Applications of Bluetooth Radio Technology and Indoor Positioning in the Hospital

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BACKGROUND

- Keeping track of the locations of objects, patients, and doctors is vital for the smooth operation of a hospital.[2]
- Radio technologies, including Bluetooth Low Energy (BLE), Wifi, & GPS, can assist.
  - BLE is preferred due to simple deployment of proximity and distance beacons.
- Deployment of multiple beacons in an array, combined with appropriate software, can inexpensively and easily be utilized for Indoor Positioning (IP).

OBJECTIVES

- To explore the potential of Bluetooth Low Energy beacons in various functions within the hospital.
- Develop a proof of concept app that utilizes four beacons to provide detailed location reporting, and to successfully execute proximity and location notifications.
- Compare Estimote and Beaconstac, two competing beacon technologies.

METHODS

- Wrote a literature review to provide background on potential uses of Indoor Positioning in health care, i.e. route finding in an emergency evacuation of the hospital.[3]
- Compared the advantages/disadvantages of BLE, Wifi, and GPS.
- Used Swift for coding; Estimote and Beaconstac provide code samples for ease of use.
- Modeled Hospital entrance to identify specific regions that triggered specific actions when device was near.
  - Had to adjust output interval for the beacons to maintain accuracy

METHODS (Cont.)

- Tested Estimote, exploring actions when activated by proximity.
  - Displayed PNG map of hospital using image display and changing object statuses.
  - Delivered sample gift store coupon using distinct storyboards.
    - Required intricate, obscure methods.
  - Redirected use to specific webpage using UIKit library.
- Tested Beaconstac, an alternative solution requiring minimal coding, but incapable of coordinate finding.
  - Actions only trigger via proximity, rather than coordinate finding.
- Analytics: Capable of tracking device location for data analysis on traffic flow, time spent at specific location, etc.

Researched SDK's, radio tech, and beacon tech → Developed proof of concept app using Estimote → Mocked demo room, used proximity beacons. → Compared beacon systems and functionality

DEMO

Custom Estimote sample app, displaying sample "gift coupon," trigger through Indoor Positioning

Standard Beaconstac sample app, listing three beacons at different states.

RESULTS

- Proof of concept app was functional; successfully displayed a map image, "coupon" link, and webpage.
  - Demonstrates that beacons can trigger a wide variety of actions, with significant potential.
- Initial concerns addressed by altering settings; accuracy improved from reducing beacon intervals.
  - However, it seems to work better when in motion.
- Estimote proved more flexible; Beaconstac proved incredibly simple to deploy complete solution.
- Lack of current literature/research on Bluetooth in health care, despite Bluetooth's advantages, i.e. less energy usage, higher accuracy, ease of deployment.[1]

CONCLUSIONS

- BLE offers potential for a wide variety of applications in health care, from information delivery to sanitary notifications. Use in way-finding seems to have potential.
- Estimote offers more potential functionality, whereas Beaconstac is simpler to deploy and includes better analytics.
- Bluetooth coding and app development could serve as an entry-level topic in programming using outside technology.
- Literature review supported belief that additional research should be explored in this area.

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