Milk Matters: Milk Donor Motivation

[Using Mobile Technology to Motivate Human Milk Donation]

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1. PROJECT DESCRIPTION

Milk Matters[1] is a non-profit human milk bank [8]. Milk Matters' core activities include motivating and facilitating the donation of human breast milk. A serious challenge faced by Milk Matters, and many other human milk banks, is encouraging mothers to donate. This project aims to investigate how technology, and in particular mobile applications, can be used to motivate mothers to donate their breast milk. In addition, the use of technology to educate mothers about breastfeeding, and human milk donation, will be investigated. In order to conduct our research, we will develop a mobile application. The mobile application is intended to be useful for both mothers who are and mothers who are not currently donating their breast milk. The primary purpose of the mobile application is to convert mothers into donors, or encourage mothers who are already donors to increase their donation, without negatively affecting their own children. This will be achieved by providing mothers, and especially donating mothers, with helpful tools and information. This is thus a software engineering project, with a strong focus on using human computer interaction (HCI) and other techniques, such as gamification, to influence users' behaviour.

1.1 Project Significance

Human breast milk has vital nutritional and immunological properties that cannot be replicated in formula [13]. Feeding infants human breast milk results in positive health outcomes [13, 12]. This is especially true for fragile infants [14], such as sick or premature infants in Neonatal Intensive Care Units (NICUs), whose immune systems may be weak. Furthermore, formula or alternate forms of food may result in health complications for some infants, such as those whose bodies are intolerant to it [13]. For the reasons stated above, human milk is considered to be a vital medical resource and the ideal source of food for infants, as stipulated by the World Health Organisation (WHO) [13, 11].

Unfortunately, the demand for human breast milk, and in particular milk from human milk banks, often exceeds supply [11, 4]. By using technology to motivate mothers to donate their excess breast milk, the supply of human breast milk to milk banks could be increased. As a result, more needy infants, such as those in NICUs could obtain access to human milk. This would likely result in positive health outcomes for those infants, and possibly even save lives. A secondary benefit of the application would be the useful breastfeeding oriented functionality and educational information it provides to mothers, regardless of whether they are donors or not. This breastfeeding oriented functionality and information may enable and encourage mothers to increase their own milk supply, for their own children, which may decrease the demand for donated human milk. A hopeful byproduct of educating mothers and enabling them to increase their own milk supply is converting them into donors, and encouraging them to donate more excess milk.

1.2 Project Issues and Difficulties

A major issue that faces human milk banks, and by extension our project, is the considerable time and effort associated with donating to a human milk bank [4]. For instance, donors have to be screened prior to donation, and more often than not have to go to the trouble of dropping off their breast milk. Furthermore, many mothers are deterred by the impersonal nature of donating to a human milk bank, and the fact that there are costs involved with receiving milk from a human milk bank [12, 4]. As a result, many mothers opt to dispose of excess breast milk, or engage in milk sharing (sharing milk directly with a recipient mother). This often results in human milk being distributed to less needy infants than those typically served by human milk banks. In response to these issues, the mobile application will need to educate mothers and, where possible, make the donation process easier, more convenient, and more interactive for mothers.

From a design, development, and evaluation standpoint, the only difficulties we envision relate to our access to donor mothers. Whilst Milk Matters have assured us that we will have access to donor mothers, organising interviews and workshops with donor mothers may be logistically challenging, particularly given the existing time and energy demands on mothers of infants. Aside from logistical issues, our use of

[1] http://milkmatters.org/

donor mothers as participants in the development, testing, and evaluation processes should be unhindered. To the best of our knowledge, there are no other major issues or difficulties associated with our project, as it is certainly technologically and socially feasible.

2. PROBLEM STATEMENT, AIMS AND REQUIREMENTS

2.1 Problem Statement

Our project aims to address two core problems. The first problem relates mainly to human milk banks and their ability to provide human breast milk to needy infants, and the second problem relates directly to donor mothers:

1. **There is often a lack of motivation for women to donate excess breast milk to a human milk bank, despite the medical importance of human breast milk.** Considering the demand for human milk bank milk generally exceeds supply, human milk banks are thus often only able to assist the neediest of infants.
2. **Mothers often lack information relating to both breastfeeding and breast milk donation (to human milk banks).** The former hinders a mother's ability to provide an infant with mother's own milk, and thus increases the demand for donated breast milk. The latter decreases the supply of excess breast milk to human milk banks.

2.2 Aims

By addressing the two problems we identified, we aim to motivate mothers to donate excess breast milk to a human milk bank, and thereby increase the supply of breast milk to human milk banks. This will allow human milk banks to assist a larger number of needy infants. Furthermore, we aim to educate mothers about breastfeeding, the importance of human breast milk, and breast milk donation (to human milk banks). This will enable mothers to provide their children with mother's own milk, and decrease the demand for human milk bank milk).

In this software engineering project, we propose a technological solution to address the problems and achieve the broader objectives identified. Specifically, we aim to provide potential and current donor mothers with a mobile application they can use to: monitor their donations, receive feedback, and educate themselves about milk donation, breastfeeding, and general child care. This work aims to identify what donating mothers would value and find useful in app, and then apply this knowledge in an effective manner, gathering user feedback to identify what is successful and what is unnecessary. The ultimate goal of the application, which will drive the design, functionality, and evaluation, is to motivate mothers to donate their excess breast milk to a human milk bank, and increase their donation where applicable.

2.3 Requirements

Our research takes on the form of a software engineering project, with Milk Matters as our primary clients. Aspects of the app need to meet their requirements in order to satisfy our primary users: potential and currently donating mothers.

Milk Matters' suggestions for the mobile application are as follows:

- Have an educational aspect. This may include lessons/diagrams on the pumping process, how to donate, increasing milk production, how to massage the breast, and how get their child to latch.
- In addition to educating mothers, mothers should be reassured about the rate of their donation and reminded not to neglect their own child.
- Promote donation, or any other contribution like equipment, money or partaking in charity events.
- Provide data visualization for mothers donating with respect to quantities, contribution over-time, the impact of their donation, and baby growth.
- Inform mothers about locations for dropping off their donations (depot location).
- Provide functionality for Milk Matters to make notifications and announcements to mothers via the app.
- Host a chat room for mothers to interact anonymously with one another.

For the donor feedback, visualization, and educational aspects we would like to incorporate an element of gamification (medals, goals etc.), in order to make using the application, and donating breast milk, a more immersive and interactive experience. At present, the only feature suggested by Milk Matters that we deem to be out of scope is the chat room for mothers.

Extensive testing and prototyping is required to ensure we meet the mothers' needs, and provide Milk Matters with a satisfactory product that hopefully entices more donations and provides motivation to continue to do so.

3. PROCEDURES AND METHODS

3.1 Development Procedures

We have chosen to develop an Android application, due to the openness of the platform and minimal resources required to develop for it. Android has the majority share of the worldwide smartphone operating system market [2] [15], which means that our application is likely to reach and benefit an optimal number of users. Android phones are also typically cheaper than their iOS counterparts, which makes development and testing less costly, and makes the mobile application accessible to a larger user base. In order to build our Android application, the Android Studio Integrated Development Environment (IDE) [3] will be used [1]. We have chosen this IDE as it is the IDE developed and recommended by the Android community, and it is thus likely to be the most supported and documented option. Similarly, the standard Android Software Development Kit and development tools will be used. We will code the application in Java,

[2] 80.7% of the worldwide smartphone operating system market as of quarter 4 in 2015

[3] http://developer.android.com/sdk/index.html

which is both the native language for Android and our preferred coding language. Our team will make use of the Git version control system to manage our code and collaboration.

3.2 Development Methods and Practices

Our project is primarily a software engineering project. It is intended to be a co-design effort with the Milk Matters organisation and milk donors. In order to facilitate the co-design process we have opted to implement an iterative software development methodology. Specifically, the project will follow a cycle of designing, prototyping/building, and evaluating. An agile development method is appropriate for us, given the short amount of time the project spans, and the low number of developers and stakeholders involved in the project. Iterative/agile development will allow us to interact with stakeholders throughout the design process, and allow us to be more flexible in the face of evolving requirements and desires. This is particularly important considering there are no set requirements or ideas pertaining to what the app should be, or do. It is likely that the purpose and design of the application will change as the development process unfolds, and stakeholders gain a better understanding of what they want, and what will be effective.

We will begin by building a skeleton, or core, for the application, into which functionality can be added. The purpose for this is to ensure that the application is as modular as possible, and its features/components can this be developed and added independently. The skeleton/core of the application will be developed by both Chelsea and Mitchell using peer review coding principles. This will ensure that the application has a strong base, with a design that effectively incorporates all the features/components to be added by both coders. Once the skeleton has been created, functionality will be developed and added independently by Chelsea and Mitchell, as per the work split. All code produced independently by Chelsea and Mitchell will be checked by the other person, in order to ensure correctness and completeness.

3.3 Evaluation Measures and Acceptance Testing

Our project will be evaluated from a software engineering perspective and, ultimately, according to how well it is fulfils its intended real world purpose. Evaluation of our project will be both quantitative and qualitative in nature. In order to maintain the privacy of users, the application will not send any personal information, such as quantities donated, to Milk Matters. As such, directly tracking the real world increase in the supply of breast milk, or attainment of donors, due to the mobile application is not likely to be feasible. One could not reliably state, without access to the donation patterns and app usage of donors, that an increase in human milk supply, or donors, was a result of the app. The fact that our project runs over a short amount of time, and the application would thus not have achieved widespread use, makes evaluation of the application's real world impact even more difficult.

As a result of the above, the application and success of our project will be evaluated primarily by assessing mothers'/donors' opinions and perceptions of the application. This information will be gathered using interviews, workshops and questionnaires. By assessing mother's opinions, we can infer how useful/valuable the app is to mothers, and thus what sort of real world impact the app is likely to have. These opinions will be evaluated both quantitatively, using a series of statements pertaining to the app and a 5 point Likert scale, and qualitatively, using open ended questions to attain a deeper understanding of mothers' perceptions of the app. The most important criteria for quantitative and qualitative evaluation and testing will be mothers' opinions of:

- How useful and valuable the app was to them
- Whether it is educational and provides useful, relevant information
- Whether it meets their expectations of what the application should be able to do (within reason)
- How easy, convenient, and intuitive the app is to use
- Whether the app is too time consuming and cumbersome (for a mother)
- How interactive and rewarding the app is
- Whether the app improves the milk donation experience, and makes it more immersive
- Whether it would motivate them to become a donor
- Whether it would motivate them to increase the frequency and quantity of their donations

The application will also be evaluated more specifically as a technological/software engineering entity. Firstly, the application will be assessed according to how well we meet our client's, Milk Matters', expectations and requirements, within the bounds of what could reasonably be considered in scope. Another important component of our evaluation will be how well the application conforms to Human Computer Interaction design and usability principles, and Android standards. The application will also be rigorously tested for bugs and other anomalies. Lastly, whether our application meets all our original criteria for features and functionality (as outlined in the key success factors), unless there are good reasons to the contrary, will determine whether our mobile application development was successful. Should the application be a success both from a software engineering perspective and in achieving its real world purpose, then our project will surely have been successful.

4. ETHICAL, PROFESSIONAL AND LEGAL ISSUES

Ethical issues have been identified in the testing, software implementation and data handling stages of the project. Each will be discussed in further detail here.

Testing:

Prior to testing with users, ethical clearance will have to be obtained from the UCT Human Research Ethics Committee. This will be done by submitting an ethical admittance form

to the committee prior to our workshop sessions and interviews with users (refer to the Gantt chart for our deadline to submit this, which includes leeway for any delays in the process). Our test subjects will be given a clear description of the project, their rights, and their roles as participants in an email before any workshop or interview sessions, as well as in a hand-out they will sign at the sessions. During the sessions, consent will be acquired for us to observe, question and report on their actions and feedback (keeping them anonymous).

Software:

Our final product and report will belong to the University of Cape Town. The Milk Matters mobile application will be open source, and freely available for download on the Google Playstore [4] for Android devices.

Data:

No personal information will be collected by the application, aside from login credentials for donors registered with Milk Matters (username and password). This is necessary, to ensure only donors have access to certain aspects of the application, while other parts are available to entice potential donors. The login database will be stored (where) and only the developers and Milk Matters will have access to it.

We have a professional obligation to Milk Matters, to treat this project with respect and provide them with an effective working product upon conclusion.

The Intellectual property of the project will belong to Mitchell Green, Chelsea-Joy Wardle and the University of Cape town.

5. RELATED WORK

To the best of our knowledge, there is nothing in the literature directly related to using mobile applications to motivate and facilitate human milk donation. However, there have been numerous projects, and research, which are relevant to our project, the problems it addresses, its purpose, and the functionality we intend to implement. Foremost, we intend to promote and motivate donation through our mobile application, which contains educational content and data visualisation aspects, and utilizes gamification to influence user behaviour. This section discusses work related to our project, with particular emphasis on using technology and gamification techniques to promote donation and educate people.

First, we review the use of educational tools, and specifically health videos, that are applicable to this project. Kumar et al. introduced an educational video program in rural India using locals in short productions to communicate various health messages/practice [7]. Molapo and Marsden initiated a similar program in Lesotho, where health workers recorded their own videos or testimonials and shared them with their peers and patients [10]. Both projects were successful and illustrate the benefits of using videos to capture, entertain and educate your audience, hopefully to change their behaviour. Similarly, we intend to utilize educational videos to persuade more mothers to donate.

As mentioned, the Milk Matters project will also contain an element of gamification to persuade and motivate donation. Gamification is a technique that can be used a number of ways to encourage and motivate a user, not only in the traditional gaming sense. McCallum's research illustrates several manners in which gamification can be utilized, such as awarding badges and status increases to users when they meet certain goals (i.e. each time they watch a video or donate milk) [9].

An example of a project which incorporates gamification and aims to both motivate donation and educate people is Free Rice[5] [3], an initiative by the World Food Program. The website makes use of gamification to entice users to donate while they learn about a certain subject. For example, if the user chooses English, they play a game where they have to match synonyms for a given word. Every correct answer donates 10 grams of rice to the program. There is a leader board for the week's top ranking individuals and groups. The Free Rice website is a fun and educational tool to gain donations; we intend to use their ideals as inspiration in the Milk Matters project.

As mentioned, despite the existence of mobile applications centred around breastfeeding, we are unaware of the existence of any research directly into the use of mobile applications to motivate human milk donation. However, there are mobile applications that facilitate and promote blood donation, and related research [6, 2, 5, 16, 18]. Some of these applications contain gamification elements. The similarities between human milk donation and blood donation [17] render this research relevant. The literature contains little about the success and effectiveness of these blood donation mobile applications, in terms of their ability to motivate donation. However, a study conducted by Yuan et al found that the majority of blood donors that partook in the study were ready for, and would make use of, a blood donation centred mobile application [18]. There is no reason to believe that the same would not be true for milk donors. As such, there is potential for a mobile application to influence users' behaviour and motivate donation.

6. ANTICIPATED OUTCOMES

6.1 System

The Milk Matters project is supposed to provide donating mothers with a mobile application that will motivate, educate and inform them. This will be achieved through the following key features.

The back-end will provide the foundation of the app, holding user credentials so only donating mothers have access to the application's core functionality. It will also contain a database with all the content displayed on the app (i.e. educational videos etc.). The front-end will provide users with an easy-to-use, interactive, and attractive interface. The interface will take into consideration the technical expertise of our target users (the mothers) and key features will allow for intermittent, one-handed use for when mothers are pumping or holding their child.

[4] play.google.com

[5] http://www.freerice.com

As stated in the requirements sections, the Milk Matters application will have:

- Educational videos and diagrams with voice-overs
- Donation tracking
- Data visualization of donations and (possibly) baby growth
- Milk Matters feed (for announcing events etc.)
- Geographic location for depots
- Gamification elements (e.g. badges, banners, alerts and timeline charts)

A challenge to consider when designing the app, is always being sensitive to mothers and how they may respond to certain elements. User workshops for brainstorming and testing will be important factors to get feedback on elements of the product. As mentioned earlier, the participation in these workshop may also be problematic for our users. We intend on overcoming any issues with workshop attendance through home visits or telephone interviews.

6.2 Expected Project Impact

We hope this project will help Milk Matters gain more donors, and motivate their existing donors to donate more. We would also like to educate more mothers on donating, breastfeeding, and general child care. We hope the our project positively impacts the milk donation community, particularly Milk Matters and other human milk banks, and contributes to the continued support for mothers who cannot provide their children with mother's own milk.

6.3 Key Success Factors

6.4 Application as a Whole

The key success factors for the application as a whole are:

- Mothers consider the application to be useful and valuable
- The application motivates mothers to donate to Milk Matters
- The application makes the donation process/experience easier, more rewarding, and more interactive
- The application provides mothers with relevant/useful educational features and information
- Mothers consider the application to be easy and convenient to use

6.5 Individual Components

Depot locator:

- Utilizing the user's geographic location on Google Maps, indicate where the closest depot is

Donation tracking and data visualisation aspect:

- Mothers are able to easily and effectively see how much they have donated
- Mothers are given a clear indication of how much their donations have helped others

Milk Matters feed aspect:

- Milk Matters is able to share notifications and announcements with mothers/donors via the app
- Mothers/Donors are able to filter which, if any, notifications and announcements they wish to receive
- Mothers/Donors can comment on posts

Educational aspect:

- Donors can watch videos
- Donors can refer to diagrams with voice-over
- Users can partake in an interactive QA after each lesson
- Users can like, save and comment on lessons

7. PROJECT PLAN

7.1 Risks and Risk Management Strategies

The risks and risk management strategies for this project can be found in the Appendix. Overall, the project is relatively low risk, and all risks we are aware of can be mitigated.

7.2 Timeline

This project runs from 12 April 2016 to 16 November 2016, and the timeline can be seen in our Gantt chart (see Appendix).

7.3 Required Resources

The resources required for this project are mainly people related. Input from, and collaboration with, Milk Matters is arguably the most important resource. The project is likely to be meaningless and be of little use if it is not endorsed and supported by Milk Matters. Equally important is access to donor mothers as participants in the design, evaluation, and testing processes. In terms of technological resources, we require laptops capable of installing and running the Android Studio IDE and, therefore, suitable for Android mobile application development. Furthermore, Android devices capable of testing and debugging the application will be necessary. Between the two of us, we are able to provide these technological resources.

7.4 Deliverables

The main deliverable for this project is the Android mobile application, complete with the features and functionality described in previous sections. The previously described features and functionality is not an exhaustive list, and is subject to change as the user-centred, co-design process unfolds. Other deliverables, in no particular order, include:

- The literature review
- The project proposal
- A presentation of the project proposal
- A paper prototype
- A short write up on the brainstorming session and interviews with donors
- A software feasibility demonstration
- Three iterations of prototypes
- Three corresponding short write ups evaluating the prototypes, and describing user feedback
- The project website
- The project poster
- A draft of the final report
- The final report
- A paper reflecting on the project

7.5 Milestones

The milestones for this project are listed our Gantt chart (see Appendix). The milestones in the Gantt chart include our honours project deliverables, as well as the milestones we set for our design and development iterations.

7.6 Work Allocation

The work is to be split evenly between Chelsea-Joy Wardle and Mitchell Green. Chelsea will be focusing more on the educational and social aspects of the application. Mitchell will be focusing more on the logistical, donor feedback, and data visualisation aspects of the application. However, this will be a co-design project, and both members will contribute towards all aspects of the application. Furthermore, both members will contribute towards the iterative design and evaluation process.

8. REFERENCES

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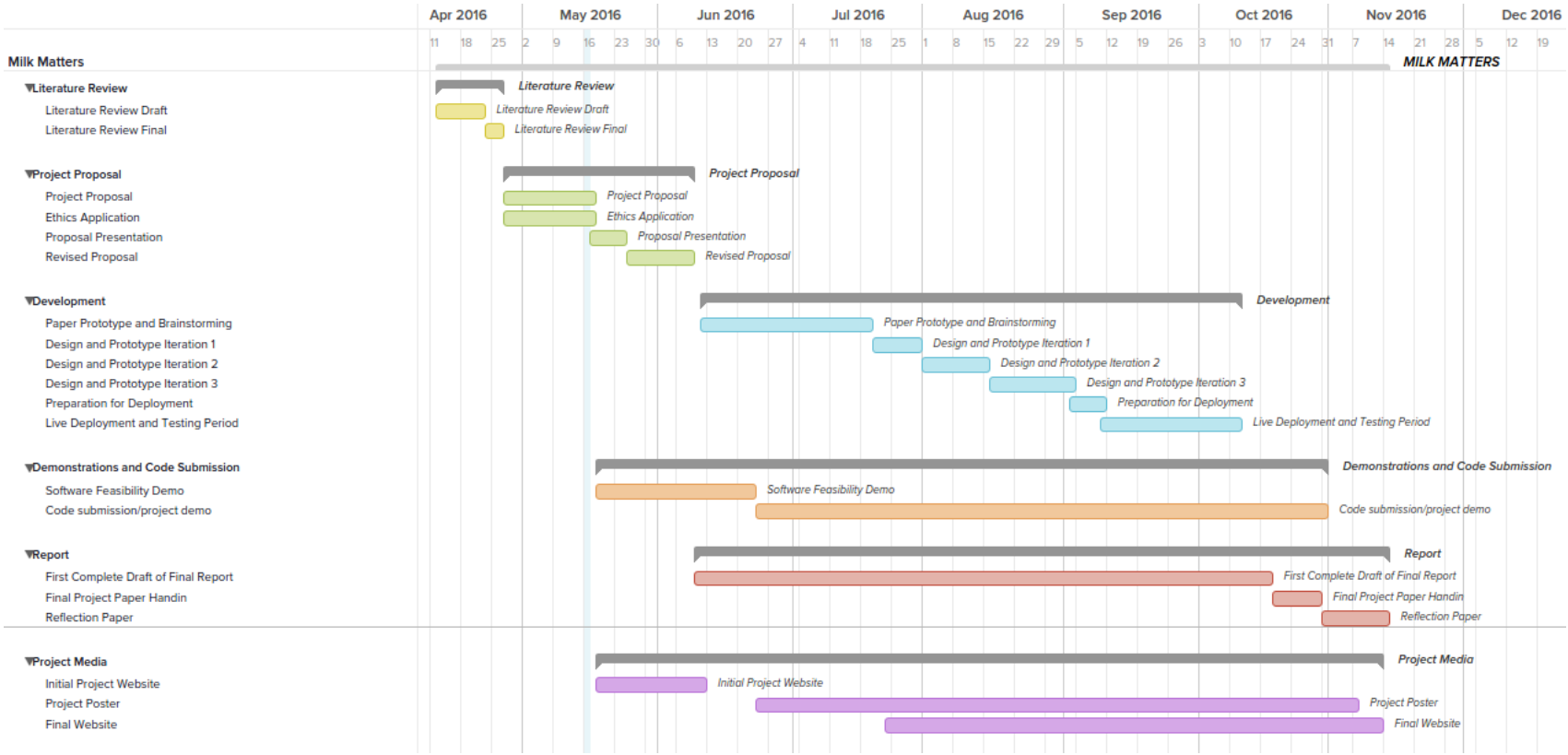
APPENDIX
A. RISKS AND RISK MANAGEMENT

Risks and Risk Management Table				
Risk Number	Risk	Impact	Probability	Management/Mitigation
1	Logistical issues with accessing donors (e.g. scheduling a time, especially trying to get many donors in the same place at the same time).	Moderate	Possible	1. Make arrangements with donors far in advance. 2. Meet with donors in smaller groups. 3. Meet donors at times and places convenient for them.
2	Scope of the project is too large, especially given the difficult/temperamental nature of mobile development.	Significant	Unlikely	Be conservative and sensible about the scope of the project, and cautious when agreeing to add functionality desired by stakeholders.
3	Milk Matters lose interest in the project, or are too busy to participate adequately.	Severe	Very Unlikely	Keep Milk Matters informed throughout the development process, and show them evidence of progress.
4	Development takes longer than expected due to inexperience or other reasons.	Moderate	Possible	1. Start development/tasks early. 2. Take potential issues into account by allocating slack time to tasks
5	One team member is unable to complete his/her part of the project, for whatever reason.	Severe	Very Unlikely	1. Ensure that the project is clearly split between members. 2. Ensure that each half of the project can be a standalone project.
6	Mothers are unable to use the app due to time constraints.	4	3	1. Make the app simple to learn. 2. Make the app quick and easy to use. 3. Streamline the functionality (i.e. no unnecessary details or components).
7	Our app does not exceed the usefulness of similar existing apps/mothers choose these other apps instead.	3	3	1. Pivot the app away from existing apps, in terms of functionality offered. 2. Offer functionality and detail unique to South Africa and local human milk banks, such as a notification feed from Milk Matters or depot locator.
8	Mothers find the app to be impersonal.	2	1	1. Make the app as user-centred as possible. 2. Make the app as interactive as possible (so mothers feel like they are interacting with Milk Matters).

B. GANTT CHART



C. TASKS AND MILESTONES

Tasks and Milestones		
Task/Milestone	Start Date	End Date
Literature Review	**12-04-16**	**26-04-16**
Literature Review Draft	12-04-16	21-04-16
Literature Review Final	22-04-16	26-04-16
Project Proposal	**27-04-16**	**08-06-16**
Project Proposal	27-04-16	17-05-16
Ethics Application	27-04-16	17-05-16
Proposal Presentation	17-05-16	24-05-16
Revised Proposal	25-05-16	08-06-16
Development	**10-06-16**	**11-10-16**
Paper Prototype and Brainstorming	10-06-16	19-07-16
Design and Prototype Iteration 1	20-07-16	31-07-16
Design and Prototype Iteration 2	01-08-16	15-08-16
Design and Prototype Iteration 3	16-08-16	02-09-16
Preparation for Deployment	02-09-16	10-09-16
Live Deployment and Testing Period	11-09-16	11-10-16
Demonstrations and Code Submission	**18-05-16**	**31-10-16**
Software Feasibility Demo	18-05-16	22-06-16
Code submission/project demo	23-06-16	31-10-16
Report	**09-06-16**	**14-11-16**
First Complete Draft of Final Report	09-06-16	18-10-16
Final Project Paper Handin	19-10-16	28-10-16
Reflection Paper	31-10-16	14-11-16
Project Media	**18-05-16**	**11-11-16**
Initial Project Website	18-05-16	10-06-16
Project Poster	13-06-16	07-11-16
Final Website	23-07-16	11-11-16