Ping Based Online Digital Marketing Service

COMP 4801 - Project Interim Report (v1)

Project By:
Apoorva Katta (3035123617)

Project Supervised by:
Dr. Chuan Wu

[21 January, 2018]


Abstract

With the rising usage of smartphones on the street, physical display advertisements in public spaces are losing their reachability to the public due to dropping public attention to reality. Moreover, advertisers are investing large sums of money to advertise their products or services in public space. Henceforth, this project aims to develop a combination of web and mobile applications to enable advertisers to digitally market their goods or service on an Online-to-Offline (O2O) service. Moreover, this project also aims to generate revenue by requiring advertisers to pay for the designed service. This report aims to provide justifications on the idea as well as methodologies to implement such idea. Hence, this report uses factual information of real world situations as well as related works to justify the idea. Adding on, this report also illustrates on the system architecture used to implement the idea. By the end of this project, 2 public interfaces will be released for public use.

1. A web interface for advertisers to publish their adverts digitally.

2. A mobile interface for both Apple and Android smartphone end-users to access adverts digitally.

This report addresses the initial stages of development of the system architecture.
Acknowledgement

I would like to thank Dr. Chuan Wu for helping me to conceptualize my idea. Also, I would like to thank Mr. Keith Chau for guiding me in writing this report.
## Contents

1 – Introduction .......................................................................................................................... 5
   1.1 – General background with respect to the real world .................................................. 5
   1.2 – Problem statement and motivation ........................................................................ 6
   1.3 – Objective and scope ................................................................................................. 8
   1.4 – Deliverables .................................................................................................................. 12
   1.5 – Rough outline of the remaining parts of the report .................................................. 12

2 – Related works .................................................................................................................... 13
   2.1 – Similar applications .................................................................................................. 13
   2.2 – Differentiating from similar applications ................................................................. 14

3 – Implementation approach ................................................................................................ 15
   3.1 – Brief overview ......................................................................................................... 15
   3.2 – System architecture ................................................................................................. 15
   3.3 – Phases of development ........................................................................................... 17

4 – Completed phases of development .................................................................................. 18
   4.1 – Phase 1 – Research and project specification ........................................................... 18
   4.2 – Phase 2 – Database implementation ........................................................................ 18
   4.3 – Phase 3 – Backend server implementation ............................................................... 19

5 – Future phases of development ......................................................................................... 20
   5.1 – Phase 4 – Client web application implementation .................................................... 20
   5.2 – Phase 5 – Client mobile application implementation ................................................ 20
   5.3 – Phase 6 – Testing and deployment .......................................................................... 20

6 – Discussion .......................................................................................................................... 21
   6.1 – Risks, Challenges and Mitigation ............................................................................. 21
   6.2 – Limitations ................................................................................................................ 21

7 – Project schedule ............................................................................................................... 22
   7.1 – Project development schedule ................................................................................ 22
   7.2 – Project management deliverables schedule ............................................................. 23

8 – Conclusion ........................................................................................................................ 24

9 – References .......................................................................................................................... 25
List of Figures

Figure 1 – Average daily usage of smartphones (US) ................................................................. 5
Figure 2 – Specialized walking lanes for smartphone users in China ........................................ 5
Figure 3 – Advertisements in Time Square, New York, US ....................................................... 7
Figure 4 – 2D posters advertisements at Causeway Bay MTR station, HK ......................... 7
Figure 5 – Illustration on the 2d advertising pings ...................................................................... 9
Figure 6 – Apple Wallet Pass on Apple Wallet ........................................................................... 9
Figure 7 – Android Pay Card on Android Pay ............................................................................. 9
Figure 8 – Illustration on no mobile notification when smartphone is not in ping range ....... 10
Figure 9 – Illustration on mobile notification when smartphone is in ping range ................. 11
Figure 10 – Technical Illustration on the architecture of the system ......................................... 16

List of Tables

Table 1 – Project Development Schedule .................................................................................. 22
Table 2 – Project Management Development Schedule ............................................................ 23
1 – Introduction

This section commences with factual information on the general background of the project idea, followed by problem statement, motivation, specifications and deliverables of the project. In addition, this section also outlines the remaining sections of the report.

1.1 – General background with respect to the real world

Over the last decade, there has been a significant rise in the usage of mobile phones [1]. Referring to a 2016 study conducted in the US by an analytics firm Flurry shown in Figure 1, on average, US citizens are spending more 5 hours on their smartphones on a daily basis in the year of 2016 [2]. Importantly, 5 hours per day accounts for more than 20 percent and 100 percent rise in daily usage compared to years of 2013 and 2015 [2]. Moreover, in correlation to the increasing usage on smartphones, pedestrian deaths due to mental and visual distraction have increased by 9 percent [3]. Furthermore, the increasing number of such nature of accidents has resulted in the Honolulu government to impose a USD 50 fine against pedestrians walking with their eyes glued to their smartphone screens [3]. Similarly, as shown in Figure 2, a district governing body in China introduced a pedestrian walkway for mobile phone users [4]. Also, since 2013, Hong Kong’s MTR have introduced anti-phone announcements to encourage public to not keep their eyes only on their smartphones [4]. These arguments provide justification on the idea that the general public is using their smartphones on the streets while commuting.

![Figure 1 – Average daily usage of smartphones (US)](image1)

![Figure 2 – Specialized walking lanes for smartphone users in China](image2)
1.2 – Problem statement and motivation

Extending from section 1.1, it is possibly safe to assume that the general public is losing its focus from reality while on the streets to their smartphones. Moreover, as shown in Figure 3 on the following page, a significant number of businesses physically advertise their goods or services. However, it is important to understand that firms advertising their products or services in public spaces are possibly losing their effectiveness as a result of decreasing advertisement reachability. In simpler terms, public advertisements are not able to gain people’s attention on the street as the public is glued to their smartphone screens while walking on the streets. Moreover, firms are spending a large sum of money for advertising in public spaces. For example, as shown in Figure 4 on the following page, a travel agency advertises potential travel locations in the world on a selection of continuous 12 physical 2-dimensional posters advertisement in Hong Kong’s MTR Causeway Bay station. Moreover, the firm has to pay HKD 35,700 per week for a minimum of 3 weeks to advertise their service to passing commuters [5]. Hence, with potentially decreasing effectiveness of traditional public advertisements, it is safe to assume that the travel firm is unable to gain significant returns from their advertisement expenditure. Therefore, this project aims to generate revenue by helping firms to effectively advertise their products or services to the general public in public spaces through its paid Online-to-Offline (O2O) service.
Figure 3 – Advertisements in Time Square, New York, US

Figure 4 – 2D posters advertisements at Causeway Bay MTR station, HK
1.3 – Objective and scope

The objective of this project is to take advantage of people’s usage habits of their smartphones in public spaces by enabling marketers to digitally market their product on an Online-To-Offline (O2O) service using Global Positioning System (GPS) and Mobile Wallet Technologies. In simple terms, Online-To-Offline (O2O) service is used to classify services that transfer online user traffic to offline user traffic, i.e. directing online users to physical shops. This will be achieved by developing and releasing two public interfaces, a web interface and a mobile interface. Note that the project will be developed for worldwide use.

The web interface will enable marketers to create virtual pings that hold their advertisement data on a 2-dimensional map. As represented by the red location icon and the green circle in the purple circle in Figure 5 on the following page, the pings will be a circular area with a certain radius that will be centered at the user defined pair of longitude and latitude values. Moreover, the web interface will allow marketers to create different types of pings to suit their desired purposes; such as Text Ping, Coupon Ping, Membership Card Ping and Ticket Ping. The functions of these different types of pings are listed as below;

1. A Text Ping will hold text based promotions.
2. A Coupon Ping will hold one-time-use offer promotions.
3. A Membership Card Ping will aid loyalty programme registration of new nearby customers.
4. A Ticket Ping will aid in distributing certain transit or event tickets.

For Coupon Ping, Membership Card Ping and Ticket Ping, the marketer will need to design a mobile wallet pass/card so that mobile interface users can store their coupons, membership cards and tickets on their mobile wallet. The web interface provides such service for Apple Wallet passes (refer to Figure 6) and Android Pay cards (refer to Figure 7).
Figure 5 – Illustration on the 2d advertising pings in the purple circle

Figure 6 – Apple Wallet Pass on Apple Wallet

Figure 7 – Android Pay Card on Android Pay
The mobile interface will periodically retrieve and notify end-users about nearby digital advertising pings based on their GPS location. To illustrate the idea, as shown in Figure 8, there is no notification displayed on the smartphone of a user when the smartphone is not in the range of the advertising ping. Furthermore, as shown in Figure 9, a notification is displayed on the smartphone when the smartphone is within the range of the advertising ping. Moreover, the mobile interface will also allow manual retrieving of nearby digital advertising pings. For Coupon Ping, Membership Card Ping and Ticket Ping, the mobile interface will aid end-user in registering for a corresponding Apple Wallet pass or Android Pay card. Also, a service for in-app purchase of certain pass/card will be provided through Apple Wallet or Android Pay payment options.

![Figure 8 – Illustration on no mobile notification when smartphone is not in ping range](image-url)
Figure 9 – Illustration on mobile notification when smartphone is in ping range
1.4 – Deliverables

To achieve the objective of this project, the following deliverables will be delivered by the end of this project.

→ One web application interface for marketers to enable them to create, retrieve, update and delete advertising pings and design mobile wallet passes and/or cards
→ Two mobile applications interface for end-users to enable them to retrieve advertising pings and register for mobile wallet passes or cards
→ One final report to justify and describe the new service
→ One final presentation to pitch the new service to the public

1.5 – Rough outline of the remaining parts of the report

The remainder of this report will proceed as follows. Firstly, there will be some analysis on some similar works that are currently being used or have been used in the past. Secondly, there will be some elaboration on the methodologies that will be used to complete this project. Then, the current status of the project will be addressed as well as some discussion on difficulties encountered and limitations. Lastly, there will be a conclusion to summarize the main focus of this report.
2 – Related works

This section includes research on similar application that are already in the market as well as comparison of those application to the one suggested by this report.

2.1 – Similar applications

Note that, only functionality based downsides are mentioned in the analysis of these applications to different these applications from the proposed application.

1) Van Leuween Mobile App [6] – Van Leuween is a New York, USA based ice cream vendor that started a campaign in 2014 that notified nearby app users about $5 ice cream campaign to attract them to visit their shop. Their app incorporated PayPal’s mobile payment service for digital payments. Such initiative was well accepted in public as the vendor was able to make 5% of its sales digitally. However, the downside to this application is that the app only allowed marketing of a specific product by a specific firm.

2) Nearbuy.com Mobile App [7] – Nearbuy.com is a New Delhi, India based digital marketing firm that allows its users to manually search for nearby offers based on region rather than dynamic location. However, the downside to this application is that its users have to manually search for nearby offers rather than automatically getting notification on them as it is not using any GPS technology. Also, the app is limited to within India use only.

3) Thinknear Marketing Solutions [8] – Thinknear is a California, USA based company that designs and develops personalized mobile apps for various companies that enable these firms to advertise to nearby people based on their locations. However, the downside to this is that, one application will only work for one firm.

4) HoKoBuy Mobile App [9] – HoKoBuy is a Hong Kong based company that allows marketers to advertise their products on its web and mobile interface. However, similar to Nearbuy.com, HoKoBuy does not use GPS technology to advertise its content to its mobile application users.

5) Eatigo Mobile App [10] – Eatigo is a Hong Kong based mobile application that advertises discounts at various restaurants based on reservation timings. However, similar to Nearbuy.com and HoKoBuy, this mobile application also does not advertise based on real-time location of its user.
2.2 – Differentiating from similar applications

Based on a couple of weeks of research on location based marketing applications, it was found that there were not any popular location based marketing application in the current market that used both GPS and Mobile Wallet technologies and allow multiple marketers to advertise their product on one interface. Henceforth, this project will address all the downsides mentioned in section 2.1, to differentiate from these applications as well as succeed over them.
3 – Implementation approach

This section includes description of the designed system architecture as well as the phases of development of the project.

3.1 – Brief overview

This project will be developed incrementally. Moreover, the development of this project is divided into six ordered major phases; the six ordered major phases are research and project specification, database implementation, backend server implementation, client website application implementation, client mobile application implementation, testing and deployment. Note that, each ordered major phase relies its preceding ordered major phases to be completed.

3.2 – System architecture

This project is a combination of three key web development processes; front-end, back-end and database. In terms of software engineering, a combination of these 3 web development process is known as full-stack project. Moreover, MEAN stack and Python Django are two commonly used frameworks to develop full stack projects. The noticeable difference between the two frameworks is that MEAN stack uses JavaScript and Python Django uses Python. Moreover, as the developer of this project is vastly familiar with the MEAN stack framework over the Python Django framework, this project will be developed using the MEAN stack. MEAN stack framework consists of MongoDB, ExpressJS, AngularJS and NodeJS for database, webserver, frontend and backend respectively.

Moreover, as AngularJS can only be used to make web interfaces, Apple and Android mobile applications will be made outside of this framework. The Apple and Android applications will be developed using XCode and Android Studio respectively. Furthermore, to isolate the database from the main application, CouchDB will be used instead of MongoDB. The reason behind the isolation of the database is to allow easy deployment of the server without the requirement of restarting the database service.

Moving on, both the backend and database server will be developed as Representational State Transfer Application Programmable Interface, in short REST API. To better understand REST API, consider it as a waiter, the server as the kitchen and the web-app client as a customer. Commonly, a customer requests an order to the waiter. Then the
waiter carries the request to the kitchen. After that, the kitchen responds with the order to
the waiter. Finally the waiter carries the order to the customer. Putting the analogy into
context, web-app and mobile clients will create HTTP request and send it to the server
REST API. The REST API will execute the request and respond to the web-app and mobile
clients accordingly.

Referring to Figure 8, all client application will have to use HTTP and JSON body for
request-response query cycle to communicate with the server REST API on the Amazon
Web Service EC2 Virtual Machine IP address. IP addresses are used to identify the target
computer on the internet. Moreover, for data security purposed, the database REST API
will only be allowed access from the IP address of the designated Amazon Web Service
EC2 Virtual Machine. This will block hackers from accessing the database remotely and
manipulating it. In contrary, the server REST API will be allowed access from any IP
address given valid user authentication details, i.e. API access key and secret. Note that,
API access key and secret will be provided to only the client web-app users. Also, note that
to enable easy scalability, the webserver will be hosted on Amazon Web Services’ EC2
virtual machine. A virtual machine is basically a virtual computer located at a remote
location.

Figure 10 – Technical Illustration on the architecture of the system
3.3 – Phases of development

1) Research and project specification – This phase includes in-depth research of the project and finalizing project specification.

2) Database implementation – This phase includes designing and implementing CouchDB database.

3) Backend server implementation – This phase includes development of backend core logic functionality using NodeJS and ExpressJS. Adding on, it also includes CouchDB database integration, Apple Wallet integration for Apple Wallet Passes, Android Pay integration for Android Pay Cards, Slack integration for error reporting, and other trivial tasks. Slack is a chatting web-app that has an open-end endpoint for sending message to a particular internal chatroom.

4) Client website application implementation – This phase includes development of a frontend website application using AngularJS, HTML5 and CSS. Apart from the functionality stated in section 1.3 for the web interface, the web application will include visual error reporting and other trivial add-ons.

5) Client mobile application implementation – This phase includes development of two mobile applications for Apple and Android devices. Both the mobile application will have the same functionality as stated in section 1.3 for the mobile interface. The Apple and Android applications will be developed using XCode and Android Studio respectively.

6) Testing and deployment – This phase will include user acceptance test (UAT) to verify whether the application is market ready or not. If needed, changes will be made to implementation of previous phases based on user feedback. After the completion of the testing process, the project will be deployed to a live environment for the public to start using. Note that, a domain name for the web application will be purchased after the whole application is completed.
4 – Completed phases of development

This section includes description of the three completed phases of development.

4.1 – Phase 1 – Research and project specification

In this phase, two major sub-tasks were completed. The first of the two major sub-tasks to be completed was market research. It is important to evaluate the current market to determine whether the market will accept or deny the suggested application. Therefore, after the research was completed, it has been determined that there are multiple marketing and advertising based applications that the public has accepted and started using. One of these applications is HoKoBuy. In this application, merchants can post their goods and services on the system for the public to view and purchase. Moreover, more than 75,000 people have downloaded the application system’s mobile application for use over the last six months. Henceforth, the market research suggested that the application suggested in this report had good prospects to survive in the market.

The second of the two major sub-tasks that was completed was finalizing the project specification. In this sub-task, with respect to the completed market research, the objective and scope of the project was finalized. In addition to that, the application’s initial system architecture was designed. Section 3.2 of this report illustrates and describes the designed system architecture.

This task was completed on schedule without any difficulties or limitations.

4.2 – Phase 2 – Database implementation

Similar to phase 1, this phase was also divided into two major sub-tasks. The first of the two major sub-tasks that was completed is Amazon Web Services (AWS) Elastic Compute Cloud (EC2) virtual machine setup. AWS EC2 has been used to create a remote virtual computer that can be accessed over the internet and perform computational tasks. Moreover, as Linux OS generally yields the best server response time, the virtual machine runs on the Linux OS instead of Windows Server OS.

The other of the two major sub-tasks was to setup database server on the AWS EC2 virtual machine. As decided in phase 1 system architecture design, CouchDB was the
designated database server for this application. Henceforth, CouchDB v2.1 was installed on the server.

Similar to phase 1, this phase was also completed on schedule.

4.3 – Phase 3 – Backend server implementation

The latest completed phase is phase 3 and in this phase I completed the backend server implementation. As stated in section 3.2 system architecture, I used ExpressJS 4.14.0 and NodeJS 6.10.0 to setup my backend server. A backend server is used to provide functionality to frontend, i.e. web or mobile, interfaces. One key decision that I had to make in this phase was to whether use a HTTP server or a HTTPS + SSL server. In the end, it was decided to use the more secured option of HTTPS + SSL server since the application requires lots of user data transfer and storage despite it being the more expensive option.

After configuring the backend server to meet the applications needs, codes that enable user authentication were implemented. To authenticate a user, JSON Web Tokens (JWT) were used. JWTs are basically named tickets that ensure that access to the backend server is being authenticated by a verified user. After the authentication layer was added, I added codes to enable create, retrieve, update and delete functionalities for user, pings and mobile wallet data. These functionalities will be used by the web and mobile interfaces to fulfill the objective of the application. Moreover, since the backend server will be allowed to interact with user defined scripts, i.e. not the designated web and mobile application, error handling was also added.

Similar to phase 1 and 2, this phase was also completed on schedule.
5 – Future phases of development

This section will elaborate on future phases of development.

5.1 – Phase 4 – Client web application implementation

This phase will be divided into three sub-tasks; user authentication, user interface and web security. Firstly, in the user authentication sub-task, user login and registration interface will be designed. Secondly, in the user interface sub-task, interface to enable create, retrieve, update and delete functionalities will be designed. Lastly, in the web-security sub-task, steps to setup anti cross-site scripting (XSS) and anti SQL injection will be implemented. Cross-site scripting is a security issue in which a perpetrator injects malicious codes on the server. SQL injection is a security issue in which a perpetrator is able to unfairly access the database.

5.2 – Phase 5 – Client mobile application implementation

Similar to phase 4, this phase will also be divided into three sub-tasks; GPS integration, offers user interface and mobile wallet integration. Firstly, in the GPS integration sub-task, the mobile application will be designed to use the smartphones GPS feature to get the location of the phone and retrieve nearby offers from the backend server. Secondly, in the offers user interface sub-task, a user interface will be designed to display nearby offers to the user. Lastly, in the mobile wallet integration sub-task, the mobile application will be designed to allow users to register for apple wallet passes and android pay cards on its interface.

5.3 – Phase 6 – Testing and deployment

This will be the last phase of development and it will be divided into two major sub-tasks; user testing and deployment. For user testing sub-task, multiple user acceptance testing (UAT) tests will be conducted to fine tune the entire application. The most important to be tested section of the UAT tests will be user interfaces as the users will judge the entire application based on the user interfaces. For the deployment sub-task, a domain name, e.g. myApplication.com, will registered for the application to allow the public to easily access the application globally. Also, as decided in phase 3, a SSL certificate will be registered for the application for security reasons.
6 – Discussion

This section provides a discussion on the risks, challenges and mitigation, and limitations.

6.1 – Risks, Challenges and Mitigation

With such a massive project, risks and challenges are inevitable. Major risks include not being able to gain access to certain services, i.e. Apple Wallet Developer account or Android Pay Developer account, as well as limited experience in mobile application development. Moreover, the major challenge for this project is user interface (UI) and user experience (UX). Success of both web and mobile interfaces heavily depend on these two elements. Henceforth, with the limited time given, it is extremely challenging to achieve satisfiable level of quality. Furthermore, to mitigate such risks and challenges, it is important to consult project supervisor and qualified personal for assistance. Also, it is important to spend significant time researching for best used practices to mitigate common risks.

6.2 – Limitations

There are two major limitations of this project. The first of the two major limitations is related to the Global Positioning System (GPS) technology. GPS technology only works on 2-dimensional maps, i.e. longitude and latitude. Hence, it needs to be understood that there is no possible approach to differentiate between pings for different altitude. Note that, this limitation cannot be resolved as there are no available mobile technologies that will resolve this limitation. The second of the two major limitations is related to end-user preferences. The mobile application requires end-users to turn on mobile data and location features all the time. However, there is no way to force or guarantee that end-user will accept that and turn on these features all the time due to monetary or mobile battery concerns. Note that, since turning on mobile data and location features is completely up to the user, this limitation cannot be resolved. Henceforth, these are the two major limitations of this project.
7 – Project schedule

This section will provide with information on the schedule of the project.

7.1 – Project development schedule

Table 1, shows the list of development phases ordered periodically. Also the current status of each phase of development is shown in the table.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Milestones</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Sep 2017 – 01 Oct 2017</td>
<td>Phase 1 – Research and Project specification</td>
<td>Completed</td>
</tr>
<tr>
<td>02 Oct 2017 – 10 Oct 2017</td>
<td>Phase 2 – Database implementation</td>
<td>Completed</td>
</tr>
<tr>
<td>21 Nov 2017 – 10 Feb 2018</td>
<td>Phase 4 – Client website application implementation</td>
<td>In Progress</td>
</tr>
<tr>
<td>11 Feb 2018 – 30 Mar 2018</td>
<td>Phase 5 – Client mobile application implementation</td>
<td>Scheduled</td>
</tr>
<tr>
<td>01 Apr 2018 – 10 Apr 2018</td>
<td>Phase 6 – Testing and deployment</td>
<td>Scheduled</td>
</tr>
</tbody>
</table>

Table 1 – Project Development Schedule
7.2 – Project management deliverables schedule

Table 2, shows the list of project management deliverables sets ordered periodically. Also the current status of each of the set is shown in the table.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Milestones</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 Sept 2017 – 01 Oct 2017</td>
<td>Project Management Deliverables Set 1 – Project proposal and Project website</td>
<td>Completed</td>
</tr>
<tr>
<td>25 Dec 2017 – 07 Jan 2018</td>
<td>Project Management Deliverables Set 2 – First project presentation</td>
<td>Scheduled</td>
</tr>
<tr>
<td>08 Jan 2018 – 21 Jan 2018</td>
<td>Project Management Deliverables Set 3 – Project interim report and preliminary implementation</td>
<td>Scheduled</td>
</tr>
<tr>
<td>05 Apr 2018 – 15 Apr 2018</td>
<td>Project Management Deliverables Set 4 – Project final report and finished implementation</td>
<td>Scheduled</td>
</tr>
<tr>
<td>10 Apr 2018 – 15 Apr 2018</td>
<td>Project Management Deliverables Set 5 – Final project presentation</td>
<td>Scheduled</td>
</tr>
<tr>
<td>15 Apr 2018 – 01 May 2018</td>
<td>Project Management Deliverables Set 6 – Project exhibition deliverables – TBC</td>
<td>Scheduled</td>
</tr>
<tr>
<td>TBC</td>
<td>Project Management Deliverables Set 7 – Project competition deliverables – TBC</td>
<td>Scheduled</td>
</tr>
</tbody>
</table>

Table 2 – Project Management Development Schedule
In conclusion, to exploit the increasing usage of smartphones in public spaces, this project aims to deliver a web-application and two mobile applications. Moreover, this application targets to generate revenue by applying some monetary rules into these applications. The web-application will target advertisers by enabling them to create virtual location based advertisements. The mobile applications aims to target the general public by showing them advertisements based on their locations. Furthermore, Global Positioning System (GPS) and mobile wallet technologies will be used to implement the designated interfaces. However, the downside of using these technologies is that GPS technology only works on 2-dimensional planes and not all users have mobile data and location service running on their phone throughout the day.

The entire project has been divided into six ordered major phases; research and project specification, database implementation, backend server implementation, client website application implementation, client mobile application implementation, and testing and deployment. The first three phases; research and project specification, database implementation, backend server implementation have been completed on schedule without any difficulties. In the coming future, the remaining three phases; client website application implementation, client mobile application implementation, and testing and deployment will be completed.

In future, there is a possibility of increasing the scope of the implementation based on user feedback and suggestions. However, at this point in time, the current scope is fixed.
9 – References


