Final Report

Project 218 – Contextually Aware Travel Application

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Abstract

In this project, I have created a technology probe that takes the time and location information from an android device, and uses it to collect information of local dining establishments and displays them on a map. The type of dining establishments returned varies based on the contextual information of the android device. This project is to serve as the preliminary step to determining whether or not developing a further travel companion application that can determine more different types of locations based on the contextual information, and as such is a proof of concept.

Most people tend to enjoy travelling, and as such, I believe that my technology probe will have a wide and varied user base. Therefore I did not restrict my user base when doing my user testing, as I felt it would be more appropriate to have a wider variety of people, for more genuine results.

The general consensus from my testing was that people liked the technology probe, and would like to use it if the technology probe were publically available, which leads into my conclusion that further development into the travel companion application would be practical.

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Introduction

Purpose of the Project

The purpose of this project was initially to develop a travel companion application that would provide information of the surrounding area based on the user's context. Due to the timeframe provided for the project, this proved too monumental a task to complete, and therefore for the sake of the project, I toned down the scope of the project. For this project, I have developed a contextually aware technology probe. The probe can take the device's current time and location, and provide information about local dining establishments based from this information. The main aim for this project is to assess whether it would prove practical to create the application I had originally intended to create, based on user reception to the technology probe.

Why the Project is Important

The reason why I believe this project is important was explained briefly in the initial report. Though the scope of the project since then has changed from developing a full blown application to developing a technology probe to test to see how feasible creating the full application would be, the reasoning behind the project has not since changed. Based on my research into the domain of travel and tourism, travel and tourism is a growing market. Outbound travel from the United Kingdom had increased by a total of 3.5% from 2012 to 2013, and inbound travel to the United Kingdom has increased by 5.6% over the same period (Rhodes, 2015).

Based on my research into travel applications available on the Google Play market, though there is an abundance of travel companion applications available on the market, there seem to be very few that do what my project aims to do. Most are either travel planners, which are used to organise trips, or they are tour guide applications which show you around a location. I feel as though there is a gap in the market for the idea I proposed, and the importance of this project is to determine whether it is a practical gap that is worth capitalising on, or if it is too obscure a market to viably capitalise upon.

Research Questions

The main research question for my project is thus, would it be practical to create a travel companion application that takes the device's context, and allow the user to plan activities to do based on locations around their surroundings while on the move? To determine this, I will need to create a technology probe with the basic functionality on a smaller scale to determine user response to the idea. To better design and implement my technology probe, I had to do research into three main fields, with research questions for each field. The fields were as follows:

- Previous research into the domain of contextual computing:
    - What past research has been done in the domain of my project?
    - What technologies are available for my project?
        - What are the advantages/disadvantages?
    - How did other projects work?
    - What shortcomings did previous projects have?

        - How can I avoid these mistakes?
    - What aspects of these projects will prove useful in my own project?
- Similar Applications:
    - What applications out there are similar to my own?
    - What is common throughout these applications?
    - How can I make my project differ from existing applications?
    - Are there aspects to these applications that could prove useful in my own project?
- Technology Probes:
    - What is a technology probe?
    - How does a technology probe differ from a prototype?
    - Why should I use a technology probe?

I aim to answer these questions in the literature review section of the report.

Contributions of the Project

What I aim for my project to contribute is to lead into a novel new travel companion application that hybridises the explorative nature of the tour-guide applications, and the organisational nature of the travel planner applications. The travel planners tend to prioritise booking locations and planning your trip, whereas the tour-guide application on telling the user locations to visit. When I go on holiday, I prefer exploring locations at my own pace, with the freedom to do what I choose to do and when, which I feel that the applications currently on the market inhibit, by forcing users to plan out their trips or going where the application tells them. The technology probe this project aims to complete should only be able to find restaurants around the user's current location, as a proof of concept of the idea of creating the application at a later date, however it should aim to offer suggestions of possible restaurants based on the user's current location, rather than telling them that they should go to any specific place.

Aim and Goals

The main aim of this project is to create a technology probe that can detect the user's current context, and suggest dining establishments to the user based on this context. This is to gauge whether user reception would deem it practical to develop this project further into a complete application. In order to achieve this, I have set out several goals for the project, which I deem necessary to complete the main aim of the project and answer the question that it asks. The following are my goals:

- The first goal is that the technology probe must be able to gather the user's contextual information, mainly time and location data, so that the technology probe is aware of the current context.
- The second goal is that the technology probe needs to be able to access information about restaurants, and display said information in a way that users can read.
- The third goal is that the technology probe needs to be able to use the contextual information to search for dining establishments that satisfy the user's current context e.g. if it's morning, the technology probe should prioritise café's in the user's general vicinity.

- The fourth goal is that the technology probe needs to display the location of dining establishments in a way that users can determine their location from the user's current location, e.g. markers on a map.
- The fifth goal is that the technology probe needs to be as simple to use as possible, so as it is accessible to everyone, as the intended audience for my project may include individuals who are not technologically literate.
- The sixth goal is that my technology probe needs to be adequately tested, for two reasons. The primary reason it needs to be adequately tested is so that I can ensure that the technology probe in fact works as intended. The second reason it needs to be adequately tested is so that I garner user opinion on the technology probe, which is critical in answering the main question of my project, which is how practical would it be to develop this idea further.

Intended Audience

Due to the nature of what the project aims to create, I feel as though my project will have a very diverse intended audience. The main characteristics that my project targets is that a person travels and the person has a smart phone. Realistically in today's world, most people will already have a smart phone, so the only real characteristic is the travelling, which again, most people do like to do. Therefore there are three categories I believe to my intended audience:

- People who have to travel for work.
- Holidaymakers.
- Backpackers.

Most people tend to fall into one of these categories at some point during their lives, which is why I feel the technology probe needs to be as simple to use as possible, as people of various technological know-how can be categorised in each of these three categories.

Constraints on the Project

There are a few constraints on the project which will limit my technology probe somewhat. The first is that it uses Google API's therefore licensing agreements will limit what I am able to do with the technology probe, and also will require internet access to locate place information. Another constraint is the timeframe of the project. As the project has a fairly short timescale, there are limits to what I will be able to implement, which is where this reliance on API's has come from. These constraints will be delved into deeper in later sections of the report.

Assumptions on which Work is Based

There are fairly few assumptions on which my work is based. The main assumption is that the hardware required for the technology probe to work will already be installed on the device. There is also the assumption that the technology probe will only be operated where a GPS signal and access to the internet is available.

Literature Review

Research Areas

I felt that in order to effectively solve the issue of my project, being to create a contextually aware location based technology probe, I needed to focus my research on three key areas. These key areas were the following:

- Previous research done into the field of contextually aware computing, with regards to location based technology.
- Applications currently available on the market that provide users with information about locations.
- Research into technology probes in general.

The following section of the report should showcase the findings of my research, and help define the methods I will take to implement my project.

Previous Research

There has been an abundance of research into the field of contextually aware computing over the past twenty years. I decided to base my research into the field of contextually aware computing on the papers below, as they were geared towards aims similar towards my project, in creating a location based contextually aware technology probe. The table below contains the authors of each paper, and a brief description of what each project did/how it worked:

Author(s)	**Description**
(Cheverst, et al, 2000)	The GUIDE project worked by creating a Wireless Network with nodes at separate locations throughout the city of Lancaster. These nodes contained location information, and could be used to determine the user's location, and could access a repository of local attractions based on the node's location.
(Abowd, et al, 1996)	Cyberguide worked by having locations and maps hard coded into the device. It also contained a GPS locator. Based on the location on the GPS locator, it would display the user's location and nearby places of interest onto the map using the pre-programmed information on the device.
(Park, et al, 2007)	This project worked by pre-programming a grid over a map of the palace. For each square of the grid, there was a range of GPS locations that was considered inside that square of the map. Whenever a device entered the square, the device would return relevant information to points of interest within that square.
(Pashtan, et al, 2003)	CATIS consists of a context manager

	that monitors the user's dynamic context, as well as their preferences. It then continually receives location information in a web browser, based on the user's current context. The information is retrieved from an application server.
(Hinze & Buchanan, 2005)	TIP works by delivering information to the user based on the user's current location, travel history, and preferences. It uses a filter engine which works in conjunction with the location engine, returning information in a client-server architecture. This project also considers the point of interest's context, such as its location, and the type of location it is, e.g. "medieval churches".
(Marmasse & Schmandt, 2000)	ComMotion works by monitoring user interaction with locations. It monitors which locations a user frequents, and then defines these locations. It then allows users to subscribe to information regarding locations, e.g. could subscribe to film listings to a cinema if the user frequents the cinema.

Location Technologies

The first question that I attempted to answer in my research into the field of location based contextually aware computing was which location technologies would be available for my technology probe, and which of these location based technologies would be best used. Based on my research into these technologies, I saw three main technologies that could be used. The first technology was GPS technology, the second was Olivetti Active Badge Infrastructure, and finally was using wireless transmissions to detect the user's location.

GPS Technologies

GPS technologies looked the most useful for my project, as my project is mostly intended to be used outdoors, which is where GPS technology excels over the other technologies mentioned in this section. Also, as most smartphones now come equipped with GPS tracking technology, there would be no need to do any modifications to the receiving device, as tended to be a problem with most of the older studies which caused them to opt for other technologies. However, GPS technology does have its drawbacks, as it is designed to be deliberately imprecise for security reasons, as GPS technology originally was designed for military usage. Another drawback is that GPS technology works poorly indoors, as they require exposure to GPS satellites in order to work properly. As my project is intended to be used outdoors, this should not prove too much of a drawback, but could cause issues if it were used inside of an establishment such as a shopping centre.

Olivetti Active Badge Infrastructure

The Olivetti Active Badge Infrastructure works by having users wear a smart badge inside of an establishment. The building is then mapped out on a system, and has sensors within each room which correspond to sections of the map. Whenever a user enters a room with a sensor, the sensor reads the user's badge, and updates the badge's location on the map. This allows the system to track a user's location throughout the building. As this technology only works indoors in a pre-mapped environment, it would be mostly ineffective for my project, as there would be limited coverage where the technology probe could work. It also has the problem of having to set up the sensors and mapping the building. This system is used in the ParcTab system mentioned in (Cheverst, et al, 2000).

Wireless Transmissions

Wireless transmissions can be used to detect a user's location by determining the signal strength from multiple base stations. Each base station has their own location information stored, and by determining the signal strength from multiple base stations, the user's location can be triangulated. This can be used to determine the user's location outdoors using cellular base stations, however the only case of this being used in the projects, is in (Abowd, et al, 1996), and they only used it to judge the strength of IR signals inside of a building to determine the user's location within a building, which would not be an appropriate scale for my technology probe.

How Other Projects Work?

The second question I attempted to answer was how the other projects worked. By looking into how these projects worked, I would be able to discover methods of implementation that may be useful for me to use during the implementation of my own project.

GUIDE Project (Cheverst, et al, 2000)

The GUIDE project works by returning information to the user through a user interface that is essentially a modified web browser. Rather than show locations on a map, it lists locations to the user, based on the user's current location. They created a wireless network with 6 communication cells with each storing the cell's location. The user's location was then determined based on their proximity to a cell. These cells then connected to the university network to access location information for attractions. The system also uses its own information model for data, rather than use some other company's information model such as google.

Cyberguide (Abowd, et al, 1996)

Cyberguide works by consisting of 4 smaller components. The first component is the cartographer component. The cartographer component is responsible for mapping the device's physical surroundings, such as buildings, pathways, and interesting sights. The second component is the librarian component. This component is responsible for finding information about the sights a tourist might encounter during their stay. The third component is the navigator component. The navigator

component is responsible for garnering the tourist's location, and orientation. The final component is the messaging component. This component is responsible for sending messages to other tourists/members of staff during their stay.

Old Palace Tour Guide (Park, et al, 2007)

The tour guide application consists of two main components as to how it works. The first component is the map positions and GPS component. A map of the palace is split into a 5x12 grid, and each square of the grid is labelled as a number between 1 and 60. Each square covers a small region of GPS co-ordinates, and the system determines the user's current square based on the device's current location. Based on the block number, the system displays information about the attractions in the current block.

The second component is the tour guide component. The information about the locations is stored on a SQL server. Once the tour guide application is started, information is downloaded from the SQL server to the user's device. Once the current GPS location is found, the device can start guiding the user. When the user passes a building, information about the current building is displayed, based on the current block of the user's locations.

CATIS (Pashtan, et al, 2003)

CATIS works by having the user's device host a web browser. There is then an application server that delivers web content customised to the user's context. A universal description, discovery, and integration (UDDI) services directory provides users with a centralised registry for tourist information services. The UDDI specifications describe the information to provide for each service, as well as provide a query, and update API to access information in the registry. The device consists of a context manager that keeps track of the user's dynamic context, as well as a collection of web services that deliver tourist content.

TIP (Pashtan, et al, 2003)

TIP delivers information on sights based on location, the user's interests, and the user's travel history. It also takes into account the location's context, such as the locations semantic group e.g. "medieval churches". It then uses maps to allow users to navigate to the location. The system's heart is the usage of a filter service which filters out irrelevant locations, used in tandem with the location engine which helps locate the user's current location.

ComMotion (Pashtan, et al, 2003)

ComMotion consists of a learning agent that monitors the user's movement patterns to learn of locations that the user frequents. It then labels the frequented locations. Once a location has been defined, a to-do list is established with the location, e.g. supermarket: buy milk. It also allows users to subscribe to information services for locations, e.g. if the location is a cinema, can subscribe to movie listings. A subscription is for each individual location. It then displays everything on a map that also displays the user's location.

Shortcomings of Other Projects

The third question I attempted to answer was what the shortcomings of the projects were. By looking into the shortcomings of the other projects, I will be able to better understand how I can build upon previous research, to make my project better, and more unique from what is already available on the market.

GUIDE Project

The GUIDE project has two major shortcomings. The first shortcoming is that it uses its own data for locations, rather than accessing readily available information. Though this is beneficial for not having to worry about licencing agreements on the data used by the application, and also contains the exact information the designers would want to implement in the application, it causes the problem of having to gather the information required in the first place. In a large location such as a city, that will mean having to gather information on many locations of interest. It also leads to the issue of having to manually keep information up to date, as information about locations is prone to change, e.g. operating hours may change.

The second shortcoming is that it uses cells as beacons to find the user's location. As they have to set up these beacons in a network to provide coverage for the application, expanding coverage proves difficult. Space needs to be obtained to store the beacon in, coupled with the fact that the beacon needs to be in range to connect to the other beacons, makes expansion of the system difficult, and possibly expensive.

Cyberguide

Cyberguide had several shortcomings during its implementation. Firstly, Cyberguide cannot garner the location of other objects. Due to the nature of the project, Cyberguide only knows the device location. To get the location of other objects/places, it needs to actively communicate with the objects. Should there be a network disruption with the system; the device could not find any objects until it is resolved. The second issue was that it relies heavily on third party communications. As it relies heavily on third party communications systems rather than its own, if the owners of the third party communications system decide to take down the systems for maintenance, or just no longer wishes to support it, the system is rendered useless until the situation is resolved. The final shortcoming was that it was forced to approximate connectivity using simple wireless serial connections, which had the issue of lacking reliability and range.

Old Palace Tour Guide

This project had very few shortcomings for the problem it was solving. The main shortcoming was that it only allows the user to tour the old palace. This works perfectly fine for the scope of that project, however as it involves pre-mapping the entire area beforehand, the solution used is unfeasible for my project, as my technology probe needs to work in a wild setting throughout a city.

ComMotion

This project too had very few shortcomings. The main shortcomings were that the hardware used was large and cumbersome, however this was mostly due to being a victim of the time period the project was conducted, as the project was conducted in 2000, small devices such as smartphones were not commonplace. The other shortcoming was that even though they implemented a speech input system, people were found to not like talking to the device. Though the social stigma of talking to technological devices has dissipated due to the popularity of smartphone devices, people may still feel uneasy talking to their phones in these days, therefore I feel that this should not be a feature of my technology probe.

What Features Can Be Used for my Project?

The fourth question I attempted to answer in my research was what features from these projects could be used in my project. Using this research, I can identify features from the previous projects which I feel could be useful in improving my technology probe, by suggesting ideas that I would not have initially thought of on my own.

GUIDE Project

The main aspect I feel that I should take away from the GUIDE project is the ability to access interactive services. As my technology probe aims primarily to find places of interest based on the device's location to time, access to interactive services could prove to better the technology probe, e.g. if the technology probe suggests a cinema, it should allow users to book cinema tickets or view movie listings.

Cyberguide

Cyberguide had several features I feel could benefit my technology probe. The first feature was some user generated content feature, to allow users to review certain locations, and other users to then view these reviews to help decide which place of interest to actually go to. The second feature that might be worth implementing would be a virtual reality display, much like Blippar, where the user could hold the camera up on a street, and the technology probe would highlight the places of interest, rather than displaying the locations on a map.

Old Palace Tour Guide

Much like Cyberguide's user generated content, the main feature I feel like I could take from the Old Palace Tour Guide would be the scrapbooking feature. The application allows users to save a scrapbook of locations they have been within the old palace, and add their own content to it. I feel as if my technology probe could benefit from allowing users to save previous locations they have been to, so that they can find it again if they wanted to, e.g. if they visited a restaurant they really enjoyed.

CATIS

The main feature I feel that I could take from CATIS would be the ability to analyse the user's heading. CATIS not only analyses the user's current location but analyses the direction the user is heading, to prioritise locations of interest that are on the route the user is travelling. This could prove beneficial to my technology probe, as it would help display more relevant information to the user. A user is less likely going to want to go to a restaurant that is in the opposite direction of the way they are heading than they are going to a restaurant on their current path.

Similar Applications

There are many applications currently available on the Google play store that are vaguely similar to what my project intends to implement. As most of the research into the field of contextual computing was done when the concept was fairly new, a lot of the research papers are somewhat antiquated by modern day standards. To help get a better view of how similar systems work in this day and age, and as to how my technology probe should look and run, I looked at the applications below. The following table contains the name of each application, a brief description of what the application does, as well as the main features of each application:

Application	Description	Features
WishBeen	WishBeen is a web based trip planning application that allows users to forward plan for their holidays, or also allows users to choose from an already designed trip. Allows users to connect with other users to share knowledge about locations to help with trip planning.	• Trip planning application. • Can download plan for use without internet later. • Provides maps. • User based suggestions. • Allows viewing of popular spots. • Allows viewing of user travel plans.
PocketGuide	Audio city guide application that provides information on local attractions relative to the user's location, as well as audio tours of the locale they are in.	• Tour guide application. • Provides voice tours of city. • Provides offline maps. • Recommendations of local places. • Tours can be downloaded offline. • Provides sporadic GPS based tours (i.e. will point out places of interest based on your location, rather than a full blown

		tour).
GuidePal	Guide application that provides users with information, and tours, about one of 57 locations, as well as local amenities to the user.	• City guide application • Offline maps and city guides • Allows booking of hotels, shows, etc. • Allows following and inviting of friends. • Can create own personalised guide
TripAdvisor	Allows users to plan trips, based on information provided by other users, such as reviews, photos, and apps. Also allows booking of hotels/restaurants.	• Trip planning application. • User reviews, videos, and photos. • Can search for options near any address entered. • Allows comparison of airfare. • Can ask travel questions and receive answers from other users. • Can download maps to use offline. • Uses location information to discover attractions around the user.
TourPal	App that provides GPS guided audio tours, as well as GPS enabled city maps to aid with navigation within a city.	• Tour guide application. • GPS map shows local bars, shops, and sites. • Inbuilt Hotel Finder. • Works offline. • Multilingual tours.
TouristEye	Provides city travel guides for thousands of cities, and supports user generated content for the travel guides, resulting in an ever store of travel guides.	• Travel guide application. • User recommendations. • Nearby recommendations. • Works offline. • Text, photos, and maps of areas available offline. • Personalised travel suggestions.

What Features are Common Throughout these Application

The first question I attempted to answer with my research on what similar applications to my technology probe currently exist on the market was what features are common throughout these applications. Based on my hands on impressions with these applications, I have composed a list of the common functionality I found among these applications:

- GPS enabled applications tend to provide tours of cities.
- Tours tend to be audio operated.
- Maps work offline in most.
- Use of user generated content prevalent.
- UIs tend to be minimalistic in tour guide applications.
- Allows usage of voice as input.
- Travel planners tended to be a bit more cumbersome.
- Also tended to lack GPS capabilities.
- Tended to provide additional information, such as photos for attractions.

What Features Should I Use in my Technology Probe?

The second question I attempted to answer with my research into what was available on the market was what features from these applications I should use in my technology probe. The first feature I feel should be used in my technology probe would be the ability to access maps offline. Most of the applications on the market allow users to access maps offline, and it would prove useful if I could do it for my technology probe, as mobile data is not always available.

The second feature I feel I should use for my technology probe is the ability for users to generate their own content such as reviews. This tends to be a common feature among apps currently available on the market. By implementing the ability to add user generated content, it could help provide more relevant results in the technology probe, as places of interest could be ranked against user reviews, as well as location, to display the best local attractions, and not just any local attractions.

The third feature I feel I should use for my technology probe is the ability to allow users to search for locations manually. GPS technology can be somewhat temperamental when users are indoors, or are in urban canyons, as these can interfere with the exposure of the device to the GPS satellites. By adding an option to manually allow the user to search for location if their GPS co-ordinates are not available, the technology probe is not rendered completely useless when GPS location is not available.

How can my Technology Probe Differ from Existing Applications?

The third question I attempted to answer with my research into what similar apps were available on the market was how I can make my technology probe differ from existing apps. The main difference between my technology probe and the existing applications on the market is mainly that the applications on the market tend to be geared more towards the planning of trips and activities. My technology probe will be designed to be used to find a location on a whim, based on the systems context. Rather than using it to plan the trip and activities beforehand, users will be using to find activities while on the go.

Technology Probes

The main reason I did research into technology probes for my project was to assist in defining what a technology probe should be in the scope of my project, so that I

could get a concrete definition of what the implementation should and should not do when the time came to design and implement.

What is a Technology Probe?

The first question I attempted to answer while researching technology probes was what a technology probe is. A probe is an instrument that is deployed to find out about the unknown. When a technology probe is deployed it should return with useful or interesting data. However there is an element of risk with a technology probe, there is the chance that the probe may fail, or the results that it returns may prove unexpected. Technology probes should be used when it proves challenging to learn about conventional human computer interaction techniques. In order for a probe to work, the main technological problems of the exercise must be solved, and the technology probe must be open-ended and explicitly co-adaptive. In order to be useful, a technology probe requires extensive analysis and reflection both during and after deployment by both researchers and users.

How does a Technology Probe Differ from a Prototype

The second question I attempted to answer with my research into technology probes was how technology probes differ from prototypes. There are 5 aspects to a technology probe. The first aspect is functionality. Technology probes are required to be as simplistic as possible, and where a prototype might be an early build of a complete system, a technology probe is only expected to be a complete implementation of a single problem, rather than a complete system.

The second aspect of a technology probe is usability. Where a prototype might be used to see how well a system works and how usable users find the system, this is not the case for technology probes. The purpose of a technology probe is to see if the solution works or not, not how usable the system is. The technology probe is not changed based on user feedback, after the results are gathered, the technology probe is scrapped. Sometimes a deliberate lack of functionality can be implemented into a technology probe, to provoke reactions from the user.

The third aspect of a technology probe is logging. Logging is a critical aspect of a technology probe, as the purpose of a technology probe is to gather information. Collecting data from a technology probe allows us to generate new ideas for the technology, and the logging of the data can help researchers visualise the usage of the technology probes. The information gathered can then be discussed by users and designers.

The fourth aspect of a technology probe is Flexibility. While a prototype is an early implementation of a rigid system, a technology probe should be more flexible and open ended with regards to use. Users of a technology probe should be considered to use the system in any way they see fit, as the purpose is to gather information, and they could come up with unexpected uses. As it is a solution to a singular problem, rather than a complete system, unexpected uses could prove beneficial to research.

The final aspect is the design phase. Where the prototype is the culmination of the initial design phase, technology probes should be used early in the design phase. Technology probes are used as tools for challenging pre-existing ideas, and can be used to influence the designs of future prototypes, based on the results returned.

Why Should I Use a Technology Probe?

The third question I attempted to answer with my research into technology probes was why I should use one. The problem I have decided to tackle for my project is a complex one, and with the time constraints on the project, creating a working prototype of the initial idea will prove problematic as the initial idea was over-ambitious given the timescale of the project. A technology probe I feel will allow me the time I need to tackle the main problem of my project, while eliminating the need for me to focus on superfluous features that are not essential to the main project. Also using a technology probe means only having to test the main feature of the project, which would allow me more time for testing and therefore allow for more rigorous testing to better assess how well the technology probe works, and how well the technology probe is received by users. Using a technology probe will also allow me to monitor other ways that the technology probe could be used, as well as gauge what future features would be needed in the initial prototype of the project.

Approach

The following section should outline how I intend to approach the project. It should prove to define the existing tools and methods that currently exist that I will use in the completion of my project. It should also prove to help define the development methodology I adopted for the project and justifications of why this methodology was chosen over other possible methodologies. Finally it should also prove to define the time plan I will follow for the development of the project.

Useful Tools and Methods for the Project

During my research into potential tools and methods that could be used to assist me in the development of my project, I came across two API's that I felt would be immensely helpful. The first API was the Google Maps API. The second API was the Google Places API. Due to the nature and the timescale of my project, I felt that the benefits of using these APIs would outweigh their limitations.

The first API, Google Maps is an API that allows developers to implement Google Maps into their projects. As my technology probe revolves around locations, using this API would allow me to display locations on a map, alongside the user's location. This is beneficial, as without a map to display locations, they would have had to have been returned in a list format, which would lessen the value of the information returned. The API however has a licensing agreement, where the developer cannot earn money from the application, unless they pay a licensing fee for using the API; however the API is free for non-commercial use, but has a limit of 1,000 requests per day. Developers can pay for additional requests. Due to the fact that the technology probe will not net any income, and also will not be publically available, this licensing agreement should not be problematic for my project, and without the API, the application would have had to either avoid using maps, or use an inferior API.

The second API, Google Places, is an API that allows developers query information stored about establishments from Google. As the main aim of my Technology Probe is to be able to garner information about dining establishments around the user's location, being able to query this information from Google solves the problem of how I would have gotten information about the surrounding establishments. Without this API, I would have been forced to find a way to manually trawl the web for the information, or would have had to physically gather information about the establishments, and created my own repository of information to be queried, either of which would have been infeasible to do in the timescale of my project. This API has a similar licensing agreement as the Google Maps API, being 1,000 courtesy requests, and having to be non-commercial, and also has the limitation of only being able to return a maximum of 20 places per query in the free version of the API, however as a technology probe that stands to serve as a proof of concept, I feel that this limitation is acceptable.

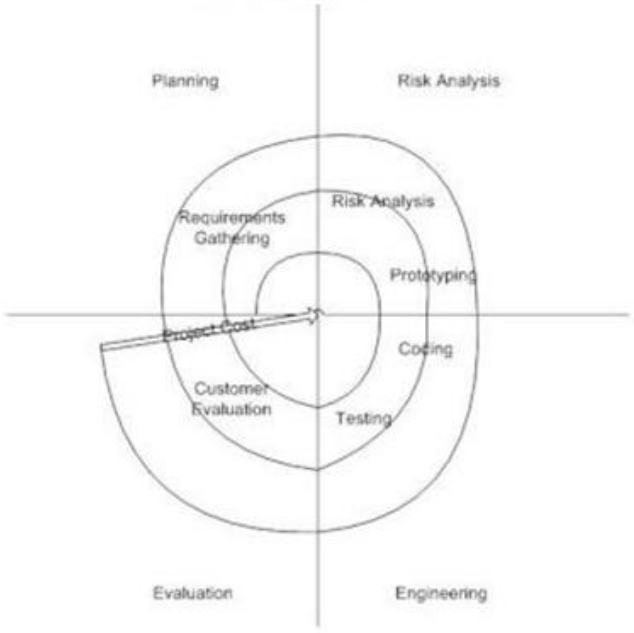
Development Methodology

In order to help plan the workload of my project, I looked at three possible development methodologies which could assist in determining how best to approach

my project. The first methodology I looked at was the Spiral Development Model Methodology. The second methodology was the Lean Development Methodology. The final methodology and the one I opted to use was the Advanced Waterfall Development Methodology.

Spiral Development Model Methodology (ISTQB, 2015)

Figure 1



(ISTQB, 2015)

The Spiral Development Model Methodology (Figure 1) consists of 4 main phases. The initial phase is the planning phase, where requirements for the project are determined. This stage then feeds into the risk analysis stage, where risks to the project are determined, and alternate solutions are suggested to mitigate severe risks. When risks have been mitigated as much as possible the project then proceeds to the next stage, the engineering/development phase. It is during this stage that a prototype is created based on the requirements gathered and the potential risks identified previously. Finally, the project enters the evaluation stage, where the prototype developed is evaluated to see how well it meets the requirements identified at the start of the project, usually via customer evaluation. As the Spiral methodology is an AGILE methodology, the process of going through the model is cyclical; each step is repeated until the project is completed, which is usually denoted by either reaching a deadline, or receiving satisfactory customer evaluation.

The Spiral Methodology is beneficial for large scale projects that are mission critical, i.e. have several functionality milestones that need to be reached, as each cycle through the model could be used for a component of the larger scale project. It is also beneficial in mitigating risk, as extensive risk analysis is conducted every time the project cycles through the development model. It also allows the addition/removal of functionality relatively easily, as it constantly cycles through the development model, requirements that were initially missed, or are deemed unnecessary, can be removed when the project re-enters the planning stage.

This methodology does also have its drawbacks. It is generally unsuitable for small scale projects. The methodology is also highly dependent upon the risk analysis. In order to prove successful, extensive risk analysis is required, which is unfeasible for my chosen project, in the allotted timescale I was given to complete it.

The reason I chose for not incorporating the following methodology was that due to its advantages, I felt that my project was not of a large enough scale for the

methodology to work correctly. The methodology is more geared towards large scaled industrial projects, with teams of people working towards the project, rather than a single developer. Another reason was that I felt that the nature of the documentation formulated by this development methodology would be inappropriate for the assessment criteria for my project, as it focuses heavily on developing smaller reports for each cycle, rather than a single report at the end of the project. Finally I felt that there was insufficient time allocated to the project to allow me to successfully cycle through the development model enough times to produce a good enough end product.

Lean Development Methodology (Ambler, 2010)

The Lean Development Methodology is an Agile Methodology that focuses on 7 key principles. The principles are the following:

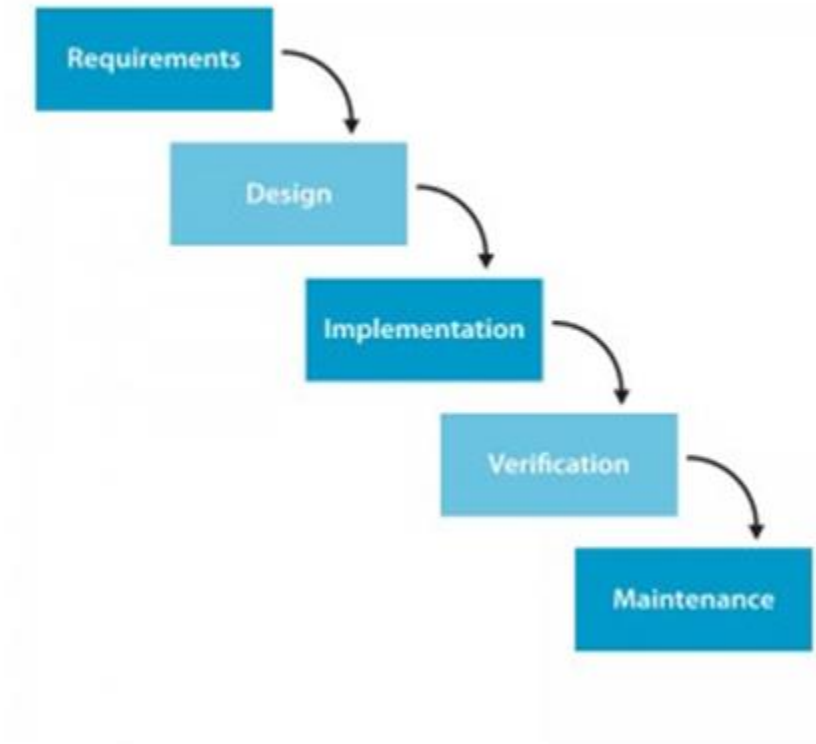
- Eliminate Waste – Lean development focuses on identifying superfluous activities that do not add value to the finished product, and aims to remove these from the development cycle.
- Build in Quality – The main aim of this principle is to prevent defects from occurring in the first place, however it also expects that when defects cannot be avoided, they should be corrected as the developer goes along, and should not be left to the end to fix all defects in the project.
- Create Knowledge – Lean development should use iterative development methods to help discover what stakeholders actually want from the project, and act on that knowledge.
- Defer Commitment – Lean development aims to leave irreversible decisions as late as possible so as to allow the development of the project to be as change tolerant as possible.
- Deliver Quickly – When a commitment has been made, Lean development aims to ship a completed implementation/documentation as quickly as possible.
- Respect People – As this is an individual project, this principle is unnecessary, as I am the only person on the project team.
- Optimise the Whole – Measurements should address how well the project delivers business value.

The Lean development methodology proves useful in reducing the amount of waste in developing a project, which would prove useful for my project, as it does have a small timescale, so it is important the most valuable features are implemented first. However I felt that this approach was too business-orientated for my project, which stands to be more of a technical report, rather than a business focused report. Also, due to the fact it was a development methodology that I was initially unfamiliar with, I decided to use the Waterfall methodology instead, as I have had experience using that methodology in the past, and given that I had no prior experience in mobile development before the project, I did not wish to complicate matters worse by choosing a development methodology I was unfamiliar with.

Waterfall Development Model Methodology (Waterfall Model, 2015)

The Waterfall Methodology (Figure 2) consists of 5 stages. The first stage is the requirements engineering stage. It is here that the requirements of the project are determined. When the requirements are confirmed, the project then moves on to the design stage, where the project is designed based on the project requirements. After the design is completed, the development cycle then enters the implementation stage, where the designs are implemented into a working system. This is then followed by the verification stage, where the system is tested to ensure that all the components work as they should. Finally, it enters the maintenance stage, where the errors found during testing stage are corrected for the final system. The waterfall model is a semi-sequential development methodology, as the project tends to go through each stage once, however the methodology does allow developers to backtrack if there is a problem in the previous documentation, e.g. if problems were found with the design during the implementation stage.

Figure 2



(Waterfall Model, 2015)

I chose the waterfall for several reasons. Firstly, it puts a higher priority on documentation than the other two methodologies do, which ties in with how the project will be assessed. Secondly is that I have used this development methodology in the past, and as such I know how it works, which simplifies some of the planning for the project. Finally, due to the time constraints on my project, I do not feel as though I have sufficient time to successfully complete the other methodologies.

Development Time Plan

The time plan for my project has not since changed from the initial report, however the scale has reduced. Please view appendix 5 for the Gantt chart of my time plan.

Design

The following section of the report should aim to define the design of my technology probe. Due to the fact that my project is a technology probe, the design section should prove to be relatively lightweight, as technology probes are generally implemented to be thrown away after the study is conducted, rather than being a continuously maintained/updated system.

System Requirements

The first step in designing my project was to evaluate the literature on the domain of my project and engineer a set of functional and non-functional requirements for the project to provide an idea of what the completed system will need to be able to do. Based on my research into the field outlined in the Literature Review section of the report, I believe that the following list of functional and non-functional requirements to be the necessary requirements for my project:

Functional Requirements

- **GPS Information** – needs to be able to garner the user's location using pre-existing GPS technologies built into the device.
- **Time Information Analysis** – needs to be able to garner the time based on the device's in built clock.
- **User Preference Analysis** – needs to be able to store and analyse user preferences.
- **Weather Forecast Analysis** – needs to be able to analyse the weather forecast.
- **Offline Functionality** – should be able to operate maps without requiring an internet connection.
- **Interactive Services** – should allow the user to inquire about attractions further, as well as allow users to book certain attractions that require booking, e.g. cinema tickets.
- **Manual Location Input** – should allow the user to input their location manually if the GPS tracking does not fully work.
- **User Generated Content** – should allow users to create user generated content, such as reviews of attractions.
- **Allow Users to Create Tours** – Users should be allowed to look up multiple attractions and queue them, so as to create a tour of locations they wish to visit.
- **Maps** – should provide users with maps of the area they are in, as well as the location of attractions on the map.
- **Translation** – should provide users with a translator that automatically configures to the local language, based on the device's current location.
- **Currency Exchange** – should provide users with a currency exchange feature that automatically configures to the local currency based on the device's current location.
- **Contextual Searching** – needs to be able to search for attractions based on the device's current contextual situation, e.g. night time in Cardiff should yield more results based on bars/restaurants.

Non-Functional Requirements

- **User Interface** – Needs to be simple and easy enough to use that it can quickly and easily be learned by the user.
- **Performance** – Contextual searching needs to be completed quickly, and use as little data network usage on the device as possible
- **Recoverability** – should the probe crash or the device switch off unexpectedly, users should be able to retrieve the previous settings on the technology probe e.g. should the technology probe crash; users should be able to easily retrieve the tour they were on before the system crashed.
- **Security –** any personal data entered into the system for preferences should be securely stored and not easily compromised, or if it were compromised, should not cause inconvenience/embarrassment to the user e.g. anonymising data should mitigate the risk of embarrassment to the user, as there would be nothing linking the compromised information to the user.
- **Scalability** – The system should be highly modular, so that additional features can be added without the risk of compromising the other features that have already been implemented in the system.
- **Reliability** – the system should reliably work in circumstances where all the required components are available, such as GPS signal and internet access.

As the initial scope of the project is too large to implement in the time allotted for this project, the scope of the project had to be reduced to developing a technology probe that can find dining establishments around the user, depending on the time of day. From the list of functional and non-functional requirements previously listed, the key ones for the technology probe are as follows:

- **Functional Requirements**
  - GPS Information.
  - Time Information Analysis.
  - Maps.
  - Contextual Searching.
- **Non-Functional Requirements**
  - User Interface.
  - Performance.
  - Scalability.
  - Reliability.

Use Cases

Upon completing the requirements analysis for my project, the next step of the design process was to develop use cases. By developing use cases, I can better understand what the necessary components for the technology probe are, based on my requirements, and how they need to interact with each other, which will aid in further design and implementation. The following section contains the use cases I developed for how my technology probe should operate with the user.

Use Case: Start Up Technology Probe	**Use Case ID:** 1
Use Case Description: Use case that defines how the user should start the technology probe to use.	
Actors: Consumer.	
Triggers: Consumer activity.	
Preconditions: Technology probe is installed on the device. The device has an internet connection. The device has GPS activated.	
Basic Flow: The consumer navigates to the technology probe on the device. The consumer launches the technology probe. Technology Probe should now be running on the device.	
Exception Flow: If GPS or Internet connection is not available, the technology probe should not be able to do anything, though the map should still be displayed.	
Post Conditions: Map is displayed.	

Use Case: Acquire GPS Location	**Use Case ID:** 2
Use Case Description: Use case that defines how the GPS location should be discovered.	
Actors: Location listener.	
Triggers: Launching the technology probe.	
Preconditions: GPS is active on device.	
Basic Flow: Location listener creates a location object. When location listener detects that the device location has changed, location listener should execute a command that updates the GPS location of the device. Location listener centres the map on the device location.	
Exception Flow: If GPS is disabled, location should not be found.	
Post Conditions: Map should be centred on current device position.	

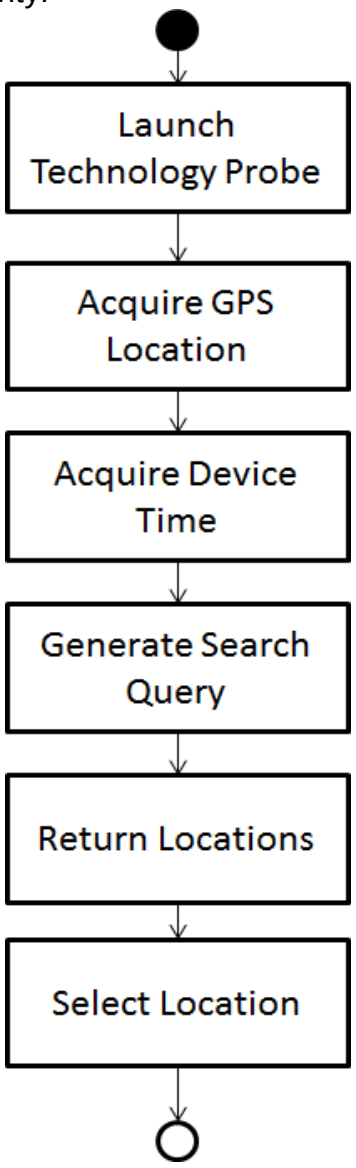
Use Case: Acquire Device Time	**Use Case ID:** 3
Use Case Description: Use case that defines how the technology probe should acquire the device's current time.	
Actors: None.	
Triggers: Location change.	
Preconditions: Technology probe should be running	
Basic Flow: Create a calendar object to get time and date of the device. Query calendar object to get the hour of the day of the device.	
Exception Flow: Search should not be able to work.	
Post Conditions: The current device time should be stored in the technology probe for future use.	

Use Case: Search for locations	**Use Case ID:** 4
Use Case Description: Use case that defines how the system should search for nearby locations.	
Actors: Location Listener. Time Class. Map.	
Triggers: Location change.	
Preconditions: Map has been created Device location has been found	

Device time has been found
Basic Flow: Create Google Places search query based on current time and location. Query Google Places using search query to retrieve results. Determine the nearest suitable locations to current location. Display on map. Repeat whenever location changes.
Exception Flow: If time or location is not available, no results should be displayed on the map.
Post Conditions: Map should display markers for nearby locations

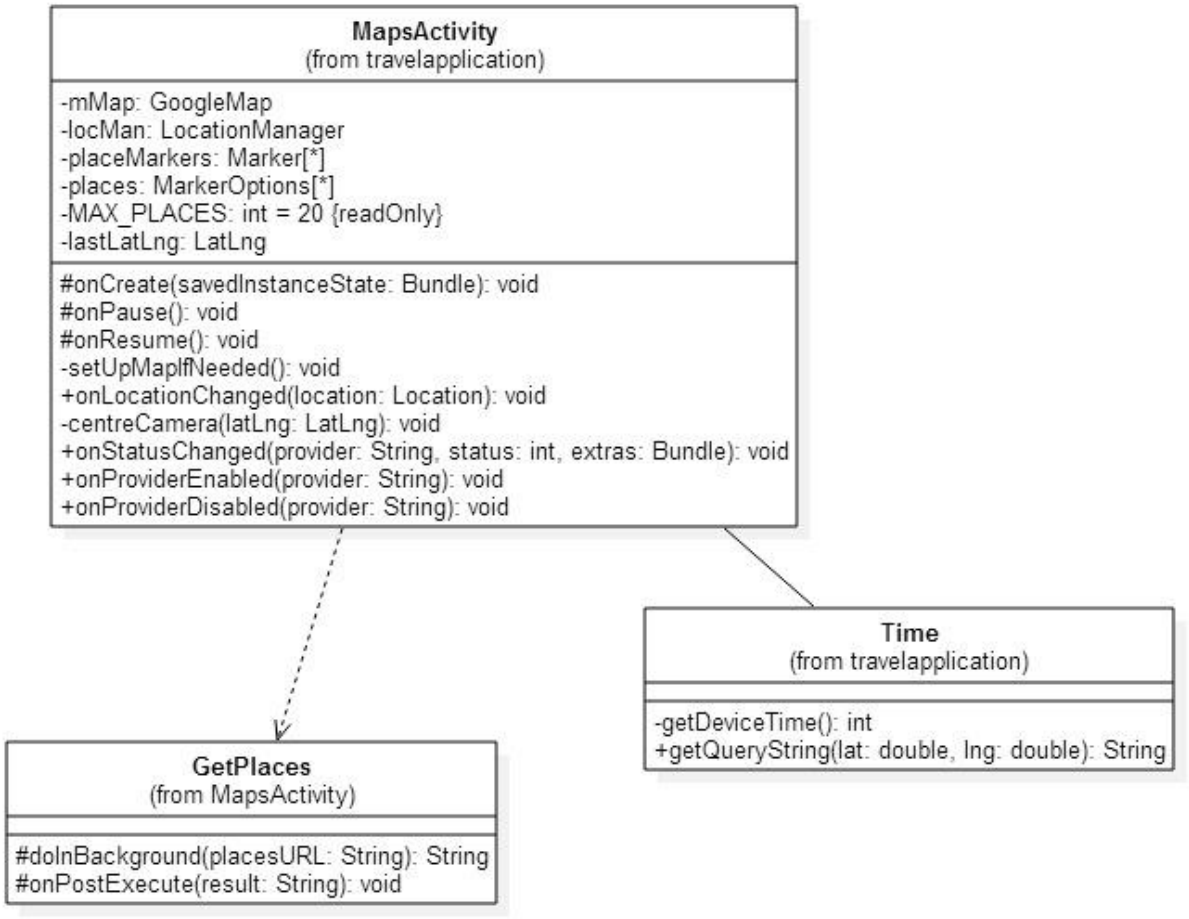
Activity Diagram

To better get an idea of how the components of the technology probe would work together, after designing the use cases, I then went about designing an Activity Diagram. The activity diagram aims to define the flow of activity throughout the technology probe. The black dot is the start condition of activity, and the white circle indicates the end-state of activity.



Class Diagram

The final aspect of my design was to design a class diagram for the technology probe. The class diagram should help in defining how the overall architecture of the technology probe should work, and the relationship between these classes.



Implementation

Based on the designs I generated for my project, I identified a need for four integral components to get the technology probe working as intended. The first component was the map component, which should handle creating and displaying a map, and also modifying the map's information displayed. The second component is the GPS location component, which should be responsible for locating the device, and detecting any changes of said location. The third component is the time component, which should be able to determine the device time, and save the time in a usable format for future use. The final component is the search component that is necessary in allowing the device find and store nearby locations.

In order to aid in development, I used the Android Studio IDE to program the technology probe. As I had no experience with mobile development prior to this project, and very little knowledge of XML, the Android Studio proved ideal, as it automatically generated the necessary XML files for android applications, such as the application manifest. It provided an easy to use UI designing tool, where the developer could draw the UI and the XML document that generates the UI was automatically created. It also made managing API's/Libraries much easier, as it came pre-packaged with nearly all of Google's API's. Finally, it made testing the technology probe much easier, as it easily allowed me to install the technology probe onto my own device, and came pre-packaged with an emulator which could be used to test the technology probe on my computer as well.

Map (User Interface)

Figure 3

Technology Probe UI

The first component that I implemented for the project was the map component. I felt as though this was the most important step at the start of the development phase, as it provided a screen upon which future development results could be displayed upon when being tested. The map served as the technology probe's user interface, as part of my requirements was that human interaction with the device should be as minimal as possible, as the device should do the majority of the work and just display the results to the user. As there were no other features, I saw no reason for developing a main menu for the technology probe, as it would only serve to slow down the operation of the technology probe. The picture inset shows the User Interface of my technology probe. The blue dot is the user's location, and each red marker is a location of interest around the user within the vicinity of 500 metres. Each red marker contains an information window, that when pressed, returns the name of the location, as well as the address, and Google+ rating of the establishment. The example inset shows that the user has selected "Pen & Wig" as their location of interest. The buttons on the bottom right allow the user to get directions to the location (left) and displays the

location on the google maps application that is standard on most android devices (right).

Creating the map UI was easy, as Android Studio allows you to define the type of activity you are creating for your project. One of the options was a maps activity, and upon selection of this activity, the IDE automatically creates an activity that contains a map. However the map generated does not have any information on it such as the user's current position. The map created also relies upon the Google Maps API, and therefore is bound by the licensing agreement for that API.

GPS Location

Upon completion of the map component of the technology probe, the next logical step in development was to implement the GPS location component of the technology probe. The GPS location was required for finding nearby locations to the user's current location, as well as for re-centring the map on the user's location, so that they can easily find their current location on the map. To develop this, the first step was to implement a location listener. Android has a class referred to as LocationListener, by extending this class on my main activity class, the main activity class starts monitoring changes in GPS Location. The LocationListener class however relies on a Location Manager being implemented in a class before it can start listening for changes in GPS location however, so I created a location manager in the onCreate method of my main class, and then set it to request location updates either every 30 seconds, or for every 100m change in the user's location. Every time the LocationListener receives an update, it then generates a new search query based on the new GPS coordinates of the device. I chose for it to only update every 30 seconds or 100metres so as to conserve network usage, as every time a location is updated, the technology probe does a new query over the internet for more locations. When the query is complete, the technology probe uses the device's current GPS co-ordinates to move the map to the user's current location.

Time

Upon completion of the GPS Location component of the technology probe, I then set about implementing a way to determine the device's time, and modify the search query based on the time. Android has a Calendar class that creates a calendar object of the device's current time and date. The class had many methods which allowed you to return different aspects of the calendar object. I decided that it would be easier to use this class than try and find my own way of getting the device time. I created a calendar object, and used the ".get(Calendar.HOUR_OF_DAY)" command, which returned the hour section of a time formatted by a 24 hour clock, e.g. 12:34, would return an int value 12. From this, I created a second method that took the device's current latitude and longitude co-ordinates as arguments to generate the search query. I then created a section of three "if" statements, corresponding to different times of the day, e.g. 3 - 11 is considered morning, 12 - 5 afternoon, etc. Based on the hour of day returned, I tweaked the search query to prioritise different locations using the "if" statements. This was how I developed Time awareness into my search queries.

Search

Upon completion of the Time component, I had the necessary components for generating a contextually aware search query. To process the query, I used the Google Places API. With the query generated in the time component, I then sent a query to the Google Places server and returned the results as a string. Upon that method being executed, a second method automatically executes that takes the results from the first method as an argument. It then parses through the results string, and creates a JSON object for each line of the string. It then retrieves the name, address, and rating of the establishment. For each location, it then creates markers, with the title as the name, and the address and rating as the snippet for the marker. It then displays these markers on the map. Due to API limitations, I could only return a maximum of 20 locations. I had difficulty with getting this section to work, however I found a working implementation on the internet which I included in the project, as I started running out of time. It extends the AsyncTask class, therefore it can run in the background of the main task, rather than interfere with the main task's operation.

Testing

Due to the nature of my project, standard unit testing was not sufficient to gauge how well the system actually worked. It needed to be proven that each component of the technology probe worked appropriately, which standard unit testing in lab was sufficient; however it also needed to be proven that the technology probe was actually operable in the real world. To test the technology probe I went through three different stages of evaluation to see that the technology probe actually worked. The first stage was to test that each component worked, and to do this, I did standard unit tests for each component in a controlled environment, with controlled variables to ensure the results returned were accurate. This was my lab testing of the project. The second stage then was to see that the technology probe worked in a real world setting. To test this, I created test scenarios of various locations around Cardiff, and then physically operated the technology probe at each location. This was my wild testing of the project, and was sufficient enough to prove that the technology probe worked as it should. The final stage was user testing. I gathered 10 users together to test the technology probe, and to provide opinions on the technology probe, such as features they liked, features they did not, and ways to improve.

Lab Testing

In order to test the application in a lab setting, I created 5 unit tests, which should prove that each component of the application works, and that the technology probe is ready to be taken out into the wild for testing. For each test, I used the same five locations, being Cardiff, London, Edinburgh, Dublin, and New York City. The following are my test cases for the Lab tests, and the results retrieved.

Test Case ID: 1			
Test Case Description: The purpose of this test case is to test that the technology probe can successfully acquire the device's GPS co-ordinates, and successfully display them on the map.			
Test Parameters: In order to effectively test this, I will run the test on my phone, with preloaded co-ordinates of 5 different locations around the world to ensure it can find the correct location. The co-ordinates I will use are: • Longitude 51.4833° N, Latitude 3.1833° W (Cardiff City Centre) • Longitude 51.5072° N, Latitude 0.1275° W (London City Centre) • Longitude 55.9531° N, Latitude 3.1889° W (Edinburgh City Centre) • Longitude 53.3478° N, Latitude 6.2597° W (Dublin) • Longitude 40.7639° N, Latitude 73.9800° W (New York City)			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Program co-ordinates for Cardiff into technology probe.		
2	Launch technology probe.		
3	Observe if map displays correct	Pass	Map displayed location within the

	location.		city centre of Cardiff.
4	Close technology probe.		
5	Program co-ordinates for London into technology probe.		
6	Launch technology probe.		
7	Observe if map displays correct location.	Pass	Map displayed location within London's city centre.
8	Close technology probe.		
9	Program co-ordinates for Edinburgh into technology probe.		
10	Launch technology probe.		
11	Observe if map displays correct location.	Pass	Location displayed within Edinburgh city centre.
12	Close technology probe.		
13	Program co-ordinates for Dublin into technology probe.		
14	Launch technology probe.		
15	Observe if map displays correct location.	Pass	Location displayed within Dublin city centre.
16	Close technology probe.		
17	Program co-ordinates for New York into technology probe.		
18	Launch technology probe.		
19	Observe if map displays correct location.	Pass	Location displayed in Manhattan, just south of Central Park.
20	Close technology		

	probe.		
Additional Notes: GPS spoofing was done by virtual GPS, an app that can be downloaded to spoof the device's GPS coordinates.			
Test Result: Pass			

Test Case ID: 2			
Test Case Description: The purpose of this test is to test whether or not the technology probe can successfully determine the time on the device, for use in determining which places of interest to display on the map.			
Test Parameters: In order to test this, I ran the device with a preloaded times that should satisfy the following criteria: • For morning: any time between 4am and 11am. • For afternoon: any time between 12pm and 5pm. • For night: any other time. I also set each branch of code for the following statements to print out the statement "morning", "noon", or "night" for each respective time period in the android terminal.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Program a morning time into the device.		
2	Run the technology probe.		
3	Observe the android studio terminal to see if the phrase "morning" appears.	Pass	With time set at 10:33, the phrase "morning" was printed to the terminal.
4	Program an afternoon time into the device.		
5	Run the technology probe.		
6	Observe the android studio terminal to see if the phrase "noon" appears.	Pass	With time set at 14:37, the phrase "noon" was printed to the terminal.
7	Program a night time into the device.		
8	Run the technology probe.		
9	Observe the android terminal to see if the phrase "night" appears.	Pass	With time set at 20:38, the phrase "night" was printed to the terminal.
Additional Notes:			

Test Result: Pass

Test Case ID: 3			
Test Case Description: The purpose of this test is to test whether or not the technology probe can successfully find and display places onto the map.			
Test Parameters: In order to best test this, I ran the technology probe off of my phone, using the GPS coordinates used in test case 1. For each one, I tested to see if establishments were marked on the map in relation to the GPS location.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Program GPS coordinates for Cardiff.		
2	Launch technology probe.		
3	Observe map for establishment markers.	Pass	Markers for various establishments appeared around the GPS location in Cardiff.
4	Close technology Probe.		
5	Program GPS coordinates for London		
6	Launch technology probe.		
7	Observe map for establishment markers.	Pass	Markers for various establishments appeared around the GPS location in London.
8	Close technology Probe.		
9	Program GPS coordinates for Edinburgh.		
10	Launch technology probe.		
11	Observe map for establishment markers.	Pass	Markers for various establishments appeared around the GPS location in Edinburgh.
12	Close technology Probe.		
13	Program GPS coordinates for		

	Dublin.		
14	Launch technology probe.		
15	Observe map for establishment markers.	Pass	Markers for various establishments appeared around the GPS location in Dublin.
16	Close technology Probe.		
17	Program GPS coordinates for New York.		
18	Launch technology probe.		
19	Observe map for establishment markers.	Pass	Markers for various establishments appeared around the GPS location in New York.
20	Close technology Probe.		
Additional Notes:			
Test Result: Pass			

Test Case ID: 4			
Test Case Description: The purpose of this test is to test whether or not the technology probe can successfully find different places and display them onto the map, with regards to the time of day.			
Test Parameters: As test 3 confirmed that the technology probe can find locations, and test 3 confirmed that the time awareness for the technology probe worked, I conducted this test based on my home location of 64 Rhymney Street. Based on the time of day, the technology probe should prioritise locations in the following manner: • Morning: | café | coffee shop | bakery | supermarket | fast food| • Afternoon: | fast food | supermarket | Café | bar | pub | • Night: | restaurant | bar | pub | takeaway | fast food | supermarket | By changing the time on my device, the results that should appear for local places should change to reflect these priorities.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Set device time to morning.		
2	Launch technology probe.		
3	Observe location types on map.	Pass	The technology probe prioritised establishments such as café's,

			bakeries and supermarkets, while disregarding locations such as restaurants, bars, and takeaways.
4	Close technology Probe.		
5	Set device time to afternoon.		
6	Launch technology probe.		
7	Observe and compare location types to morning search.	Pass	The technology probe returned less café's, and started returning other establishments such as bars and fast food restaurants in greater numbers.
8	Close technology probe.		
9	Set device time to night.		
10	Launch technology probe.		
11	Observe and compare location types with morning and afternoon searches.	Pass	The technology probe returned more restaurants, takeaways and bars, and put less emphasis on fast food outlets.
Additional Notes: Due to constraints with the API, only 20 locations may be returned at any given time, so there were cases of some locations that were applicable being left out, based on how google compared them to other outlets that matched the search criteria.			
Test Result: Pass			

Test Case ID: 5			
Test Case Description: The purpose of this test is to test whether or not the technology probe does not return information about locations that are closed.			
Test Parameters: I conducted this test in a similar manner to test 4, however for several locations; I looked up the operating hours on google to verify that the location is in fact open at the time of testing.			
Test Step:	**Step Description:**	**Result:**	**Notes:**

1	Launch technology probe.		
2	Observe locations on map.		
3	Look up operating hours and days for location on google to verify location is open.	Pass	Of the locations I verified, all appeared to be operating at the time of testing.
Additional Notes: Test conducted on Saturday at 5:36pm. Establishments verified: • Pen & Wig – 11:30am – 1:30am • Woodville – 11:30am – 12:30am • Mezza Luna – 5:30pm – 11:00pm • The Vulcan Lounge – 11:00am – 12:00am • Noodlebox – 12:00pm – 10:30pm • Fortune House – 5:30pm - 11:00pm • Rocket Joe's Pizza – 11:00am – 1:00am			
Test Result: Pass			

Wild Testing

For my wild testing, I took the application out to 5 different locations at different times of the day to determine that everything worked as it should in a wild setting. The locations I chose were the car park of the Queen's building, outside Sainsbury's on Queen Street, Cardiff Central Station, outside the castle, and Talybont court.

Test Case ID: 6			
Test Case Description: The purpose of this test is to test whether or not the technology probe can successfully track the user's movement, and update their location on the map.			
Test Parameters: There was no simple way to test how well this works in the lab, so I put the technology probe on my phone and walked down the street outside my house to see if the tracking updated.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Run the technology probe.		
2	Observe the starting location of the application		Location was 64 Rhymney Street, Cardiff.
3	Walk down the street.		Walked from Rhymney Street to Woodville road
4	Observe the end location on the map, and compare to the starting	Pass	Location displayed as Woodville road.

	location.		
Additional Notes: Phone was periodically checked on the walk and position was continually being updated, though not in real time. 30 second delay between updates due to usage limits on the Places API.			
Test Result: Pass			

Test Case ID: 7			
Test Case Description: The purpose of this test is to see that the technology probe can return user location in a real world setting.			
Test Parameters: To test this, I walked between five locations, and at each location launched the technology probe to check that the map displays the correct user location. The locations are as follows: • Car Park of the Queen's Building. • Outside of Sainsbury's on Queen Street. • Cardiff Central Station. • Outside the Castle. • Talybont Court.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Travel to location 1.		
2	Launch technology probe.		
3	Observe and verify location shown.	Pass	Location displayed as in the car park of The Queen's Building.
4	Travel to location 2.		
5	Launch technology probe.		
6	Observe and verify location show.	Pass	Location displayed as outside Sainsbury's on Queen Street.
7	Travel to location 3.		
8	Launch technology probe.		
9	Observe and verify location show.	Pass	Location displayed as Cardiff Central Station.
10	Travel to location 4.		
11	Launch technology probe.		
12	Observe and verify location show.	Pass	Location displayed as outside the castle.
13	Travel to location 5.		
14	Launch technology		

	probe.		
15	Observe and verify location show.	Pass	Location displayed as Talybont Court.
Additional Notes: Locations were chosen to be far apart enough so that distinctions on whether it found the location properly was easy. As GPS is not entirely precise, doing a check at the door to The Queen's Building on Newport Road and the car park for The Queen's Building could have been considered a grey area as the location results could have overlapped.			
Test Result: Pass			

Test Case ID: 8			
Test Case Description: The purpose of this test is to see that the technology probe can return places in a real world setting.			
Test Parameters: For the sake of consistency, I used the same locations as I used in test 7, as the route involved a fair bit of walking, I tested whether locations could be returned at the same time I tested if it could garner the user's location.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Travel to location 1.		
2	Launch technology probe.		
3	Observe locations shown.	Pass	Technology probe displayed establishments surrounding The Queen's Building car park.
4	Travel to location 2.		
5	Launch technology probe.		
6	Observe locations shown.	Pass	Technology probe displayed establishments surrounding the outside of Sainsbury's on Queen Street.
7	Travel to location 3.		
8	Launch technology probe.		
9	Observe locations shown.	Pass	Technology probe displayed establishments surrounding Cardiff Central Station.
10	Travel to location 4.		
11	Launch technology		

	probe.		
12	Observe locations shown.	Pass	Technology probe displayed establishments surrounding the castle.
13	Travel to location 5.		
14	Launch technology probe.		
15	Observe locations shown.	Pass	Technology probe displayed establishments surrounding Talybont Court.
Additional Notes:			
Test Result: Pass			

Test Case ID: 9			
Test Case Description: The purpose of this test is to test whether or not the technology probe can successfully determine the time on the device, and find appropriate locations based on the device time.			
Test Parameters: To test this, I visited the locations mentioned in test 7 at separate times, corresponding to morning, afternoon, and night times. At each time, I checked the results based on the list of priorities for each time, mentioned in test 5.			
Test Step:	**Step Description:**	**Result:**	**Notes:**
1	Travel to location in the morning.		
2	Launch the technology probe.		
3	Observe locations returned.	Pass	Results tended to prioritise cafés, coffee shops, and bakeries.
4	Travel to location in afternoon.		
5	Run the technology probe.		
6	Observe locations returned and compare to morning results.	Pass	Results tended to prioritise fast food outlets, cafés, bars, and pubs.
7	Travel to location at night.		
8	Run the technology probe.		
9	Observe the locations returned	Pass	Results tended to prioritise

	and compare to morning and afternoon results.		restaurants and bars.
Additional Notes: Each location was visited at the following times: • Morning: between 10-11 • Afternoon: between 2-3 • Night: between 7-8			
Test Result: Pass			

User Testing

Approach

To garner user opinion on my technology probe, the third step of my testing was to test on willing participants. As testing on people has ethical repercussions, the first task of user testing was to complete the university's ethics module to gain ethical approval to allow the testing on potential users. Upon passing the module, the next step was to develop a consent form and an information sheet for the study. This allowed me to explain the study to potential participants, and have them explicitly state their consent to me using information gathered for my report. After these were complete, I created a questionnaire to record information from the test. Upon completion of this, I went about getting people to participate in the user testing. In total I received 6 willing participants. The test was conducted as follows:

- I installed the technology probe onto my device.
- I handed my device to the participant.
- I briefly explained the purpose of the project, without divulging any usage guidance for the technology probe.
- I then allowed them 10 minutes to operate the technology probe how they saw fit.
- I asked them to vocalise their thought process while operating the technology probe.
- Upon completion of the test, I sat down with the participant and filled out the questionnaire in an informal interview.

Results

During the User Testing, one fault that did crop up was that rotating the screen of the device caused the markers to disappear from the map. Due to the length of time it takes to update the screen, as I wanted to try and balance network usage and battery life with performance, it caused the map to display no results for a fairly substantial length of time until the search updated. Other than this, no faults were discovered during the user testing.

I shall now provide a brief synopsis of the questionnaire results received, if you would like to read into the questionnaire results in more details, they will be in Appendix 4. In general, my technology probe was received fairly well with the test participants. When asked if they would use the technology probe if it were publicly available, 83% of participants responded with yes, while 17% responded with no.

When asked how usable the system was, most users agreed that it was fairly easily accessible. The lowest score received on usability was 5, and the highest was 10, with an average of 7.7. This is backed up that during the test, very few people got angry or confused with the technology probe during the time that they were operating it. When asked what features of the technology probe users enjoyed, the general consensus was the simplicity of the technology probe, the ability to get directions to locations, and the easy to read manner of the information displayed about the location. However there were many areas that required improvement that were pointed out during the user testing. The main points were to make the technology probe display more detailed information about locations, have the technology probe display more locations than 20, allow users to modify the search criteria, and it to make the technology probe work offline. There were other minor suggestions such as more interactivity with map markers that one test participant did point out, however I feel it is more important to pay heed to the opinion of the general consensus initially. Based on some quotes I recorded from the participants, the general consensus was positive towards the technology probe, even with its current faults. One user did state “I don’t see really see what the point of being able to find places around you is. Wouldn’t it make more sense to be able to search for places that aren’t nearby”, however that was the only negative remark the technology probe received. Another participant stated “I’m going away to Europe over the summer and this seems like it would be really useful.” even going to the extent of asking me for a copy of the technology probe upon completion of my project.

Results and Evaluation

For this section, I will take the results from my tests, and use them to evaluate how well my project answered the main research question of my project, which was would it be practical to develop a contextually aware travel application?

Main Findings of the Study

There are two parts to the question of whether it is practical to develop a contextually aware travel application that requires answering to fully evaluate this study. The first part is how well the technology probe actually worked. To evaluate this, I tested each component of the technology probe to ensure that it worked correctly. Based on my lab tests, and wild tests, all components of the technology probe worked as they should, as has been documented with my test cases in the testing section. The only bug that seemed to be uncovered was that screen rotation did have an adverse effect on map markers which made operation of the technology probe difficult. From this it can be determined that from a technical standpoint, implementation of the contextual travel application would be practical, as the main feature of the application has already been developed to an extent with the technology probe, and it appears to operate correctly.

The second part of the question that needs answering is the user opinion of the technology probe. Just because something can be done, does not necessarily mean that it should be done. This is where the questionnaires came in, to garner user opinion on the technology probe to see if there is any reason to develop the project further, or if the idea should be abandoned. I have mentioned previously that during the user testing, general response from the test participants tended to be favourable towards the technology probe. More detail can be found in the user testing section of the testing part of the report. Based on these favourable reviews, with 83% of test participants said that they would use the technology probe if it were publically available, this tends to suggest that if I were to take development further, people would be interested in the result. This answers the second part of the question, as if users would want to use application, there is a practical reason to develop the application.

The results returned are significant, as with these results, I am able to conclude that it would be practical, should I wish, to develop the application I had originally intended to develop, as there is a demand for such an application.

Alternative Explanations for Findings

There are no alternative explanations for how well the technology probe worked, as the tests used to determine how well it worked were binary tests, they either passed, or they failed, there was no room for interpretation. However, for the user feedback, there is another possibility that would explain the results obtained. The people who actually agreed to test the technology probe are friends and family of mine. They have been aware of the amount of work I have put into the project, and as such, their responses may have been skewed for fear of hurting my feelings. I did inform them to be honest in their feedback; however, it is still a possibility that this was the case.

Relevance of Background Literature

The background literature for this project was not overly relevant. As mentioned in the Literature Review of the project, most of the background literature for similar projects was antiquated by today's standard. They did provide some insight into the location based technologies available for my project, as well as providing an insight into the domain of contextually based computing. However, they tended to go in depth about how to set up hardware to create mobile networks and GPS receivers, which was irrelevant to my project, as nowadays, most phones are capable of accessing the internet and have GPS receivers built into them. The research done into similar applications to my technology probe however proved relevant, as it assisted in help me design the technology probe, and helped me establish what features are important to my application.

Limitations of the Project

The technology probe had its fair share of limitations. The 2 biggest limitations it had were due to the Google Places API, which I relied upon for the finding of information about places. The first limitation of this was the number of locations I could return. The free license of Google Places has the limitation that it only returns a maximum of 20 places at a time. This was fine for a proof of concept that the technology probe intended to be, however for further development, this would need to be remedied. The other major limitation of the Google Places API is that the OpenNow Boolean in the search query does skew some of the results returned. It only returns places that are currently open based on the opening and closing times of the location. If the data is incomplete for opening and closing times, the location is never shown on the technology probe, even if it is actually open during the time of operation. It also had a lesser limitation in the information that can be returned. The Google Places API can return technical information like address, phone number, name, etc. It lacks more meaningful information, such as a description of the location, e.g. a description of a restaurant stating what kind of food they serve, etc.

The Google Maps API's main limitation was the markers that I used to display the locations. The map markers have limited space that information could be displayed on. Due to this, I was unable to return the amount of information that I would have liked to return. I was only able to return the name, address, and rating of a location. There was also an issue with the GPS listener and the API's. As the API's have a limited number of free queries per day, if the GPS listener update is set too short, the technology probe can end up exceeding these free queries and then the technology probe is inoperable for the remainder of the day, until the queries reset.

Future Work

There are several aspects of the project that I would improve upon in future work. The main aspect I am unhappy with the technology probe is its reliance upon the Google Places API. The free license for the Google Places API has its fair share of limitations, as mentioned previously. In the future, I would like to find a way to no longer have to use this API, either by finding a different one that has similar functionality, or finding a way to create my own location information objects. I also intend on implementing a review feature that would allow users to review places, however, as the current system for viewing reviews was tied into the Google Places API, which had no functionality for submitting reviews; this is currently not possible, until I find a way to replace the Places API with something else. I would also like to implement more contextual information gathering into the technology probe in future, such as weather forecasts and user preferences, to better analyse which locations would be best considering the user's context.

Based on user feedback, there are more features that I should consider adding in the future to the technology probe. These features include the following:

- Being able to interactively reserve seats at restaurants.
- Allow users to modify search criteria.
- Save locations to revisit later.
- Create routes between places.
- Offline functionality.
- Ability to check location prices.
- Ability to share location with other people.
- Customisable map markers, based on location type.
- Additional interactivity with map markers, such as clicking the location name takes you to location website.
- Colour blind mode.

Conclusions

The main conclusion that I can draw from the study is that my initial idea of creating a contextually aware travel application would be a practically viable should I choose to continue development upon completion of the project. User feedback from the technology probe was favourable, which suggests that people would be want to use the contextually aware travel application if it were developed, which means there is a reason to develop it should I wish to continue. However, I feel that I should also conclude that further testing would need to be done, before this conclusion could be acted upon. Though the user response was positive, my test space was fairly small, and therefore my results may differ from actual opinion. A larger test space will need to be used to be able to comfortably conclude that it would be practical; however I feel the feedback I received is indicative that it would be practical.

Reflections on Learning

During the course of my project, I feel as though I have managed to learn a lot, especially with regards to contextual computing and also mobile development. When I initially started this project, I had no knowledge of how mobile development worked; I had never had the opportunity to do any mobile development. During the course of the project, I had to look up a lot of the documentation for android development in an attempt to try and understand how I could approach my project, e.g. there was an issue with importing classes that I could not get to work as you have to enable permission to use certain classes in the application manifest, which I was initially unaware of. Thanks to this project, I feel as though I have developed enough knowledge in the domain of android development to become a competent android programmer. As for contextual computing, I feel as though my research into the field of contextual computing has helped me develop a better appreciation of contextual information, and how it can be used in computing. Contextual computing was briefly touched upon in a module in the second year of university; however it primarily focused on location based technology. I have learnt to understand that there is a broader range of contextual information that can be used, than I had initially assumed, such as user preferences, user mood, etc.

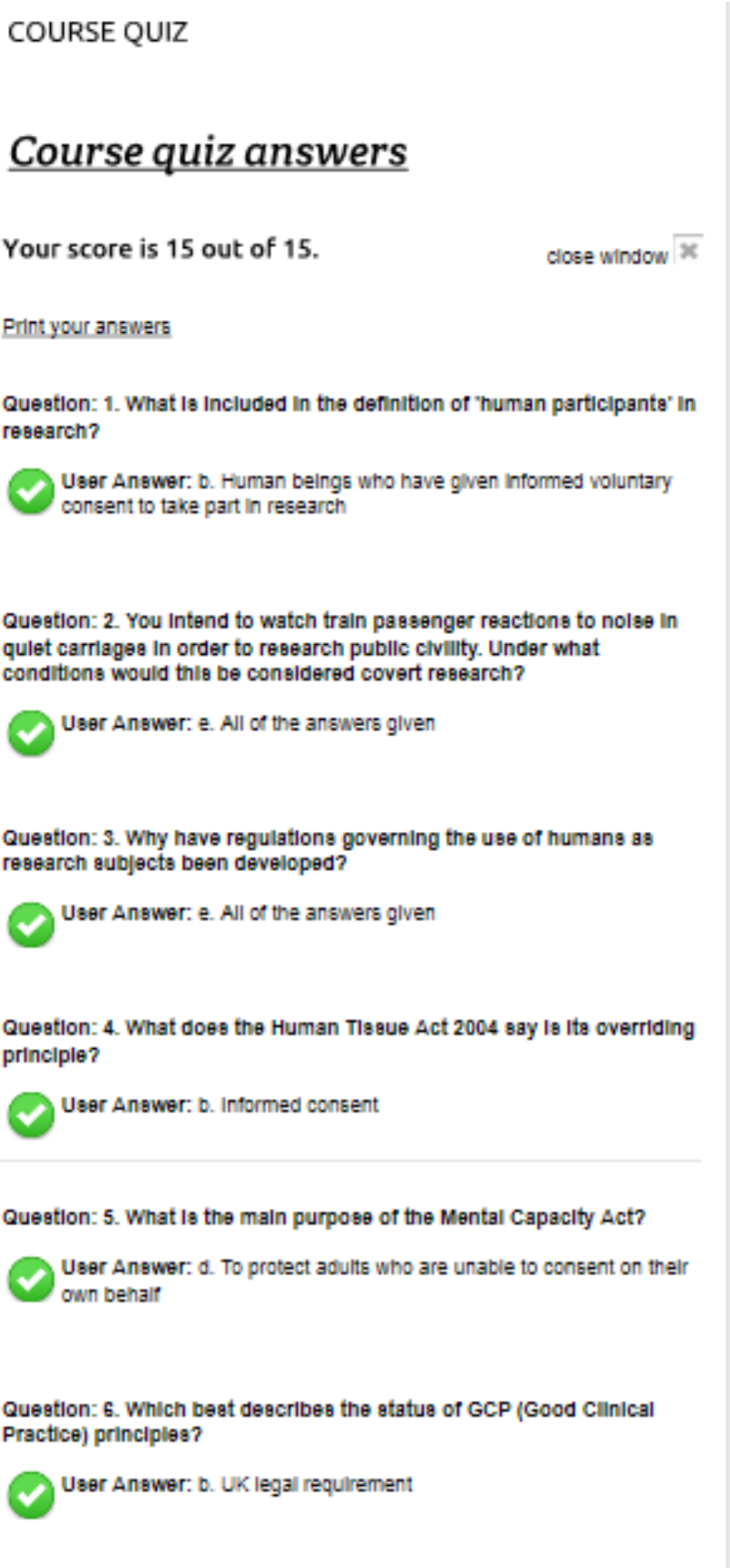
The project has instilled in me a greater appreciation for the importance of time planning and self-discipline. Prior to this project, I have never had to manage my own time before, as most of my work has been structured by other people, e.g. Lecture timetables for university, or lesson timetables for school. Granted there is some element of time management to this, such as scheduling coursework/revision around the lectures, it was not to a similar degree as this project focused upon. Given the timeframe of the project as well, it was crucial that I actually managed to manage my time effectively. Self-discipline was also crucial, as there was no real structure to the project module, such as intermittent deadlines, I found that it was easy to fall into the mind-set of “I don’t feel like doing that today, I’ll do it tomorrow”. In previous work that I have had to manage, the timeframes and scale of the work due has been so small that this has not really been an issue, as the deadlines are never that far off.

The project has also taught me that I have flaws that I was unaware of previously. Before starting the project, I believed myself to be a proficient programmer. However, I discovered that when implementing the project, I had difficulties getting the components of the technology probe to work properly. Whether this was due to programming for an unfamiliar operating system, or simply because my programming skills were lacking I am not entirely sure of. However this has proved eye opening and is something I feel I need to look into bettering after the project is done. I also feel that my design abilities are lacking. This has been an issue that has ailed me in previous project as well. I am able to conceptualise the main functions that need to be in the implementation, as well as who will be interacting with the implementation, but I find I have trouble in conceptualising the relationships between components and how components should be implemented in an object orientated manner. I shall have to read more into the literature surrounding designing software, as well as practice more in the hopes that it will improve my design abilities.

I also learned the importance of working with other people during the course of the project. Though it was an individual project, having a supervisor to meet with every week proved invaluable, as it provided someone with more experience with this type of work than I did, that I could ask for advice when I ran into difficulties with the project, and also bounce ideas off of for when I was unsure of whether ideas were good or not. Had it not been for having a supervisor for my project, and being left to my own devices to do the project, the project may not have been completed by the deadline.

Appendices

Appendix 1 – Ethics Module



COURSE QUIZ

Course quiz answers

Your score is 15 out of 15. close window

Print your answers

Question: 1. What is included in the definition of 'human participants' in research?

User Answer: b. Human beings who have given informed voluntary consent to take part in research

Question: 2. You intend to watch train passenger reactions to noise in quiet carriages in order to research public civility. Under what conditions would this be considered covert research?

User Answer: e. All of the answers given

Question: 3. Why have regulations governing the use of humans as research subjects been developed?

User Answer: e. All of the answers given

Question: 4. What does the Human Tissue Act 2004 say is its overriding principle?

User Answer: b. Informed consent

Question: 5. What is the main purpose of the Mental Capacity Act?

User Answer: d. To protect adults who are unable to consent on their own behalf

Question: 6. Which best describes the status of GCP (Good Clinical Practice) principles?

User Answer: b. UK legal requirement

Question: 7. An important part of the protection of participants is the process of informed consent. Which statement about the information required for consent is true?

User Answer: b. It must provide the information necessary for participants to decide whether or not to take part in the study

Question: 8. Which of these is NOT a section you should include in a patient information sheet?

User Answer: b. Short CV of members of the research team

Question: 9. Under what conditions is a research participant allowed to withdraw from a study?

User Answer: c. The participant wants to withdraw

Question: 10. You wish to include children aged 14 in your research. According to best practice how should you gain their consent?

User Answer: e. You gain the child's consent or agreement to their involvement with the study and the informed consent from the child's parent or legal guardian

Question: 11. You are writing a participant sheet for a study involving early stage Alzheimer's patients. What should you consider when providing them with information?

User Answer: e. All of the answers given

Question: 12. What must a child who agrees to try out a new asthma treatment demonstrate to be considered Gillick competent?

User Answer: e. All of the answers given

Question: 13. When is it not possible to anonymise data fully?

User Answer: e. In longitudinal studies where researchers will return to the original group of participants AND in studies where personal results will be fed back to participants

Question: 14. Which of the following would be considered negligent harm?

User Answer: c. Contracting an infectious disease from a dirty needle

used to extract blood

Question: 15. You intend to identify a street in an area known to be polluted and approach the general public to ask them questions about their attitudes towards pollution. To whom should you apply for ethics approval?

User Answer: c. Your university ethics committee

Appendix 2 – Consent Form

Christopher Davies – DaviesCT1@cardiff.ac.uk

Participant Identification Number:

CONSENT FORM

Contextually Aware Technology Probe User Testing

Name of Researcher: Christopher Davies

Please initial box

1. I confirm that I have read and understand the information sheet dated for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. ☐

3. I understand that any information given by me may be used in future reports, articles or presentations by the research team. ☐

4. I understand that my name will not appear in any reports, articles or presentations. ☐

5. I agree to take part in the above study. ☐

6. I am at least 18 years old. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature

Appendix 3 – Information Sheet

Contextually Aware Technology Probe User Testing

Information Sheet

The Technology Probe

The aim of this project is to create a technology probe that can analyse a user's context, and return locations of interest to the user based on the user's context. For the purpose of this project, contextual information pertains to two types of information. The first type of information is location information, and the second type of information is the current time. The technology probe aims to be able to analyse your current location, and the current time, in order to find locations of interest around your surroundings, and return information to you regarding them. For the sake of the test, the locations of interest will all be dining establishments; however the type of dining establishments shown should differ depending on the time of day, e.g. mornings should prioritise returning café's over restaurants.

The Purpose of the Study

The user testing of the technology probe has two main objectives. The first objective is to test that the technology probe can operate correctly in a non-controlled setting. The second is to test the practicality of creating an application from the technology probe. To gather information as to the practicality of this, user feedback will be required, which is where you will come in as the test participant.

The Test Procedure

The test procedure should be straightforward, and you will be provided with a device with the technology probe pre-installed, so there is no risk to your own phone. The test will comprise of two parts. The first part will be the hands-on testing. During this part of the test, you will be given the device with no instruction on how to operate the technology probe. You will have 10 minutes to use the device however you wish. It is asked that during this section, you vocalise your thought process while using the technology probe. If you are unsure on how to do this, I will gladly run through another application on my phone demonstrating how I'd wish for the test to be conducted. Upon completion of the first part of the test, the final part of the test will be conducted immediately. A questionnaire has been created to allow you to give feedback on the technology probe. I will run through the questionnaire with you in an informal interview to gather your feedback.

Appendix 4 – Questionnaire Results

Contextually Aware Technology Probe User Testing

User Feedback

1) How would you rate the usability of the technology probe on a scale of 1 – 10? (1 = Unusable, 10 = Very easy to use)

1 2 3 4 5 6 (7) 8 9 10

2) Would you use this technology probe if it were commercially available? (Yes) No

3) What functionality could be included to improve the technology probe?

Ability to book seats at location
Ability to choose what types of location to look for
Ability to rate locations

4) What features did you like about the technology probe, if any?

Can find locations on the fly, rather than having to manually search.
Easy to use
Simple display, not overcrowded
Can get directions to locations

5) What features of the technology probe could be changed to improve the technology probe?

Display more locations
Display more information about location
Allow users to modify the search criteria

6) Any further comments you would like to add about the technology probe?

Sluggish waiting for location to update
Map markers are finicky to use in location dense places

Contextually Aware Technology Probe User Testing

User Feedback

1) How would you rate the usability of the technology probe on a scale of 1 – 10? (1 = Unusable, 10 = Very easy to use)

1 2 3 4 5 6 7 8 (9) 10

2) Would you use this technology probe if it were commercially available? (Yes)/No

3) What functionality could be included to improve the technology probe?

Review locations
Save locations
Create routes between places

4) What features did you like about the technology probe, if any?

Really simple to use "you just turn it on, and it shows you all these places"
No need to type anything, can easily use while moving
Can get directions to places, handy in unfamiliar locations

5) What features of the technology probe could be changed to improve the technology probe?

Ability to change search criteria
Display price range information, and contact number
Displaying restaurant menus would be useful
Offline functionality

6) Any further comments you would like to add about the technology probe?

"I'm going away to Europe over the summer, and this seems like it would be really useful. Could you give me a copy of it after you've finished your project?"

Contextually Aware Technology Probe User Testing

User Feedback

1) How would you rate the usability of the technology probe on a scale of 1 – 10? (1 = Unusable, 10 = Very easy to use)

1 2 3 4 (5) 6 7 8 9 10

2) Would you use this technology probe if it were commercially available? Yes (No)

3) What functionality could be included to improve the technology probe?

Ability to check location prices
Ability to search for other locations and times for Pre-Planning
Ability to save location to a Favourites menu
Legend to explain what markers mean

4) What features did you like about the technology probe, if any?

Can get directions
Information is displayed in an easy to read manner.

5) What features of the technology probe could be changed to improve the technology probe?

Offline Functionality – Concerns of data limits
Ability to review locations
More detailed and relevant information on locations
Ability to modify search criteria

6) Any further comments you would like to add about the technology probe?

"I don't really see what the point of being able to find places around you is. Wouldn't it make more sense to be able to search for places that aren't nearby?"

Contextually Aware Technology Probe User Testing

User Feedback

1) How would you rate the usability of the technology probe on a scale of 1 – 10? (1 = Unusable, 10 = Very easy to use)

1 2 3 4 5 6 7 (8) 9 10

2) Would you use this technology probe if it were commercially available? (Yes) / No

3) What functionality could be included to improve the technology probe?

Ability to book seats at a restaurant
Save locations
Review location
Ability to share locations with other people

4) What features did you like about the technology probe, if any?

Very lightweight and easy to use
Find ~~things~~ places with minimal effort
Information easy to read.

5) What features of the technology probe could be changed to improve the technology probe?

Offline functionality
More information
Customisable markers
Modifying search criteria
Display more locations

6) Any further comments you would like to add about the technology probe?

"The markers are a bit confusing, it would be nice to be able to differentiate between restaurants and bars"

Contextually Aware Technology Probe User Testing

User Feedback

1) How would you rate the usability of the technology probe on a scale of 1 – 10? (1 = Unusable, 10 = Very easy to use)

1 2 3 4 5 6 7 8 9 (10)

2) Would you use this technology probe if it were commercially available? (Yes)/No

3) What functionality could be included to improve the technology probe?

Booking
reviewing
routes between places
Ability to change the map view
Ability to see pictures of locations

4) What features did you like about the technology probe, if any?

Simplicity of the application
Very difficult to get lost using it
Can get directions
Useful for when in unfamiliar locations

5) What features of the technology probe could be changed to improve the technology probe?

include price range information
Speed up location updates - it feels sluggish
Offline functionality
Allow users to modify the search priorities.

6) Any further comments you would like to add about the technology probe?

"It seems really good, however it does feel a bit unfinished. Navigating the map in a densely populated area is difficult as the markers tended to interfere with the zoom touch commands"

Contextually Aware Technology Probe User Testing

User Feedback

1) How would you rate the usability of the technology probe on a scale of 1 – 10? (1 = Unusable, 10 = Very easy to use)

1 2 3 4 5 6 (7) 8 9 10

2) Would you use this technology probe if it were commercially available? (Yes) / No

3) What functionality could be included to improve the technology probe?

more info
Title click leads to website

4) What features did you like about the technology probe, if any?

Simplicity
lack of clutter
Accuracy

5) What features of the technology probe could be changed to improve the technology probe?

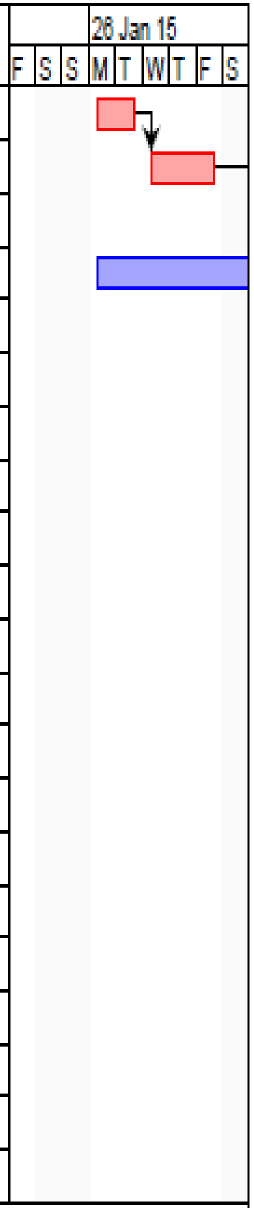
change search distance
Icon for app on android menu
colourblind mode

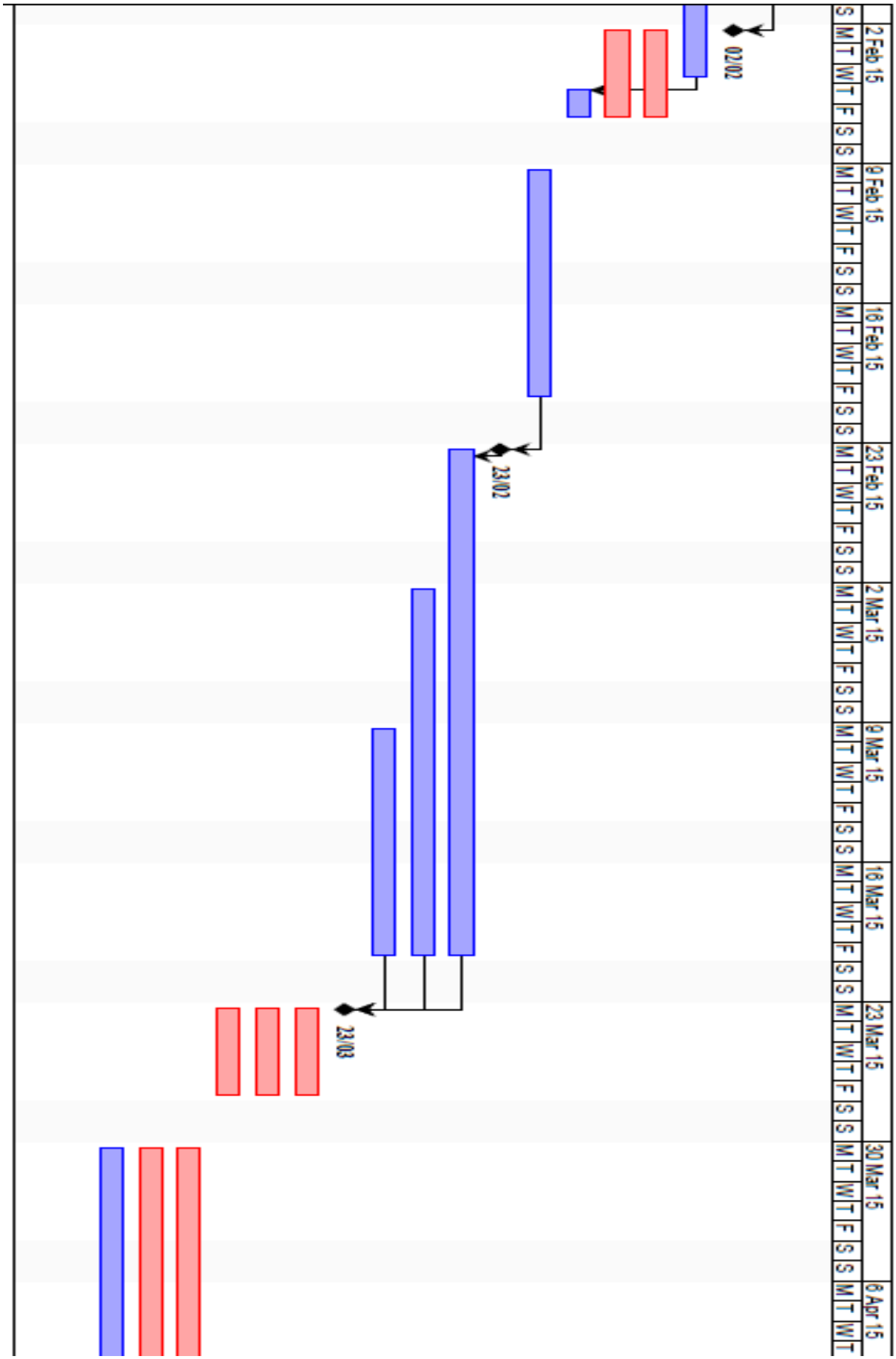
6) Any further comments you would like to add about the technology probe?

"could do with more features, but not to the extent that it clutters"
"more interactivity with markers"

Appendix 5 – Time Plan

	Name	Duration	Start	Finish	Predecessors
1	Discover Aims And Objectives	2 days	26/01/15 08:00	27/01/15 17:00	
2	Complete Initial Plan	3 days	28/01/15 08:00	30/01/15 17:00	1
3	Hand in Initial Plan	0 days	02/02/15 08:00	02/02/15 08:00	2
4	Background Research	8 days	26/01/15 08:00	04/02/15 17:00	
5	Finalise Development Strategy	5 days	02/02/15 08:00	06/02/15 17:00	
6	Report Introduction	5 days	02/02/15 08:00	06/02/15 17:00	
7	Research Write Up	2 days	05/02/15 08:00	06/02/15 17:00	4
8	Specification And Design Of System	10 days	09/02/15 08:00	20/02/15 17:00	
9	Design Complete	0 days	23/02/15 08:00	23/02/15 08:00	8
10	Implementation Of Contextual Information Gathering	20 days	23/02/15 08:00	20/03/15 17:00	9
11	Implementation Of Search Using Contextual Information	15 days	02/03/15 08:00	20/03/15 17:00	
12	Implementation Of UI	10 days	09/03/15 08:00	20/03/15 17:00	
13	Complete Implementation	0 days	23/03/15 09:00	23/03/15 09:00	12;11;10
14	Write Up Of Test Cases	5 days	23/03/15 08:00	27/03/15 17:00	
15	Lab Testing	5 days	23/03/15 08:00	27/03/15 17:00	
16	Wild Testing	5 days	23/03/15 08:00	27/03/15 17:00	
17	Application Debugging And Additional Testing	15 days	30/03/15 07:00	17/04/15 17:00	
18	Evaluate System For Final Report	15 days	30/03/15 08:00	17/04/15 17:00	
19	Final Report Write Up	25 days	30/03/15 08:00	01/05/15 17:00	
20	Record Demo Of Application	5 days	20/04/15 08:00	24/04/15 17:00	
21	Final Report Hand In	0 days	05/05/15 08:00	05/05/15 08:00	19

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9 Feb 15
16 Feb 15
23 Feb 15
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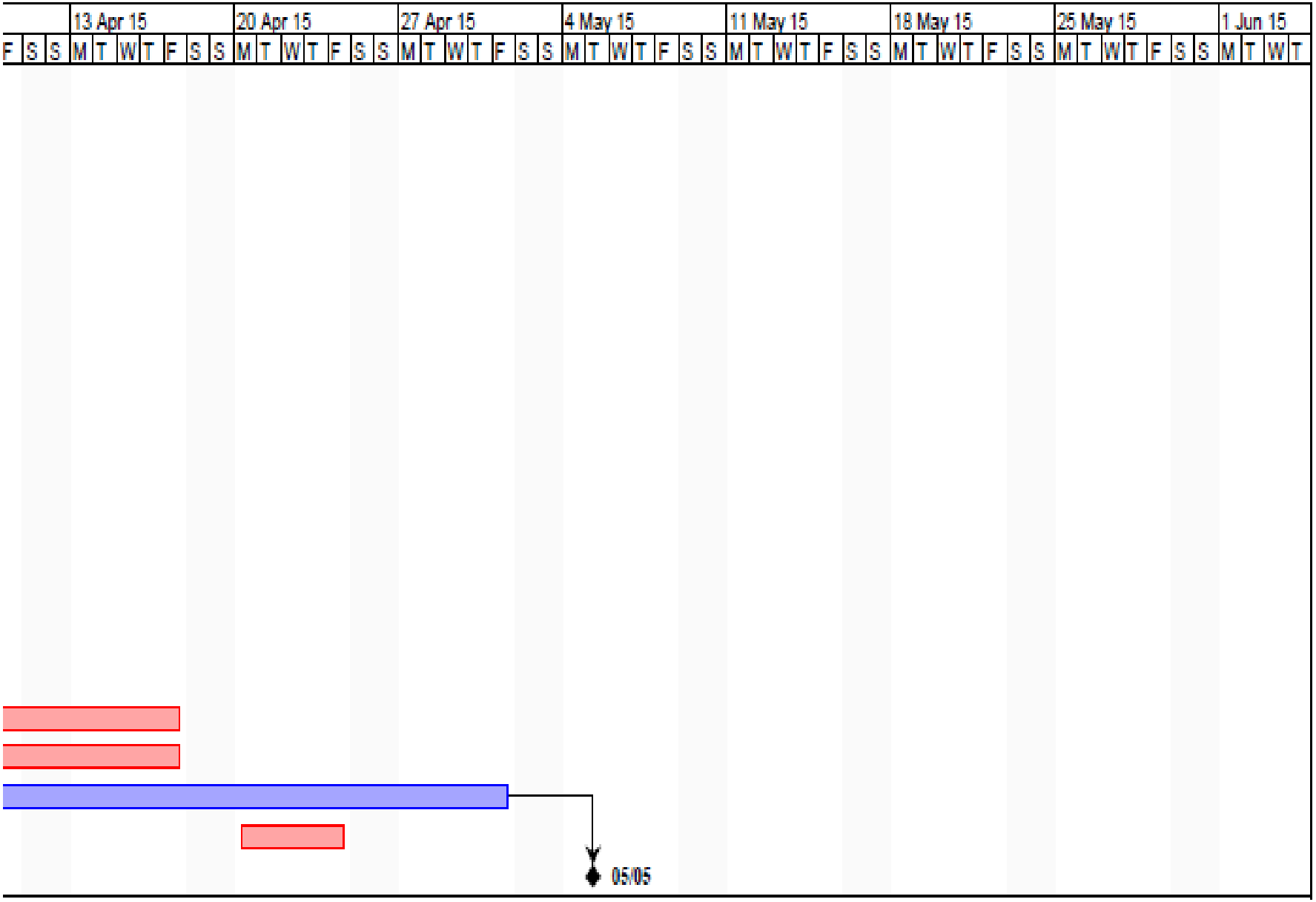
16 Mar 15
23 Mar 15
30 Mar 15
6 Apr 15
02/02
23/02
23/03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1 Jun 15
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