Project Outline

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Contents

1 Executive Summary

This project is about how mobile devices could be used to help generate data to enhance different environments. This involves tracking different devices within a certain environment and recording select information. This would be done through wifi tracking and pinging the mobile devices to gather information such as the mac address and Received Signal Strength Indicator (RSSI)[1]. The title for this project is;

"Investigating the use of individuals mobile devices as a mechanism to enhance locational information within a geographic setting"

The goal for this project is to develop wifi tracking techniques and research different possibilities that the system could be used in to improve the environment within appropriate legal and ethical boundaries. Scenarios that this project could be used for;

- Visit Records - the wifi tracking could be used to count how many people enter and leave a building. Further information that could be gathered is how long they are inside the building. This data would help give a more accurate results of visits and whether the building is being used as a short cut instead of what it is intended for.
- Path Tracking - using Tomographic Reconstruction, through multiple device would allow the network to track the location of each of the devices within the wifi area. Therefore allowing the exhibit or shop to find out the most used locations within their building and adapt the exhibit or shop according to the data gathered.

2 History

This idea has been around since mobile devices have been a more common part of life. This is due to almost every person in first world countries having at least one mobile device capable of connecting to wifi.

There are multiple projects that have looked into this area. One of these projects was 'Smart Bins' that were found in East London, developed by Renew[2][3]. These devices would track the paths of different mobile devices and record where they went through the mac address. Using this information, select advertising would be presented to a person as they walked pass the Smart Bin. The Smart Bins were on the news as it violated people private lives from the data that was being collected. This is because the Smart Bins were recorded to only collect that that was "'extremely limited, encrypted, aggregated and anonymised data"[2]. However, in reality the data was being sold to perform an advertising front for businesses that would provide money for the advantages the tracking data would give. This data was therefore gathered to track the devices and where they went to provide appropriate advertising. Therefore, the Smart Bins were shut down as a project and removed for violating these rules.

Another project that has looked into this area is Position Tracking Using wifi by Nathan Conrad[4]. This project used the Arduino Uno and wifi Shield to create a tracking system for the employees inside the building. The goal of this project is to create a safety mechanism that would provide position information in an emergency situation to give faster support. The position tracking was used to give more accurate information on the persons location than GPS, as this device would give the location inside the building on a map. When a emergency button is pressed on the employees device, a signal is transmitted to the central server and a map is provided to give a path between the two devices. To provide fast support in case of an emergency. This project had a success in creating a device that would create a map of the emergency position inside the building, although problems were discovered throughout testing that showed that the device struggled with communication when there were too many wifi networks within the building.

3 Use Cases

This chapter discusses different scenarios in which this research could be used to help improve different environments. Each environment will require some different programs depending on what is being recorded and the questions that are being answered for that specific piece of research. These use cases are;

1. Small Event Visit Counter - This scenario is about counting the amount of people who enter a event and for how long. This will provide the managers of that event with visualisations of the total amount of visits people get, peak visit times and how long do people stay at the event for. This data will be turned into a visualization and then to the product owner.

   This device should be built into a box that will be put into box that will collect and store the data. There should be a initialization stage to set the range of the event. This case is for a small event inside a hall or field.

2. Medium Event Visit Counter - Similar to use case 1, the data recorded will be the amount of time. Then give the total amount of visits and other visualisations. This case study will require a network of recording devices due to the size of the building having multiple floors or a larger area.

   The network of devices should upload the data collected to a database or will need to be collected at the end of the day.

3. Path Tracking Application - This use case will record the path that people take around a shop or museum. This will then be used to inform the product owners of the most used routes people use and from this data the manager can reorganize the shop to best suite what people prefer or most likely need.

   This will take a look into using tomographic reconstruction[5] and RSSI[1] to track where the person goes throughout the building. Meaning multiple ESP boards will be required to triangulate the location of the person.

4. Rerouting Application - This use case records data over a set period of time. Using the data collect the application should be able to reroute people a peak hour times, to reduce the flow of traffic.

   The case will require the device to collect training data of the tracking area. Then to use a machine learning classifier to predict when the area is going to have high traffic, the application will reroute users onto another route to avoid this traffic.

These use case give examples in which this research could be used to help support different environments. While developing the device the priority for development will go from one to four in the use case, which each stage increasing the difficulty. Throughout the project time period use cases one and two are expected to be completed, however, three and four have the potential of being finished.

4 Objectives

Once the project has been developed to a basic level, where the device can count the footfall within the wifi range of the device. There are multiple hypothetical directions the project could take into researching the possibilities of wifi tracking advantages. This chapter will discuss the expected work, potential work and for future work after the project time period has been completed in late September 2019. These can be seen in the Table 1.

Objective ID	Objective description	Priority Level
	Expected Work	
1	Ensure the project follows the ethical and legal boundaries.	High
2	Create device to record foot fall count.	High
3	Data collected will be able to be stored on the ESP board.	High
4	Design and create a database to store gathered data. Make sure that the database is secure.	High
5	Data collect on ESP board will be able transmitted to the main database.	High
6	Record the amount of time a person/device is within the network range.	High
7	Create a visit counter - records who visits the building and the amount of time they are inside the building.	High
8	Test devices in a appropriate environment over a set period of time.	High
9	Be able to recognize if a person has more than one device.	Medium
10	Can set a range for the device to detect inside. To avoid traffic outside a event. Collaborating the device.	Medium
11	Create a network of devices to record footfall.	Medium
12	Create secure connections between devices in the network.	Medium
13	Use data mining techniques to collect the required data from the database.	Medium
14	Produce visualisations to report to product owner. E.g. Shows total counts visits and peak visit times.	
	Potential Work	
15	Display the most used paths to least used. Additionally to include peak hours of travel.	Medium
16	Use tomography reconstruction[5] to calculate the location of the device in the building. Then produce a graph for the most and least used locations.	Low
17	Use statistics or machine learning techniques to reroute people to avoid traffic in buildings.	Low
	Future Work	
18	Create a route planner application, to guide the user around the building.	Low
19	Create sign in application for meetings or university lectures. Record attendance through wifi tracking, used to counter scan and leave scenarios.	Low
20	Develop devices to work with vehicles.	Low
21	Create a application for emergencies. Give specified location inside a building. Test if wifi tracking is more accurate than GPS.	Low
22	Security support - Be able to tell what people are inside the building at a given time.	Low

Table 1: Objectives

5 Execution Plan

The project time span will be between July to late September. This chapter will discuss how the development of the project will progress throughout the time frame. Figure 1 shows a Gantt Chart and a Kanban board, displaying the initial deadlines for the objectives shown in table 1. The Kanban board will provide a more adaptable plan for week by week periods and their tasks. Then the Gantt chart will provide an overall view of the project time line. The sites used to help create these project are Trello[6] and GanttProject[**?**].

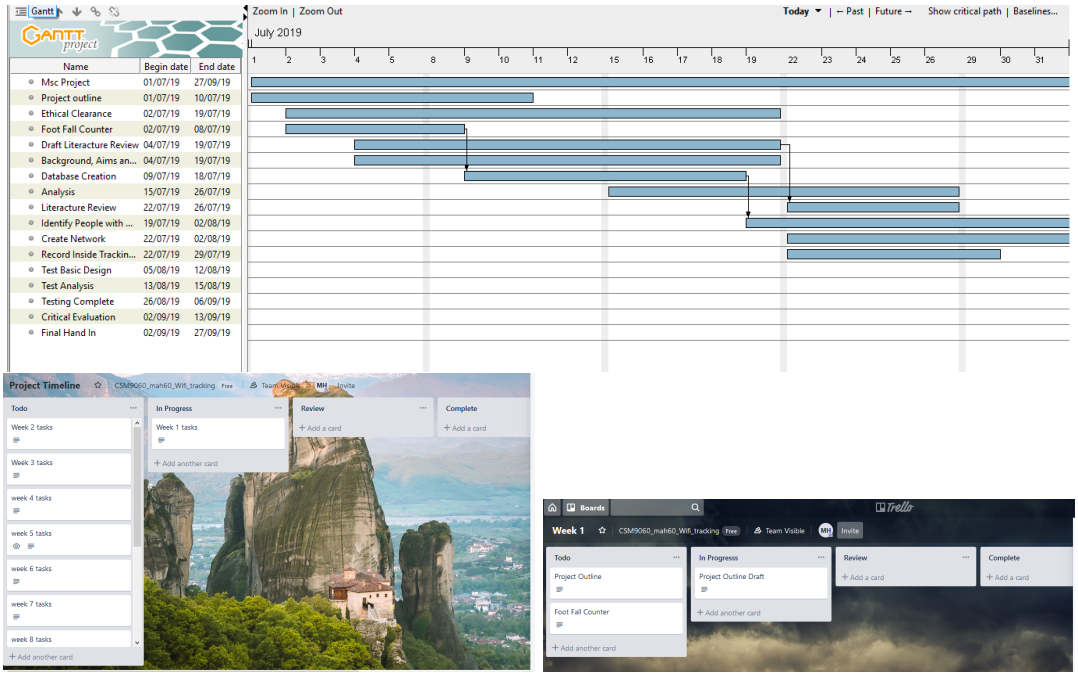

Figure 1: Gantt Chart and Kanban Board

As the project progresses throughout the time frame, certain standards will need to be kept within the code and documentation. This will be done through version control, which will record what is being modified within the file. .

Throughout the project there will be a lot of work being produced, therefore if the data is lost it will severely delay the project. Therefore, backups will be made, this will be done through Github[8] and a portable hard drive to reduce the possibility of delay in the project due to loss of data.

The overall project plan will have the initial research complete and planned out, then as time progresses the given tasks will be complete. During this progression separate research will be done for each of the given tasks, then recorded to help support unforeseen events. The overall plan will follow a Scrum format[9], where at the start of each week there will be a meeting to review what has been completed and to what state. Then the overall plan will be modified accordingly.

The approach that this project will take is to first complete the expected work in Table 1. Then run the program over a set period of test to gather results for the data, this will also test if initial code works. After this data mining techniques will be applied to the results to present the data that was gathered and its key points of interests. Once the basics are complete, further research will be committed to try and build the potential work seen in Table 1. This code will have to be tested and processed appropriately.

6 Version

Version	Description	Date
0.1	Initial Design - fist official write up for the project outline chapters Executive Summary and History and began objectives.	29/06/2019
0.2	Completed Draft - finished objectives chapter and Execution chapter. Added references and proofread	30/06/2019
0.3	Use cases were added to the document and modifications were made to the objectives. This includes swapping objective 9 and 12. Objectives were added after review of use cases.	01/07/2019

References

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[3] Quartz; Smart Bins Technology; 30/06/2019;
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[4] Western Michigan University; Nathan Conrad; Position Tracking using wifi; 30/06/2019;
https://pdfs.semanticscholar.org/c369/f4ea8cf81b14e445ac45fd4f2fa72d3f8c3f.pdf

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https://www.scrum.org/resources/what-is-scrum