

Initial plan: Occupancy Monitoring System for Windows Lab

One Semester Individual Project

CM3202

40 Credits

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Role of Supervisor

- Weekly meetings in order to monitor the progress of the application
- Advice on beacons and placement of beacons
- Guidance with respect to functionality
- Supervise overall project

Project Description

Providing the public or individuals of relevance with contextual-based information is a rising industry in modern software development. In this scenario, students of the school of Computer Science would be provided with context regarding the occupancy of the Windows lab. Thus, at any given time, students are able to check how many individuals are currently in the labs. This allows them to determine whether or not they want to use the labs to continue some work or study, for example. Furthermore, Bluetooth beacons have been versatile with respect to the fact that paired with an application, they are able to provide individuals with contextual information. In this scenario, the beacons will provide data to a central database system, and a basic Android application will be developed in order to retrieve information from the central database systems to provide users of the occupancy of the Windows lab along with sending information to the database regarding the entering or exiting of labs.

This project, thus, aims to provide students with information regarding the occupancy of the Windows lab at any given time. This would be achieved with Estimote and iBeacon Bluetooth beacons. The Android application will be used as an interface to process the proximal data being transmitted from the beacons. This is due to the fact that the beacons themselves are not capable of connecting to the internet and sending data to the database. The application will then use the internet to send this information to the MySQL database for storage purposes. MySQL is used due to the fact that this is a centralized database which will be used to send data to each phone that is connected to it regarding the occupancy of the lab at that time. With respect to retrieval, the application will make use of a PHP script stored on the server to get data stored on the database and convert that data into JSON objects which will then be parsed by the application. The application will then display the parsed information on the screen.

Project Aims and Objectives

Fundamental Requirement

The fundamental requirement is to build an Android application that shows data regarding the occupancy of the Windows lab at any given time. The application will be built using Android Studio v2.2.2 with the use of Java. For the central database, MySQL will be used along with PHP to send and retrieve data. Finally, the Bluetooth beacons that will be used in this project are both Estimote and iBeacon beacons.

Assumptions

It is assumed that any user running the application will be running a minimum of Android 4.0.3 Ice-cream Sandwich (each further iteration of the OS until Android 7.1 Nougat are also accommodated for). Furthermore, it is assumed that each user will have the application and have Bluetooth switched on.

Application Requirements

The application must provide users information of the occupancy of the Windows lab (at any given time)

- *Fundamental feature of the application; must be able to constantly pull data from the database in order to update the application.*

Find the ideal orientation (in terms of placement across the lab) for the beacons

- *This entails placing the beacons in such a manner that monitors occupancy within the labs as opposed to picking up noise from those passing by the labs in order to prevent inaccurate results. This requirement also regards the signal strength of each beacon.*

Disallow duplicates within the system

- *If an individual is sat in such a manner which allows more than one beacon to pick up his/her location, the system should recognize that individual as the same person and count him/her as only one person.*

Find the ideal refresh time in order to determine whether an individual is staying in the lab or not

- *This is in regards to many individuals entering the labs for the sole purpose of printing documents, etc. Thus, an ideal refresh time in terms of sending data to the database is essential to determine the true occupancy of the labs at that time. Can also be used as a solution to counter individuals who are simply passing by the labs.*

Find a way to retrieve data from the database consistently.

- *This is due to the fact that the occupancy of the labs are constantly changing as an individual enters and exits the labs. The use of sockets are a potential solution, but needs to be researched in more detail.*

Determine ideal structure for database

- *Entails the right attributes and types suitable for the data being sent and retrieved to and from the database.*

Create PHP script

- *Simple PHP script used to interact with the database sending and, creating and returning JSON objects for storage and retrieval.*

Desirable

Display visual statistics regarding the peak times of the labs

- *This is based on historical data of occupancy of the labs on each day of the week.*

Display general occupancy of the labs graphically (map individuals to a particular location of the lab)

- *Based on how each individual should be connected to only one beacon at a specific time.*

Ethical Considerations

Given that this project does not require personal information, there is no need for an ethical review to be conducted with respect to the Ethical guidelines set out by Cardiff University (Spasic, 2015). However, if in the future, personal data is required, the ethics approval will be requested.

Work Plan

The project will undergo weekly additions to it with respect to both research and functionality. The progress of this project will be discussed weekly with the project supervisor, and each weekly sprint of the project in this plan will take into account 30 - 40 hours spent on the project. The development of the project will be done in an extensible manner so as to allow future modification and additions to the application along with attempting to meet best coding practices with respect to comments and documentation. Notes and parts of the final report will also be compiled on a weekly basis.

Week 0: Time prior to week 1

- Research on basic functionality of Estimote beacons
- Ensure skills in Android are up to the standards required for developing the project application
- Establish requirements of the application

Week 1: 23/01/2017 – 29/01/2017

- Research into placement of beacons in the Windows Labs*
- Research into refresh times for beacons*
- Research into beacons' range for monitoring*
- Finalise functionality of the application
- Work on initial plan

Week 2: 30/01/2017 – 05/02/2017

- Submit initial plan: 30/01/2017
- Meeting with supervisor: 30/01/2017

- Determine ideal architecture for database of the system – this regards the ideal attributes and types for the data being sent and retrieved to and from the database
- Design how each component in the system will interact with the other components (E.g. application sending data to the database, etc.)
- Design each screen in the application and figure out the information on each screen

Week 3: 06/02/2017 – 12/02/2017

- Meeting with supervisor: 30/01/2017
- Begin implementation of occupancy monitoring system (Android Application)
- Connect to database and work on functions for both sending to (onEnteredRegion and onExitedRegion functions) and retrieving from the database.
- Create simple PHP script to send data to and retrieve data from the MySQL database
- **Milestone: Basic framework for application should be done**

Week 4: 13/02/2017 – 19/02/2017

- Meeting with supervisor: 13/01/2017
- Determine ideal positioning of beacons in labs – this regards to whether it is necessary for the beacons to have overlapping signals to pick up from phones within the labs
- Determine ideal range of beacons – complements the positioning of beacons
- Determine ideal refresh time for beacons – regards avoiding individuals who are temporarily in the labs or individuals who are walking by
- Research and implement the use of sockets (or any other means) in order to constantly pull data from the database.
- **Milestone: Fundamental functionality of the app should be done**

Week 5: 20/02/2017 – 26/02/2017

- Meeting with supervisor: 20/02/2017
- Start implementation of front-end of application
- Start research into incorporating desirable requirements into the application – this includes finding out how to visually display statistics from the database in Java for peak times and occupancy map, etc.
- **Milestone: MVP of a fully functional app should now be complete**

Week 6: 27/02/2017 – 05/03/2017

- Meeting with supervisor: 27/02/2017
- Complete implementation of front-end of application – initially, a basic front-end will be used (via the use of textboxes, etc.) for testing whether the functions created for the application’s back-end work as intended to. A more thorough and interactive front-end will then be focused on in week 5 and 6.
- Continue research on implementation of visual statistics in Java
- Start implementation of “peak times” desirable

Week 7: 06/03/2017 – 12/03/2017

- Meeting with supervisor: 06/03/2017
- Continue implementation of peak times
- Start testing at a larger scale (getting people with phones running Android OS to volunteer to test out application) – allows data for peak times.**

Week 8: 13/03/2017 – 19/03/2017

- Meeting with supervisor: 13/03/2017
- Continue testing the application**
- Complete implementation of peak times
- **Milestone: More established app including peak times**

Week 9: 20/03/2017 – 26/03/2017

- Meeting with supervisor: 20/03/2017
- Retrieve feedback from testing phase
- Implement changes into application
- Research into implementing occupancy-based map

Week 10: 27/03/2017 – 02/04/2017

- Meeting with supervisor: 27/03/2017
- Test changes with application and ensure that changes do not impede any functionality**
- Compile notes of project from previous weeks, and start initial draft of final report
- Try and implement occupancy-based map
- **Milestone: Fully functional application with partial or full desirable features**

Week 11: 03/04/2017 – 09/04/2017

- Meeting with supervisor: 03/04/2017
- Continue final report draft
- Continue implementation of occupancy-based map

Week 12: 01/05/2017 – 07/05/2017***

- Complete final report
- Project submission: 05/05/2017
- **Milestone: Completed project**

Notes:

* Research in this case refers to searching the documentation for functions provided, etc. The confirmation of the use of these functions would be implemented and tested. Once the functions have been tested, they would later be incorporated into the required context within the application.

** As mentioned, each new functionality will be tested with my personal Android device, and it will be tested in a manner keeping the orientation of beacons in mind along with each function sending and retrieving data to and from the database. Furthermore, test data will also be used along each iteration with respect to functionality, etc. However, the phases marked within the work plan will be a more extensive testing phase where many individuals with Android phones will receive the application (given that the application is necessary to connect to the beacons). The interaction between multiple individuals and the database will be monitored and if changes are required, they will be made throughout the duration of this testing phase. The changes will then further be tested. If necessary, a questionnaire will also be created to receive feedback from each individual that has tested the application.

*** Prior to week 12, there are 3 weeks allocated for the Easter recess. This time will be used to either implement any missing functionality or further improve the already implemented functionality. Furthermore, this time will also be used to develop a more thorough draft of the report geared towards the final draft of the report.

Deliverables

The deliverables of this project will be an Android application consisting of the functionality mentioned in the “Aims” above along with any supplemental code such as the PHP script. Furthermore, a detailed final report based on the application will also be submitted by May 5th, 2017 – the set deadline.