Individual Project
Interim Report
The London Loop

Emma Hulme
Under the supervision of Professor Michael Huth

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Contents

1 Introduction

1.1 Motivation

People are getting more and more reliant on technology these days. We look up our journey online, use mobile applications to find where we are, looking at the little blue arrow on the screen to see which direction we need to walk in. If we drive, we have SatNav in our cars so that we know what the fastest route is, which turn to take and which lane to be in.

In 2013, it was found that 72% of those aged 16 to 64 in the UK own a smartphone [1], and between the years 2012 and 2014, we have seen a steady increase in smartphone and tablet take-up, most notably between the ages of 35 and 54, which had an overall increase of 28% in smartphone take-up and a 38% increase in tablet take-up.

Before the digital age, online maps and mobile-internet connectivity, the traditional navigation aids consists of fold-up maps and the classic "London A to Z", a bound street atlas of London often recognised by the familiar appearance seen in Figure 1. However, the former suffers from the lack of fine granularity required for navigating off the main roads of London, and the latter suffers from the user having to traverse through several pages to connect the boundaries of each page. Today, at a time where most phone contracts and pay-as-you-go bundles include data, and particularly in London, where losing a mobile signal is rarely an issue, there is little need for these traditional aids. Instead, we just open Google Maps, TFL(Transport for London), or even ask Siri, Okay Google, Cortana to show us the way.

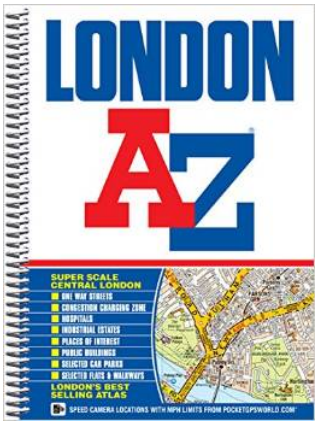

Figure 1: London A to Z Book

Despite London reaching a population of 8.6 million [3], 47% of the 1572 square kilometre city is green space [4], giving Londoners little excuse not to go out and exercise, and yet research shows that Londoners spend less time walking than anywhere else in the UK [5]. With 64% of UK adults being classed as obese or overweight [6], more effort needs to be done to help Londoners fully utilize all the space there is around and become more active.

The London Outer Orbital Path, also known as the "London LOOP" is a 150-mile walk along the edge of Outer London [7]. It is divided into 24 sections in three groups, "blue" for South London, "green" for North-West London, and "yellow" for North-East London. Proposed in 1990, in a meeting between ramblers and the Countryside Commission, the London LOOP opened its first section in 1996, and became fully accessible in 2001. It is a clear example of how much walking space there is in London, taking us through parks, woods and fields. However, we need to look at just how accessible the London LOOP really is.

Currently, the walk is sign-posted with the London LOOP's logo, a flying kestrel, as seen on our cover page. There is also a London LOOP guidebook written by David Sharp [8] which details each section of the walk together with photographic illustrations. There are also GPS co-ordinates of each start and end point available [7] as well as GPS co-ordinates of the whole route [9]. However, unless one went out and bought the book or knew how to download GPS routes onto their smartphone or GPS device. There is no quick way to start the London LOOP. For a nation where 72%[1] of people own a smartphone, then the solution is clear. If we were able to open a smartphone app and find an electronic guide for the London LOOP, perhaps

more of us would not only partake in the walk but also get to see what the city has to offer.

1.2 Objectives

The project specification requires the creation of a mobile application which guides people through the London Outer Orbital Path. This is, however, a quite broad requirement so I compiled a list of my own objectives for my application.

1.2.1 Core Objectives

O1. The application must guide the user through the London LOOP walk.

O2. The application must contain a map with the GPS route of the London LOOP.

O3. The application must be flexible in that it should work on any device regardless of screen size.

O4. The application must be easy to use regardless of technical skill.

O5. The application's interface must be clear without any ambiguity.

1.2.2 Extended Objectives

O6. The application should not require user authentication.

O7. The application should allow users to input places of interest along the walk.

O8. The map should be able to switch to turn-by-turn navigation.

O9. The application should allow users to take a break from a walk section and return to it when they choose.

O10. The application should allow users to take photographs an in-app camera.

O11. The application should be able to connect to social media so that users can share their photos and experiences online.

2 Background

I identified that the first step was to make some core decisions regarding the application so I did some initial background research.

2.1 Technologies

I made a comparison of different mobile operating systems [10] from both a technical and personal point of view, as seen in Table 1

The only OS which ticked every box was Android and so I chose to develop on the Android SDK, and test on my own devices. I will develop my application on Android Studio, using both their emulator and through debugging software. I will have access to 4 different Android mobile devices, including a tablet, which will allow me to test the application on a variety of screen sizes and processors.

OS	License Free and Open Source	Free Development Cost	Common APIs for smartphones and tablets
Android	Yes	Yes	Yes
iOS	No	No	No
Windows Phone	No	Yes	8.1+
Firefox OS	Yes	Yes	Yes
Blackberry OS	No	Yes	No
Sailfish OS	Yes	Yes	Yes
Mer	Yes	Yes	Yes
Tizen	Yes	Yes	No
Ubuntu Touch OS	Yes	Yes	Yes
OS	Familiar with Interface	Familiar Programming Language	Easy access to Devices
Android	Yes	Yes	Yes
iOS	Yes	No	Yes
Windows Phone	Yes	Yes	Yes
Firefox OS	No	Yes	No
Blackberry OS	Yes	Some	No
Sailfish OS	No	Some	No
Mer	No	Yes	No
Tizen	No	Yes	No
Ubuntu Touch OS	No	Yes	No

Table 1: Comparison of available Mobile Operating Systems

2.2 Similar Applications

I realised that the most important requirements for the application was utilizing routes, GPS tracking and an simple UI, so I had a look at what apps were out there, looking at apps from the iTunes Store, Google Play Store and Windows Store, and made a comparison of the apps against my requirements (Table 2).

App	Planned Route	GPS Tracking	Social Media	Easy UI
TripAdvisor	•	•	•	•
London Tours	•		•	•
MapMyWalk	•	•	•	•
Trek Nepal	•			
Split Audio Tours	•	•		•
NYP Guide	•	•		•

Table 2: Comparison of different Mobile Apps in relation to my requirements

As seen in Table 2, I first looked at the TripAdvisor City Guide App [11]. Its design was simple, but the main menu had so many buttons that I had to scroll down to see all of them. This was too much information to start off with. I felt that they could have broken down the menu into sections and subsections rather than all sections, as many of the sections searched for something nearby, be it a shop, food or attraction. However the user interface was simple. The suggested itineraries was important as it provided planned routes that I could go on that would, for example, not miss any of the most famous parts of London. I found it particularly useful as it used GPS tracking to help guide me on the route. Additionally, if I were to want directions to a shop nearby, I could click on "Point Me There" and it would guide me with an arrow, much like a compass, and tell me how far away I am.

My first impressions of the London Tours App [12] was not quite the same. It requires an update before each start of the application, which is not appealing to any user. However, once the app is up and running, its design is much more elegant than TripAdvisor's app. However, whilst it provided itineraries similar to TripAdvisor, it does not guide you with a map, preferring simple descriptions instead. It has more weight on the social media aspect, where it asks if you want to add a photo or like each attraction. The City Map tab of the app takes you to a great map of London, which isn't explained except for some icons at the top, which seem like an interactive key for the map. The load time is very slow, and it is not clear what each icon does.

The MapMyWalk App [13] seemed most elegant so far. There was a a clear menu that described each section of the app. I was able to create my own routes or used those created by other users. I could add friends via Facebook, Twitter, my Contacts or find friends already using the app. I could record my "workout", and see when friends were on a certain route. This was a useful feature to consider for users of my own app to find others walking the LOOP.

Trek Nepal [14] is a very different app as it is for trekking rather than walking or exercising in a city. However, it was useful as it showed me how Google Maps can be used - even to plot routes around mountains in Nepal. It also showed me how Google Maps can show elevation in areas. This could be useful for users to see how onerous the walk will be before going on it.

Split Audio Tours [15] was a different type of app also. It did not guide me in the same way as the other apps, but used audio guides to explain attractions, whilst allowing the user to see on a map where all the attractions are by number. This is a way of guiding users on a route that I had not considered before and may be a useful extension to the app to include.

The New York Pass Guide [16] has a very clean UI, with sample itineraries, as well as the ability to create a personal itinerary. Within each attraction, there is the option to go to it on a map, find out specific details such as opening times, phone number and address, as well as the ability to "like" it. However, this is only within the app and does not allow the user to interact with any social media.

Looking at different apps gave me a better idea of how to proceed with my own app, and also brought some ideas that I could incorporate into the app. For example, the "compass" used in TripAdvisor's App would be a unique and simple way of guiding users. I could also allow users to choose whether other users could see if they were on the same walk as them, allowing different users to meet each other. I also saw how important a simple and clear user interface is as although the developer may know what all the buttons do, this does not necessarily mean every user does. This reinforces my Objectives, particularly **O4** and **O5** as an unclear interface can really discourage a user from the app.

What I found that was less common in these apps in comparison to my objectives relates to my Extended Objectives, particularly **O6-8**. These applications, on a whole, did not allow a great deal of user input. What I would

like is to be able to allow users to keep a interactive travel diary, by adding a pin to the map and writing about it. I found no turn-by-turn navigation in the apps which meant that users could not follow voice navigation and were forced to refer to the map on the application which may not appeal to everyone. Additionally, although users were able to stop a walk at any point, the apps would not remember where they were when they last used the app. It would be up to the user to keep track of where they were in any given situation.

3 Project Plan and Management

Having done all the background research necessary, I am now ready to begin my project. I used the iterative development model [17] to help manage the project. Here, I do my planning, so that I am able to form the requirements for the project. Then I can begin analysing my requirements so that I can design the application. Once I have completed the design process, I am ready to begin implementation, deployment and testing.

3.1 Development Tools

As with any project, it is necessary to use a revision control system. For this, I have chosen GitLab [18], a revision control system which I am accustomed to using through previous lab projects. I created a group on GitLab, "london-loop", and a project within, "londonloopapp" [19], where my project repository resides.

Having chosen to work with the Android SDK [20], I decided that despite being accustomed to the Eclipse IDE, I wanted to use the Android Studio IDE, which has a better UI for development with an improved graphical preview, and the ability to easily define unit tests in separate classes.

For the database, I will use SQLite and host the database on the Apache Cloudstack available to me through the Imperial College Department of Computing. I will use JSON as an API format for my RESTful Web Service which will act as an intermediary service for communication between my application and my database. In doing this, I ensure that all user and app data is stored safely on a server, and that my app is not too heavy in terms of size on a device.

To aid development I use a web-based project management application, Trello

[21], modelled by the kanban scheduling system, to manage tasks and personal deadlines so that I can stay on track with my project.

I also made some mockups using NinjaMock [22] which we will discuss in more detail later.

3.2 Release and Iteration Plans

I plan to fully utilize Git's support for branching and merging in the development process. I want to have a constantly working iteration on one branch - the "master" branch. Therefore, using Trello tasks, I am able to create a new branch for each task or feature, and merge it with the master branch once the task is complete to create the next iteration, before creating a new branch for the next task. Ideally, once I begin development, I want to have a weekly iteration to coincide with the weekly meetings I will have with my supervisor, Professor Michael Huth. Once each iteration has been completed, I can release my app. I have created an initial plan, as seen in Appendix Section D Figure 2, taking consideration of exams and deadlines in order to see how much time I have to complete my application. I also created a detailed implementation plan, within the weeks of Implementation and Testing, as seen in Figure 3, where I can plan how long I would like to take in each time, giving 6 weeks towards to end of the project to finalize the app and any bugs or delays that may occur.

Month	January			February				March					April				May				June				
Week Commencing	12	19	26	2	9	16	23	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29
Exams																									
Easter Holidays																									
Interim Report Due																									
Final Report Due																									
Preliminary Source Code Archive																									
Final Project Archive																									
Initial Planning																									
Planning																									
Requirements																									
Analsis & Design																									
Implementation																									
Testing																									
Final Report Writing																									

Figure 2: Initial Plan with consideration of Exams and Deadlines

Month	March					April				May				June				
Week Commencing	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29
Skeleton App																		
LOOP List Page																		
Tabs																		
Section Detail																		
Basic Statistics Page																		
Insert Map Into Map Page																		
Insert GPS Routes																		
Separate Routes into Sections																		
Link data to Statistics Page																		
Link App with Phone Camera																		
Link App with Social Media																		
Finalize App																		
Testing																		

Figure 3: Detailed Implementation Plan

As seen in Figure 3, I have made a list of tasks and milestones and assigned them to certain weeks. I realised that creating a skeleton app with simple features such as pages and the list of London LOOP sections would be trivial so I gave that particular part of the app just one week, allowing another week for the tabs as it may take me time to get accustomed to the Android environment. Following that, I gave the London LOOP Section detail page and the basic statistics page, with dummy data, the second week as once I have the skeleton app available, it should be easy to fill in the necessary detail. I then allow for two weeks off with accordance to the exams seen in Figure 2. Following my exams, I have my Easter Holiday period during which I would like to complete as much of the project as possible. I have given each task 2 overlapping weeks, in anticipation of any difficulties I may have in implementing them, particularly as I have not worked with maps and GPS coordinates before, nor have I with the camera on a phone. Although I have yet to find out my Summer Exam timetable, only knowing it will be in the month May, I cannot yet see how much time I will have in between my exams and the project deadline where I can fully focus my efforts onto this project. Therefore, I want to aim to get as many of the features done as possible beforehand, giving myself 6 weeks following the holidays to finalize any unfinished features, or add extensions to my app time permitting.

3.3 Testing

An essential part of the development process is testing. Although it would be ideal to make the application development test-driven, it is not ideal as the application's main features requires the use of GPS tracking, which in practice can only really be tested out on the London LOOP path. However, I am able to create certain test suites to ensure that the UI is robust and consistent.

3.3.1 Automated Testing

The Android framework includes an integrated testing framework which I will use to test as many aspects of the application as possible. The SDK includes tools for setting up and running test applications which makes testing a much smoother step in the development, as I am able to run my tests from within an emulator or device.

However, there are some limitations to unit tests in my case. Although I will be able to test certain aspects such as how the activities and services perform, I will be unable to fully test how the app behaves when the device's main feature is actually in use. For this, I must also use human testing.

3.3.2 Human Testing

In order to test the application fully, I have asked my friends and family to help me. This is because I, myself, will of course be biased towards my own application. By asking those who had no part in development, who are from different technical backgrounds and of a variety of ages, I will be able to ensure that the application fulfils my objectives.

As the main limitation of automated testing in my situation is that it is necessary to physically go to the London LOOP and test the features there. That way I can be sure that as I approach a place of interest, I receive more information on it, that if I find a place I want to note down, I am able to do so easily, and if I went off course, the application would ask me if I intended to.

Another limitation of automated testing is that I am unable to see how different people react to the application (**O4**). I will create two surveys on SurveyMonkey [23] to help me with this. I will send out one survey prior to the development process to find out what people would like to see in the application. Then, I will send out another survey once they have tested the

application to see how they found the it and if it met their expectations. In each case, I will analyse the feedback both quantitatively and qualitatively so that I can improve the application as best that I can.

3.4 Features List

Before I begin development, I created a features list consisting of what I consider important to be included in the application, and an extended features list which I will consider once all my core features are in place. I list these features in the order I intend to implement them in.

1. List of London LOOP sections
2. Detail of London LOOP section
   (a) More detailed information about section
   (b) "Start Walk" button which takes you to a map of the route
3. Map of London LOOP section
   (a) Marker showing device location
   (b) GPS co-ordinates of section plotted
4. Camera Interface
   (a) Use camera to take photograph whilst on walk
5. Social Media Interaction
   (a) Check-In Facebook Button
   (b) Share photograph with Facebook
   (c) Find others using the app

3.4.1 Extended Features List

1. Turn-by-turn navigation
2. Voice navigation
3. Find other friends currently on a walk

3.5 Mock Designs

Following my Features list above, I created a series of mock designs of my application. These are intended to guide me through the implementation of my app. However, as these are only my first designs, I intend to improve them as the development process progresses, adding colour, as well as looking into how to make these designs more unique and themed towards the London LOOP.

I used my Implementation Plan in Figure 3 and my Features list to help me create my mock designs and, as seen in Figure 4, is the "LOOP List Page" from Feature 1.

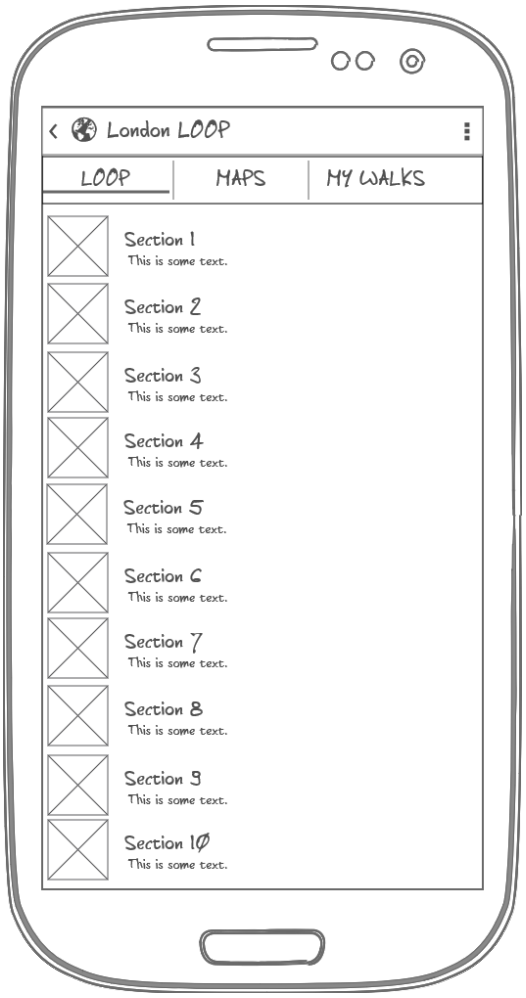

Figure 4: List of London LOOP sections

I also decided that it would be necessary to have an "About Us" section for the user to learn more about. As this information does not necessarily require its own page, I decided to put this into a toast, as seen in Figure 5.

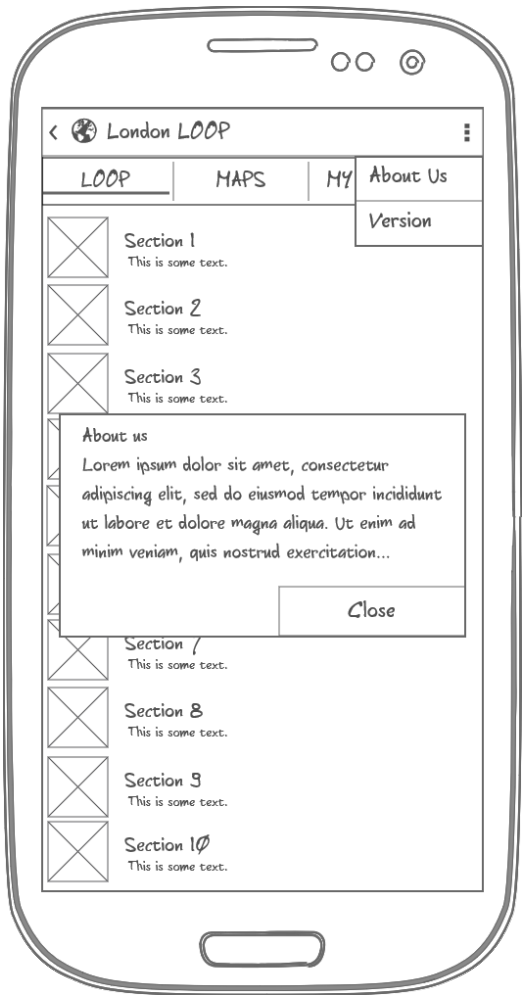

Figure 5: Toast containing "About Us" information

I would like the user to be able to click on one of the London LOOP sections on the list in Figure 4 and find a page explaining in more detail what the section consists of, how long it is, and where it takes you. I have shown this in Figure 6, where I want the layout to include an image taken from the walk, with the details underneath, and a "Begin Section" button, conforming with Feature 2.

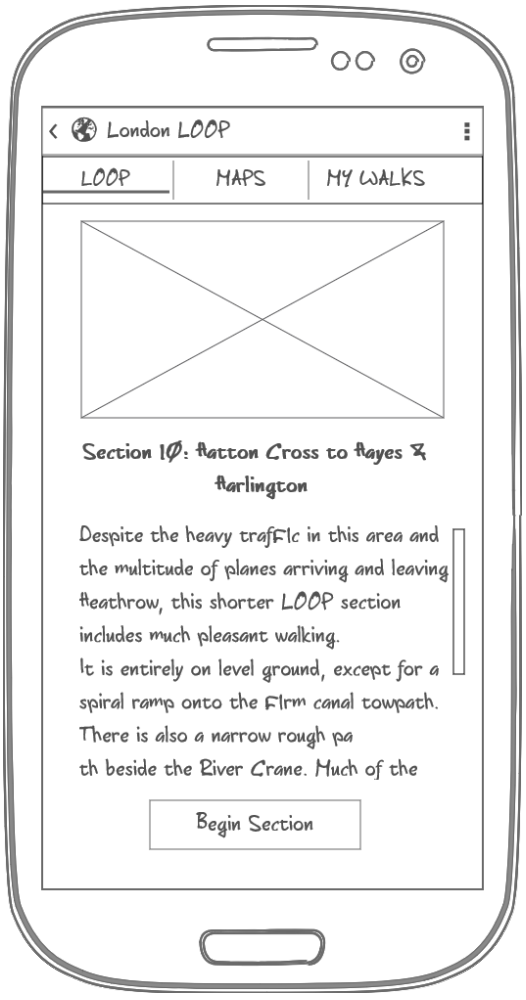

Figure 6: London LOOP Section Detail, using Section 10 as the example

The main feature of this app will be Feature 3, the map of the London LOOP section. As seen in Figure 7, this consists of the plotted route overlaying the map, with a marker showing the user's current location and a marker showing the destination. I also included an arrow pointing at the direction for the user to walk and a counter of how far is left of the walk. Additionally, as Feature 4 and 5 require camera and social media interaction. This is easily seen by the Camera and Check In buttons at the bottom of the screen.

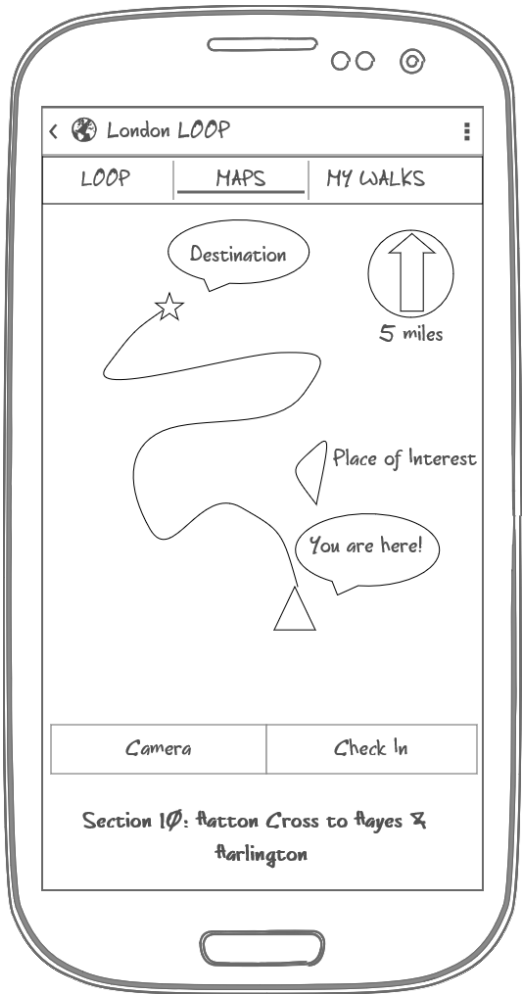

Figure 7: Map of London LOOP Section Route

Following the Camera button, the user will be taken to a screen where they are able to take a photo and, as in Figure 8, share it with a social media website such as Facebook.

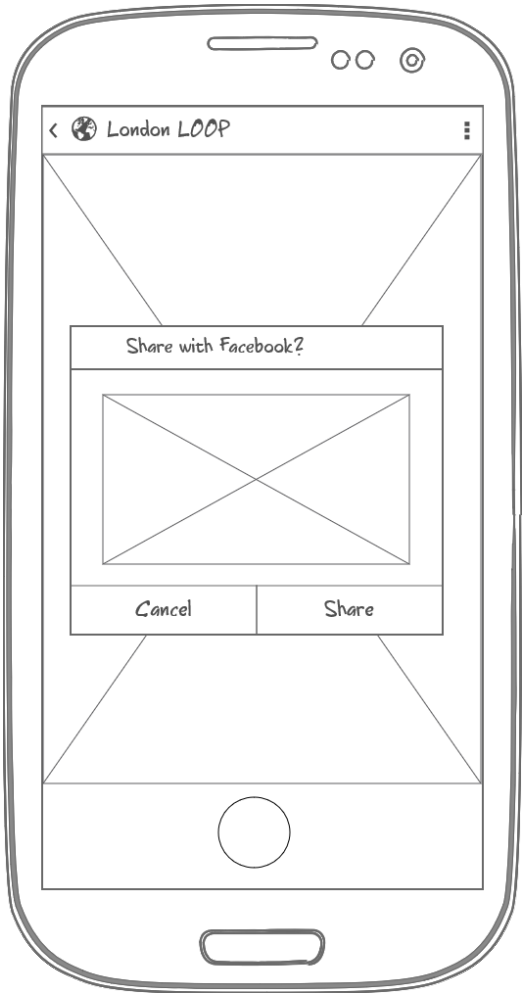

Figure 8: Take and Share Photo with Facebook

The final screen of the app will be the "My Walks" screen. As shown in Figure 9, the user will find their own statistics such as how many sections they have walked, how many miles they have walked, and how long they have taken to do all of this. It will also show the photos they have taken through the app and have a button that allows them to connect to Facebook, which, when connected, will be replaced by a list of Facebook friends who use the app.

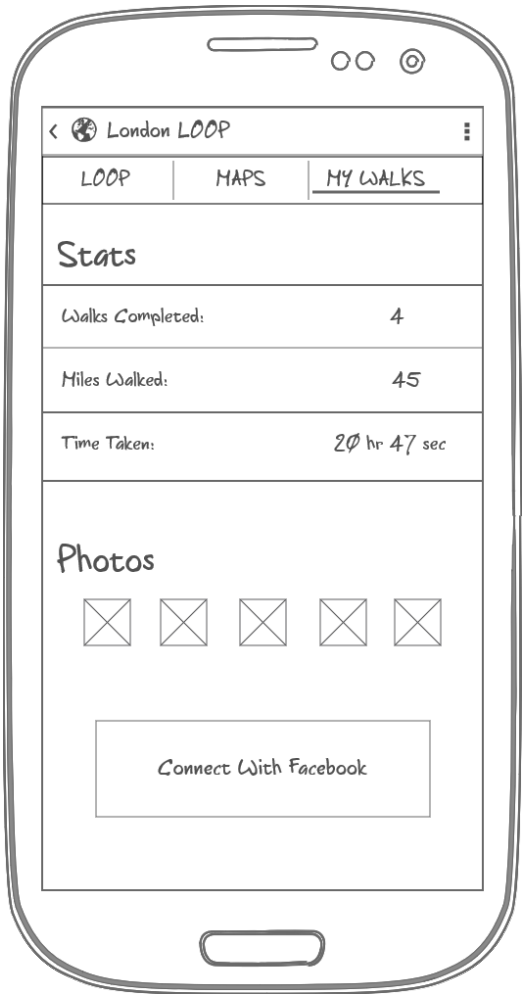

Figure 9: My Walks

3.6 Constraints

As I am not making an application for profit, but as an academic piece, there are some unavoidable constraints to be faced. The project is limited to the time given, and must be completed by the end of term in June 2015. As such, I must be mindful of time-management. I have already spoken of the use of Trello [21] which I will use to help plan my time. I will have 5 lists - Requirements, To-Do, To-Do(this week), In Progress, and Done. This way I can see both how much is left and how much is done, as well as set personal deadlines for tasks within the project. When assigning these tasks I must also consider how much workload I will have during that week as there will be weeks where other coursework and exams take precedent over this project.

I realised that if I tried to complete the entire application with all its features in every single section of the London LOOP, I may not have time to show the full potential of the application, so I have decided that I will flesh out one section of the application and leave the others as a skeleton so that I can demonstrate how far I am able to take the application given the time. This also makes it much easier to test as when testing the application at the LOOP, only a fraction of the 150 mile London LOOP needs to be walked.

The other thing I will have to consider are the usage limits for the APIs I will use (Table 3).

API	per 24 hours	per request	per second
Google Maps Direction	2500 Requests	8 Waypoints	2 Requests
Google Maps Distance Matrix	2500 Requests	100 Elements	10 Elements
Google Maps Geocoding	2500 Requests		5 Requests
TransportAPI	1000 Requests		

Table 3: API Usage Limits for Free Licence

I can see that I am faced with the problem of how many requests are allowed to be made within a period of time. To help reduce this problem, I would like the application to cache each request so that there need not be multiple requests for the same information, hence avoiding an error for going over the query limit.

The problem faced from the Google Maps API Direction Services is the limit of 8 waypoints per request. This means that I will not be able to make the route as accurate as I would like it to be. I will attempt to split the sections of the routes into subsections, but I will not be able to use continuous waypoints to map out the route. Of course, if this were for a business I would not be restricted to the free usage limits, so I will have to consider these limitations in my evaluation to show that given the full means, I would be able to produce a much smoother route for the sections.

4 Evaluation

So far in my project, I have learnt that despite almost half of London, a city with a thriving population, is green space, it is scarcely taken advantage of. I realised that the London LOOP, a 150 mile sign-posted walk along public footpaths around the outskirts of London, takes you through the very same green spaces that are neglected by so many people in London. I wanted to make this more accessible to Londoners and in an age where some consider their mobile phone an extension of their arm, it of course made sense to make an mobile phone application. I chose my tools based on research, and my features based on my analysis of current applications on the market.

I made a list of features and mock designs of the application. However, these are not complete, as I have yet to send out the surveys, which will allow me to make any changes to my feature list as necessary, and to complete my first draft mockups.

As I will test the application using both test suites and by going to the London LOOP to test it individually, I will ensure that I don't miss any edge cases. By getting others to test it and giving feedback after testing, I am given a different perspective to help me find any bugs and faults in my application.

I will be restricted to using free services, so when using APIs I will be unable to do more than a certain number of requests per day, and in particular, I will have to split the sections up into subsections of 8 waypoints which do not meet the request limit, as I am unable to use the full Google API Directions Service. This could make the routes less accurate, and I must consider the limit to how many times the app can be tested per day.

I will also be restricted in time and helpers to test my application. I have

my friends and family to help me by trying out the application and walking a section of the London LOOP. In order to make it easier to build up the application, I decided to flesh out only one section so that I do not spend all my time on trying to implement specific features into each section of the application, but have enough time to show how far I could take this application given the time. I am also using kanban system to aid my time-management, however I should also consider a table of all the weeks left, and where I want to be in my application development at each week.

Walking is known to be beneficial to people's health, reducing the risk of heart disease, stroke and type 2 diabetes, and I want to promote walking for both health and leisure, and show that exercise needs not to be a chore, but can be enjoyable, and show people that the city is not all concrete and buildings, but full of beautiful open spaces to explore.

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