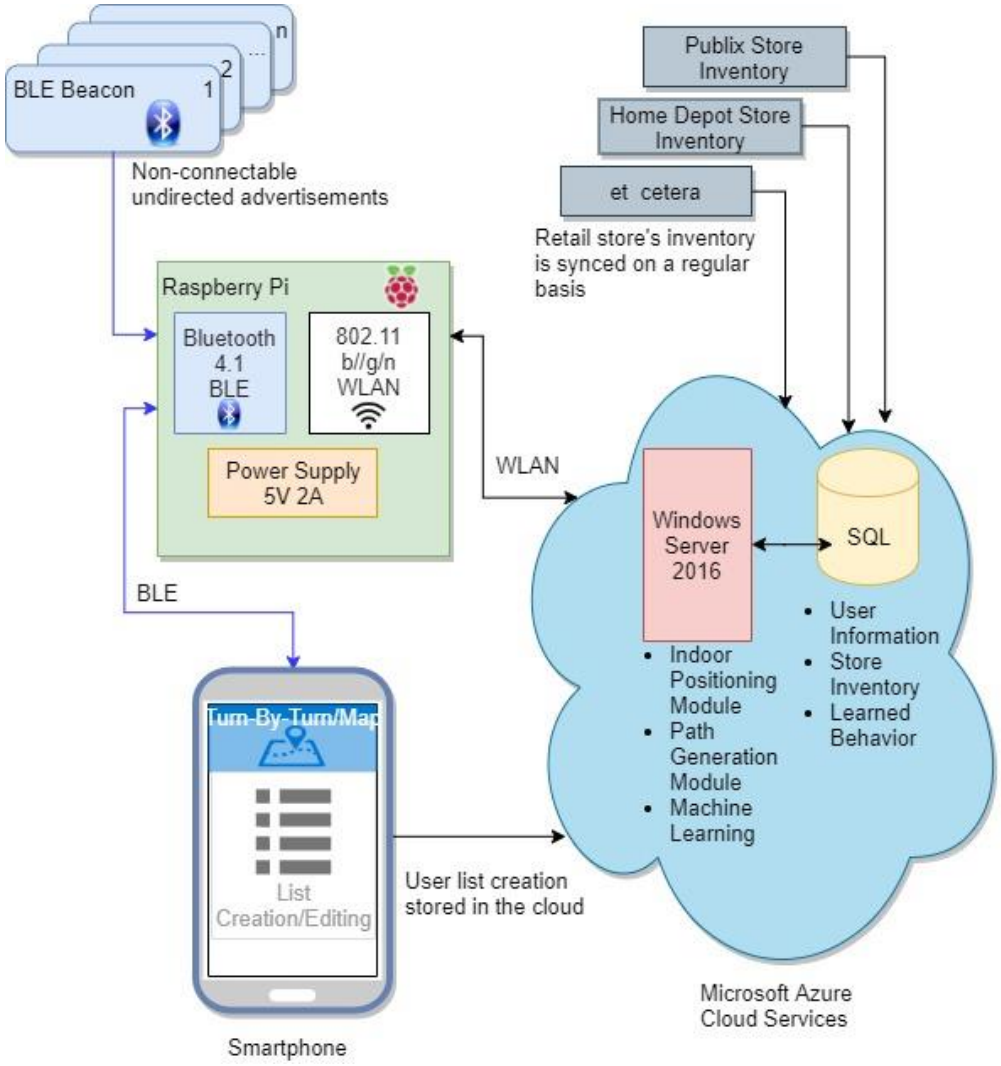
Components

- BLE beacon transmitters
- Microcontroller recievers
- Relational database
- Web application
  - Client/Server model
  - Interface w/ Map
- Pathfinding algorithm w/ custom heuristics
- Server hosting services

Presented by Jon Yim

Project Architecture: Block Diagram

- Kontakt.io Smart BLE Beacon
- Raspberry Pi 4 Microcontroller
- Microsoft Azure Cloud Services
- Smartphone Application



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Localization using BLE Beacons

Set up for Path Loss experiment,
RPi receiver on left connected to laptop,
BLE Beacon on right at fixed distance(s)

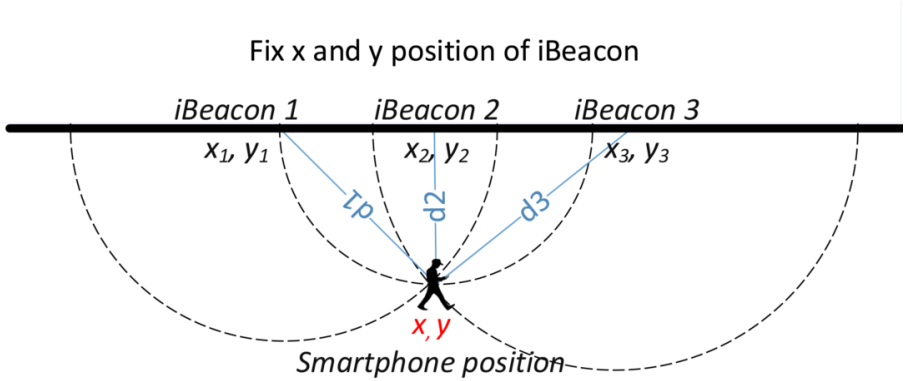

Image Property of Maytham Fahmi

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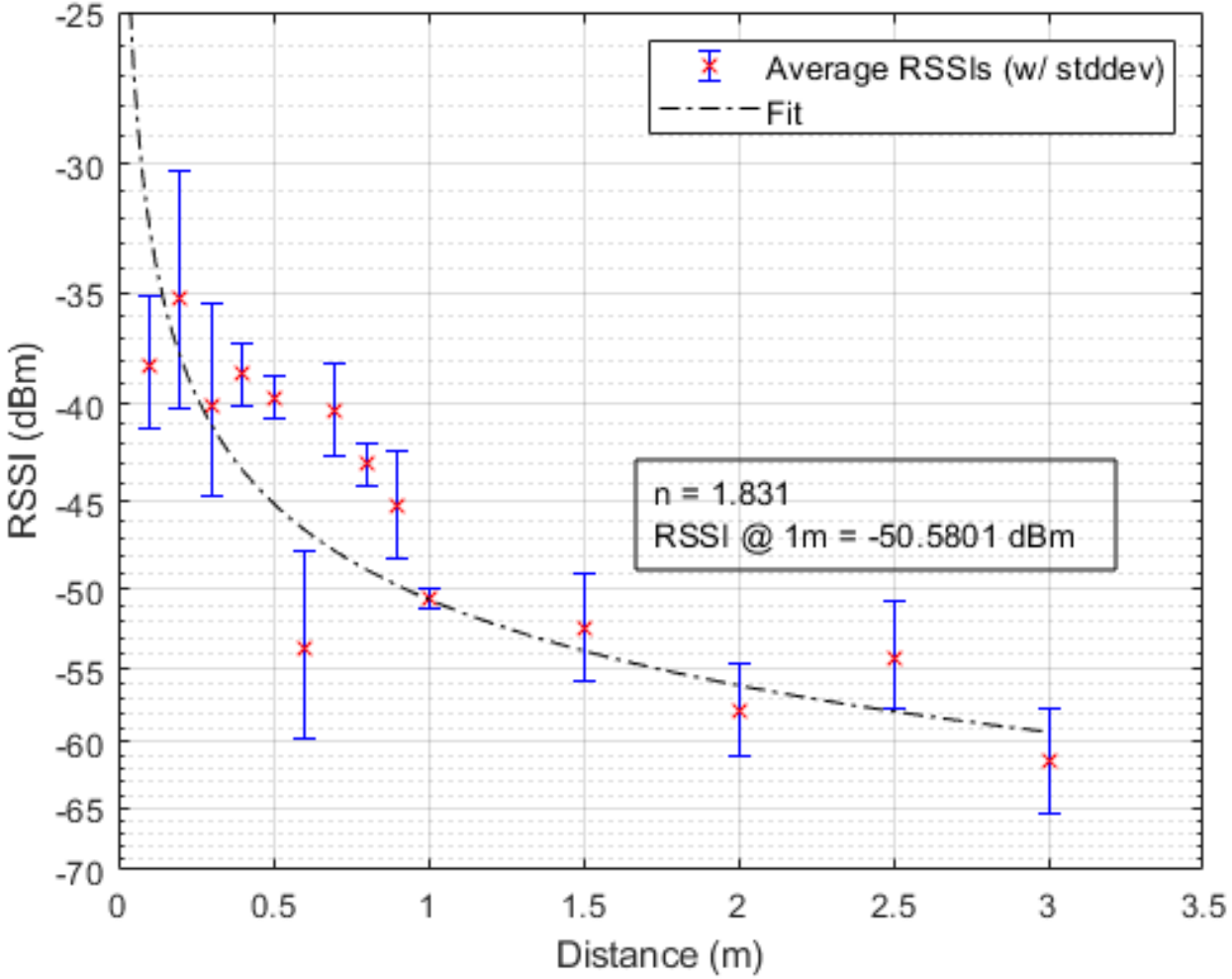
Path Loss Model



$$\text{RSSI} = -10n\, log_{10}\frac{D}{D_0} + C_0$$

$$\text{D} = 10^{\frac{RSSI+C_0}{-10n}}$$

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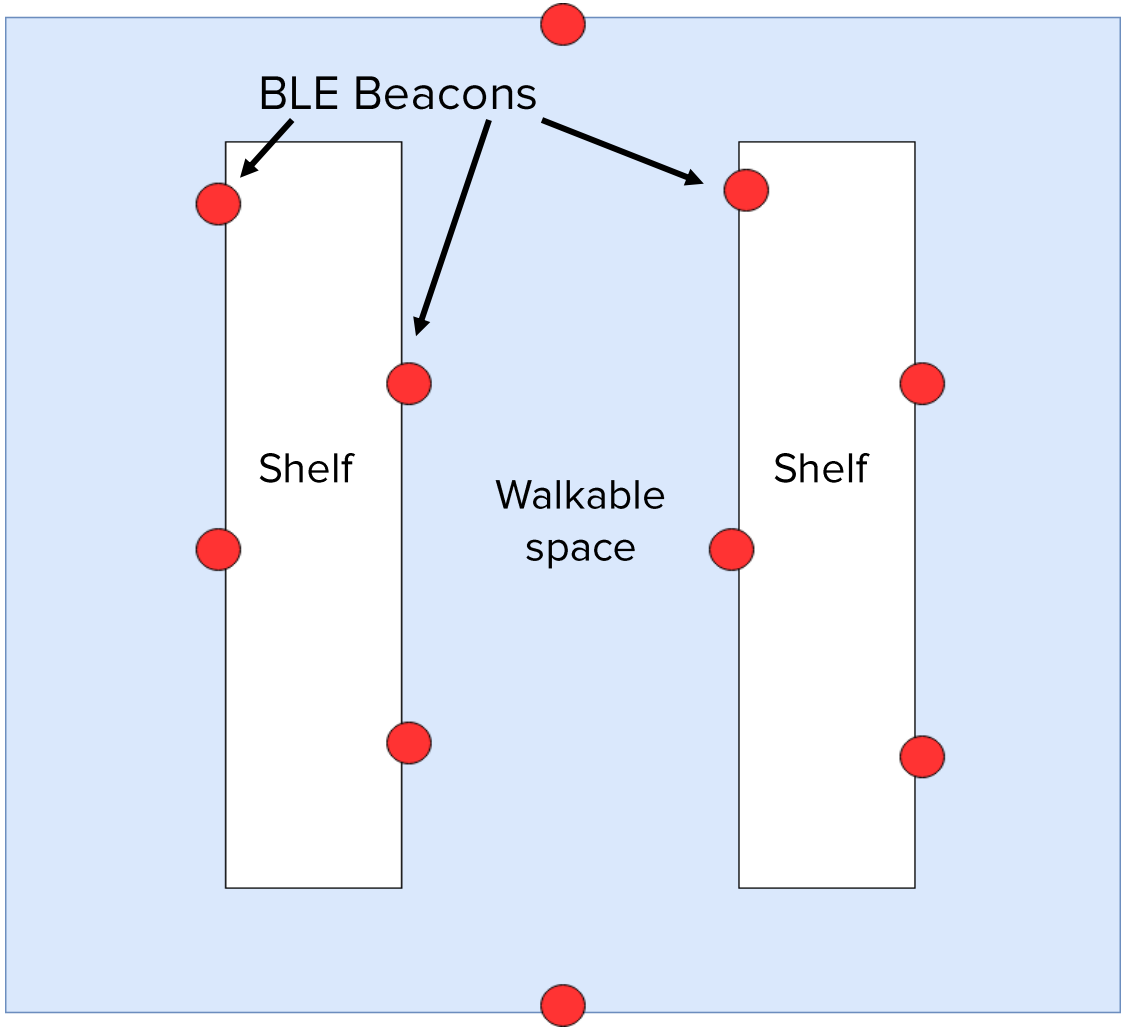
Beacon Layout



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Client and Server Demo

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Pathfinding Demo

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Web Application Demo

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Future Work

- Bluetooth Core Specification v5.1 ; Angle of Arrival (AoA) and Angle of Departure (AoD).
- Increasing the number of beacons.
- React Native smartphone application.
- Microprocessor functionality expansion; image-recognition cameras, UPC Scanner, various sensors.

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