

Dissertation in Computer Science  
Project Proposal

## Providing mobile access to clinical data in complex environments

### Motivation and rationale

#### *The context:*

A healthcare informatics company based in the north-east of England named Clarity Informatics currently produce and maintain a large amount of high quality clinical data used by a large number of primary healthcare professionals globally to assist their day to day work. This data comes in the form of 'Clinical Knowledge Summaries' (hereby known as CKS) which are summaries of almost 350 different topics (e.g. asthma, meningitis, HIV) consisting of 1000 clinical presentations or patient scenarios, the topics contents are presented in a common format making them an easily readable resource and are continually reviewed and updated [7].

Primary healthcare professionals (e.g. GP's) use the CKS to obtain specific information on different topics, sometimes in time constrained environments in order to make informed decisions on how best to treat a patient. They can view background information on the topic, different patient scenarios alongside management and prescribing information through their web browser.

#### *Use case:*

Consider Dr Jones, a GP in rural Australia who spends half his time in the office and half his time conducting home visits for patients. He is an active user of CKS and somewhat relies on the information he obtains from the website to diagnose his patients. Dr Jones receives a call from a patient a long distance away who would like him to visit, so he enquires as to the symptoms of the patient to ensure that it is worth his time to go. Dr Jones agrees to visit and travels to the patient, he further listens to the patients' symptoms - however he is unsure as to what exactly is wrong with the patient and so attempts to access the CKS over the browser of his laptop to confirm a diagnosis. Dr Jones cannot access the CKS as he cannot gain access to an active internet connection - he fails to make a diagnosis and advises the patient that he will need to return to his office before issuing a prescription, prolonging a potentially critical diagnosis on the basis that he cannot access the information that he needs.

#### *The problem:*

Users of the CKS must have access to both a web browser and an active internet connection in order to view the clinical data. As presented in my use case, you can see that there are a number of potential use cases in which users will not be able to satisfy these requirements, another example being healthcare professionals working in 'no' zones in hospitals which require that devices be operated on flight safe mode. Some use cases involve users operating in a time constrained environment and must rely on a weak internet connection in order to fetch data, which may not be up to speed. It is important that primary healthcare professionals have fast and reliable access to the information that they require, and should not need to rely on a consistent internet connectivity to perform this task. There is a very large amount of data contained in the CKS, including multimedia, and so fetching this data may be too slow in a time constrained environment.

#### *The solution:*

Clarity have commissioned me to develop an end user system as a solution to this problem and to ensure that its users have access to this data when they need it, particularly in complex environments. I intend to develop a cross-platform mobile application capable of presenting all CKS data to the user in a responsive and accessible manner. The applications design will comply with NC State University's Universal Principles of Design [1] in an effort to create a highly usable application that not only serves the requested information to the user but intelligently caches the data offline to account for the accessibility problems introduced with each use case.

### Aims and Objectives

**Aim:** Get Clarity's clinical data into the hands of healthcare professionals in challenging environments, via a cross platform mobile application.

This context aware mobile phone application will be fit for use on iOS, Android and Windows devices, and it will serve as a platform from which primary healthcare professionals can not only view all the topics and information contained in the CKS, but from which the contents can

be downloaded and stored for offline use. The app will serve relevant topics tailored for each specific users needs, as well as accounting for unforeseen events, whilst keeping the user informed and up to date in a user friendly and non-obtrusive manner.

#### Objectives:

1. Rapid prototyping of the app, taking data from Clarity's API, hosting it on the web and serving it from there
2. Research and implement the required functionality to serve data specifically accounting for intermittent or non functioning network connections
3. Personalise the offline caching of data to tailor accessibility to individual users' needs
4. Account for changing epidemics/diseases and the effect this will have on the users' requirements for data access
5. Extensive user testing to obtain confirmation that each potential use case is satisfied with appropriate mechanisms
6. Research usability, accessibility and UX and construct a UI centred around these principles

#### Background

[2]	"Mobile Cross-platform development versus native development A look at Xamarin Platform" Armgren M.	<p><b>Description:</b> This paper takes a close look at the performance of Xamarin Platform, a cross-platform app development tool and compares it to the performance of natively developed apps. The performance of Xamarin on iOS and Android is native for most user interface and network components, however computational tasks are slower in comparison.</p> <p><b>Relevance:</b> My application will be cross platform and thus I must take into account the affect developing it using a third party software like Xamarin will have on its performance. Since I will not be performing large in-app computations I find that there will be little affect on creating my app this way - the positive aspect is that it will save an inordinate amount of time in comparison to developing an individual app per platform.</p>
[3]	"Agile development iterations and UI design." Ferreira, J., Noble, J. and Biddle, R.	<p><b>Description:</b> This paper explores the agile development methodologies when used in addition to UI design. There are a number of points raised which show how iterative development can work in sync with UI design to an advantage. It explains how projects which understand iteration planning and its affect on UI design can improve development towards their end goal.</p> <p><b>Relevance:</b> This paper is particularly useful for me to understand the need for combining agile methodologies into my development cycle. My investigation and analysis of user cases and the solutions i decide to implement will all have affect on the UI and so it is important that I account for the effect each agile iteration will have.</p>
[4]	"Location management for mobile commerce applications in wireless internet environment" Upkar Varshney	<p><b>Description:</b> Varshney analyses the role and challenges involved with creating context aware applications with functionality like location based services, studying their compatibility with existing wireless infrastructure. He advises that the overhead involved with location management can be estimated by modelling or simulating applications in terms of location precision, response time, transaction frequency etc. &amp; how performance compromises can be made to incorporate desired functionality.</p> <p><b>Relevance:</b> I intend to incorporate location based push or pull notifications into my application and it is key that I not only understand the capabilities of the infrastructure behind my services but also how to estimate and plan for the physical toll this will have on my application.</p>

[6]	<p>“Rapid prototyping: lessons learned.” Gordon, V.S. and Bieman, J.M.</p>	<p><b>Description:</b> Gordon and Bieman assess the effectiveness of rapid prototyping in this paper, analysing 39 ‘real world’ case studies on the use of rapid prototyping for software development. They investigate and assess the specifics of the practice and conclude that it is an affective method of development in software, noting that a lot of potential problems can be avoided by carefully designing the purpose and scope of the prototype.</p> <p><b>Relevance:</b> During the first stages of my development I intend to employ rapid prototyping as a technique in order to create a platform from which I can analyse and evaluate the effect of different use cases on my system. This will help me develop solutions and continue with my design process. It is important for me to understand the pitfalls of other projects using a similar process so I can avoid making the same mistakes.</p>
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### Work plan explanation

There are a lot of elements to consider in this project, and with my devised Gantt chart (Fig 1 below) I have given enough time to systematically work through the stages required to produce a working product.

As per this plan I initially began research into the problem and throughout November started to identify research papers that will be useful for the development of the application. Using the information gathered on project development I have devised an implementation plan and will begin to tackle it with a rapid prototype of my app using what I have learned from Gordon and Biemans paper [6], using my time before the Christmas break to plan the development of the prototype from which I can simulate the use cases, which can then be analysed and tested to define the technical requirements of the final product. The initial implementation will begin after the exam period and will employ agile development methodologies, the prototyping is not technically strenuous and should be completed within weeks, leaving sufficient time to then fully investigate the use cases associated with the problem. My objectives state that I must then address each use case and identify fully what capabilities my application will need in order for them to be satisfied.

Throughout January and February I will be using this information to generate a definitive list of functional requirements for the application, whether it be intelligent location based push notifications to alert the user that they should download X or developing an offline caching strategy capable of predicting content that they would like to view, or even simply a system which allows users to explicitly download topics ahead of time. There are a number of other key pieces of functionality I could think about including to best serve the user their clinical data, and after the analysis of use cases is complete I should have covered all bases.

During March I will be implementing this functionality into the app. Again I will be using agile methodologies, with an iterative approach to solving each individual requirement. As discussed earlier each functional requirement will have a different consequence on the UI for the app and thus I will be combining the design of the UI into this iterative approach [6].

There is the potential for a number of problems to arise due to the intricacies of offline storage and the computational usage that location based services require in mobile applications. Other problems could arise when caching this information for offline use as it could eventually become out of date due to the regular maintenance performed on this data by Clarity. These problems should all be solvable with enough time, and I have allowed a contingency period around key development areas to solve or adapt to any technical issues.

The research I conduct on the solutions to any of these problems should be beneficial to the wider community, in particular those designing context aware applications. Throughout these final stages of the implementation I will simultaneously be conducting user testing in order to allow time to fully satisfy the requirements listed.

In April, upon completion of user requirements I have allowed time to develop the user experience side of the application, and will be following Nielsen’s guidelines for user interface

design [5] in order to create a professional, accessible and ergonomic UI to allow users to fully utilise the functionality that lies within the product.

This project is highly technical and will focus on the architecture and tailored offline capabilities for its use. Aside from all the technical aspects, there is a lot of work to be done throughout the year completing the associated write up, I will be documenting all aspects of my development including analysis of use cases in order to contribute meaningful data with regards to the way that users interact with clinical applications like this.

### Diagrammatic work plan

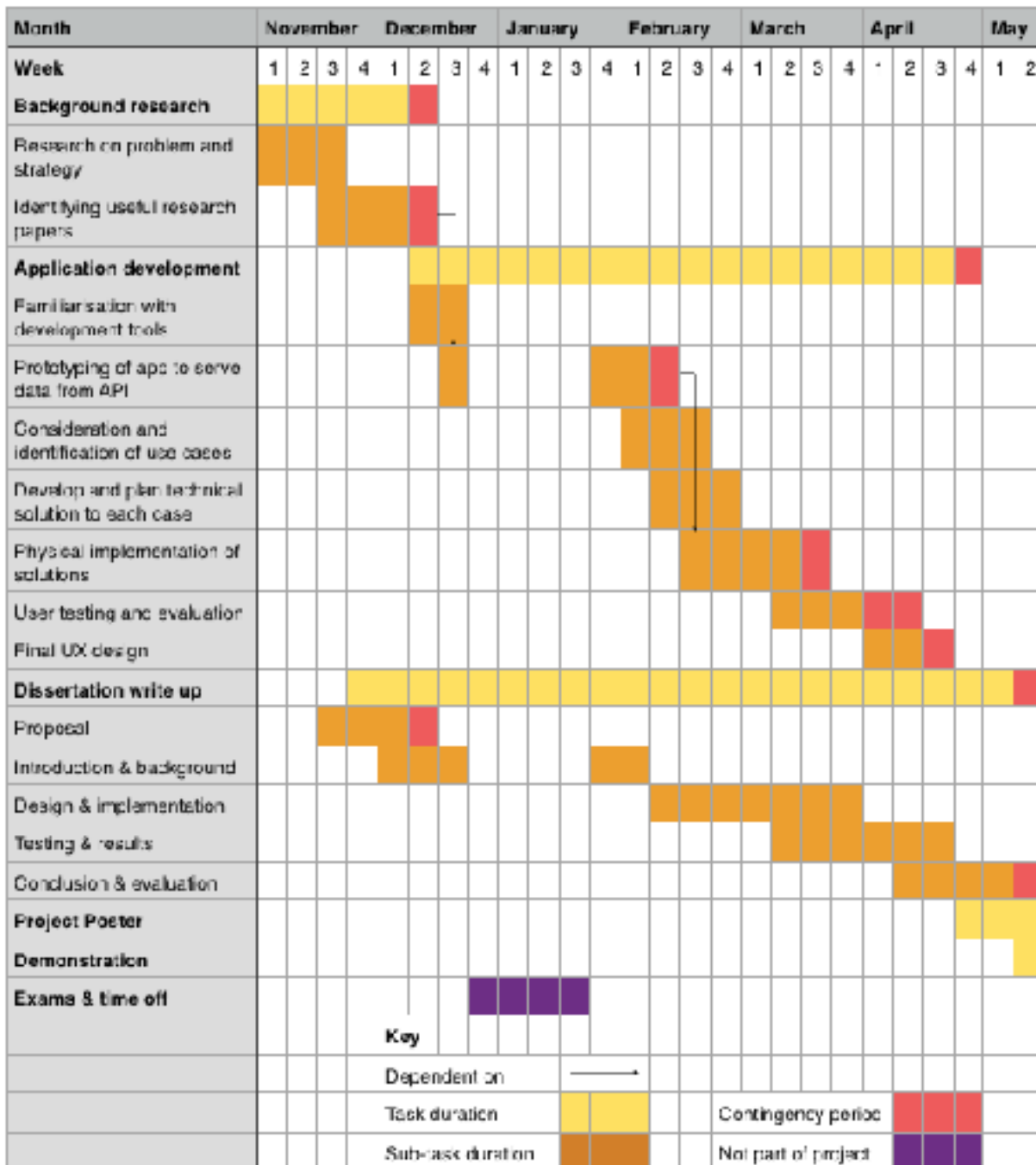


Figure 1: Work plan Gantt chart

## References

- [1] The Center for Universal Design - Universal Design Principles. (2015). The Center for Universal Design - Universal Design Principles. [ONLINE] Available at: [https://www.ncsu.edu/ncsu/design/cud/about\\_ud/udprinciplestext.htm](https://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm)
- [2] Armgren M., (2015). Mobile Cross-platform development versus native development A look at Xamarin Platform
- [3] Ferreira, J., Noble, J. and Biddle, R., (2007), August. Agile development iterations and UI design. In Agile Conference (AGILE), 2007 (pp. 50-58). IEEE.
- [4] Upkar Varshney. 2003. Location management for mobile commerce applications in wireless Internet environment. *ACM Trans. Internet Technol.* 3, 3 (August 2003), 236-255
- [5] 10 Heuristics for User Interface Design: Article by Jakob Nielsen. 2015. 10 Heuristics for User Interface Design: Article by Jakob Nielsen. [ONLINE] Available at: <http://www.nngroup.com/articles/ten-usability-heuristics/>. [Accessed 02 December 2015].
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- [7] Clarity Informatics .2015. Prodigy - CKS. [ONLINE] Available at: <http://prodigy.clarity.co.uk/>. [Accessed 04 December 15].