Poster: Milk Matters 4.0: Challenges in deploying university-led mobile application development for small NGOs

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ABSTRACT

Milk Matters is a small Cape Town based non-profit milk bank. Their primary role is to collect expressed breastmilk from donor mothers, pasteurize it and distribute it to recipient infants in need.

Previous postgraduate projects from the University of Cape Town (UCT) have co-designed a donor facing mobile application with Milk Matters, however no mobile application is currently deployed or promoted by the non-governmental organization (NGO). This project will build upon the work already done with Milk Matters and aims to update the full system for deployment. While post-deployment evaluation will also analyse the uptake and usage of the application, this poster will focus on discussing the challenges in the deployment of university-led mobile application development for small NGOs.

CCS CONCEPTS

• Human-centered computing → Empirical studies in HCI.

KEYWORDS

non-governmental organization, university-led development, mHealth, mobile application development

1 INTRODUCTION

Breastmilk donation allows mothers who cannot provide breastmilk to their own infant the chance to use donated breastmilk. The majority of milk donation occurs through milk banks, such as Milk Matters [1]. Technology can be used to simplify the sign-up process and provide positive feedback and information to donor mothers, potentially increasing the number of donors and motivating them to continue donating breastmilk for longer.

Work between the University of Cape Town and Milk Matters has been done to develop a mobile application aimed at increasing communication with and feedback to breastmilk donors. The current version of the Milk Matters application system has not been approved by Milk Matters for deployment, and therefore requires further debugging and development. This project aims to update the current Milk Matters mobile application and staff-facing web application for deployment. Where possible, and within project scope, additional features requested by Milk Matters will be included. Post-deployment evaluation of the

system aims to determine uptake and continued usage by both donors and Milk Matters staff.

Many small NGO's have limited resources. While university-led ICT projects aim to benefit the NGO, they also require significant resource input from the NGO. They are often run in a limited timeframe with no continued support after project completion. Despite NGO input, they may be left with no successful outcome. This project will investigate the relationship between a small NGO and a university and aims to answer the question: *What additional challenges occur in the ICT development for the small NGO in this case study because the project is university-led?* This includes sustainability issues and ethical concerns raised, aiming to answer the question: *How does this NGO perceive the sustainability of the mobile application?*

2 BACKGROUND

2.1 Previous work with Milk Matters

Fourth year computer science student projects from UCT have been completed with Milk Matters in 2016, 2020 and 2021. These projects iteratively developed a donor facing mobile application and a staff facing web application. The 2016 version of the application reached deployment; however, it was a static application and its content could not be updated by Milk Matters [2]. In 2020 the application was converted to a cross-platform, dynamic mobile application [3], with continued work on the dynamic version in the 2021 project [4]. However, neither the 2020 nor 2021 project versions reached full deployment. No further development was done on the application once university course requirements were met. Despite the potential value of the co-designed Milk Matters application and the effort already given to its development, no application has been able to be deployed since the 2016 deployment.

2.2 Breastmilk related mHealth applications

The use of mobile phones to promote public health is known as mHealth and is encouraged by the World Health Organization [5]. mHealth apps developed for breastfeeding mothers include the global app, LactApp [13], Milktrack [14] and Gmilk [15] developed in the Philippines and CuidarTech Doe Leite [11] in Brazil.

Of the breastmilk donation apps discussed, the educational component of CuidarTech Doe Leite focuses solely on breastmilk donation, whereas Milktrack, Gmilk and the Milk Matters app focuses on both breastfeeding and breastmilk donation. Literature available on these apps covers initial design and usability studies, but no deployment or usage data.

Although research shows that mHealth apps have the potential to positively influence users' behaviour and are well accepted by

users in pilot studies and usability studies, limited evidence shows that most mHealth app users either do not use the app frequently or stop using it after a limited time period due to loss of interest, hidden costs, a manual data collection burden [6, 7] and unmet expectations [8]. Many mHealth applications are found to have poor quality content and rely on a high level of user literacy [9]. Larger clinical trials are needed to evaluate their impact on health outcomes [10]. Further research also needs to be conducted into the longevity of such mHealth applications and how to use post-deployment evaluation to ensure that they foster effective long term user engagement that leads to behaviour change.

2.3 University-led development

Challenges to sustainability are presented when development of these applications is initiated by university researchers partnering with small NGOs. Co-design methods require significant time investment from NGO project partners, such as Milk Matters [11], who often have limited resources available. The project time frame and funding set by the university or research facility are also often limited [12], with inadequate or no ongoing maintenance. Despite the input of the NGO, they may be left with no deployable outcome at the end of the university project timeline. While some ICT development projects are "failed" by choice [13], others may fail to meet the goals of the NGO simply due to timing or logistical reasons.

3 MILK MATTERS MOBILE APP FEATURES

Once logged in, users can navigate to all screens from the home screen. The home screen also displays a News and Events feed, updated by Milk Matters. A bottom navigation bar links to Donation Tracking, Education and Home. A left slide drawer provides links to About Us, Become a Donor, Depot Locator, Frequently Asked Questions (FAQs), Privacy Policy and Logout screens. The home screen also displays a widget at the top, summarizing total donations by the user. If they are not yet registered as a donor it shows a link to become a donor.

3.1.1 About Us

The About Us screen introduces Milk Matters and the importance of their work. It also provides contact information and social media links.

3.1.2 Become a Donor

All potential donors are required to complete a pre-screening questionnaire. This can be done within the app and answers are emailed directly to Milk Matters.

3.1.3 Depot Locator

Depots provide a convenient location for donors to drop off their breastmilk donation. Registered donors, logged in with their donor number, can access depot information in the form of either a list of depots or marked as pins on a Google map. Clicking in a pin displays the information related to that depot. Functionality is included to locate the depot nearest to their current location.

3.1.4 Donation Tracker

The donation tracker allows donors to record donation volumes and view their total donations on a graph as either total volume donated or total number of feeds provided for infants in need. From within the app donors can declare a donation drop-off at a depot. This notifies Milk Matters to organize collection from the depot.

3.1.5 Educational content

Categorized educational articles are available to all app users. These aim to provide users with evidence-based information and support them through breastfeeding, breastmilk expression and donation. Additionally, users can submit educational article suggestions to Milk Matters for inclusion.

3.1.6 FAQ

Commonly asked questions are available to users within the app.

4 PROCEDURES AND METHODS

This section details how this project will go about software development, user recruitment, testing and data analysis. The complete system has two groups of users, Milk Matters staff, referred to as "staff users", and breastmilk donors, referred to as "donor users". Ethics clearance has been obtained from the Faculty of Science Research Ethics Committee.

4.1 Archive analysis

To fully understand the history of the project and the context in which challenges with translation of a student research project into an adopted application have occurred, all previous student project write-ups on the Milk Matters project will be studied.

4.2 Development Processes and Methods

In order to debug and add additional features to the previous versions of the Milk Matters application system, the mobile application and web application will be further developed using Flutter. This allows for cross-platform development with a single codebase. The backend system will remain hosted on Google Firebase due to its benefits of scalability, security and affordable payment model (currently free for this system). All code will be stored on the project's GitHub repository.

Development will be done iteratively, using an agile approach of cycles of design, development and evaluation. This will allow for continued user engagement throughout the development process and for requirements and design to be adjusted quickly and as needed.

4.3 User recruitment

Milk Matters will select engaged donors to contact for participation and email them directly. The initial email will include an introduction to the research as well as the researcher. Contact details of donors who are interested in participating will be made available to the researcher who will then contact them directly to organise a convenient time to meet. We will aim for recruitment of 3 donor users for the pilot study and 8 donor users for deployment evaluation.

All Milk Matters staff who will be using the system will be included. They are a small team of only three, so this will entail 2-3 staff members. The project supervisor and the university have a long-standing relationship with Milk Matters, so full co-operation is anticipated.

Informed consent will be obtained from all participants before commencing data collection.

4.4 Pilot Study

A pilot study will be completed in order to test the research tools used and ensure all relevant data is being collected. Donor participants will be asked to install the application on their mobile phones for two weeks. An initial visit to their homes will allow for assistance in installation. Another visit two weeks later will allow for them to give feedback on their app usage, issues encountered and improvement suggestions. During this visit, the semi-structured interview will be piloted. Contact can be made with the researcher via WhatsApp for the duration of the pilot study.

Training and observations with staff users will be done onsite, during the researcher's weekly volunteering sessions at the Milk Matters office. These sessions aim to find any additional issues within the system and to give the staff confidence to make effective use of the system before deployment.

Approval from the Milk Matters CEO will be required before release of the application to deployment evaluation.

4.5 Deployment evaluation

Both quantitative and qualitative evaluation methods will be used in this evaluation.

4.5.1 Quantitative Evaluation

Both the mobile application and web application will be quantitatively measured using usage logs as well as error logs, for the duration of the deployment evaluation. All users will be able to consent to or opt-out of usage analytics before logging in to the application. All data will be recorded anonymously to ensure privacy of the users.

Through these analytics the researcher will be able to determine how often either application is used, which features of the mobile application are accessed most often, how often content is updated by staff users and how often various errors are encountered.

During this time, Milk Matters initiated communication events, such as newsletters and social media posts will also be tracked. This will allow the possible changes in usage of the application when these events occur to be quantified.

4.5.2 Qualitative Evaluation

4.5.2.1 Donor users

Within two weeks after deployment a sensitizing session will be organized with the donor users. Each one-on-one session aims to increase awareness about the application, determine user expectations of the application, offer initial installation support and then shift donor users from awareness to usage of the mobile application. Donors will be required to download the application onto their own mobile device.

Individual interviews, lasting 45-60 minutes each, will then be performed with the donor users three weeks later. These will be done at a location and time convenient to each donor mother, improving the likelihood that donor users will be willing to give of their time to complete the interview. Semi-structured interviews will be used with open ended questions, allowing for donor users to provide their own insight into their use of the mobile application. Themes from these interviews will be analysed using nVivo software.

4.5.2.2 Staff users

Usage of the staff-facing application will be observed and discussed during weekly volunteering in the Milk Matters office, as well as additional arranged times. This will allow the researcher to obtain insight into the contextual use of the web application post-deployment and observe any issues that may arise.

Semi-structured interviews will also be done with staff four weeks after deployment.

Staff user questions will cover the following topics:

- Usefulness/value of the web application
- Ease of use of the web application
- Difficulties encountered during use
- Perceived change in donor user's behaviour
- Feedback on usage statistics

Endline interviews will be performed with Milk Matters staff three weeks later to discuss usage, beneficiary feedback, the impacts on the NGO, challenges in the ongoing project development and maintenance or future work.

Additionally, challenges encountered during the project by the researcher will be included in answering the question of sustainability as well as a semi-structured interview with the project supervisor.

5 PRELIMINARY FINDINGS

5.1 Contacting previous students

Since the Milk Matters project is a continuation of previous work, contact with previous postgraduate students who worked on the project is beneficial. While students, contact with the supervisor was made via university accounts. Once a student is no longer registered with the university, these accounts are deactivated, making continued contact challenging. Other methods of contact such as LinkedIn and Facebook were used to attempt contact.

5.2 Continuity of access

With the initial redesign of the Milk Matters app in 2020, Google Firebase was chosen to host the application and its database. The students set up the Firebase project using their Google workspace accounts associated with their university accounts. In 2021 access to the project was passed on to the new project members' university accounts, before the accounts of previous project's members were disabled. No postgraduate students took up the project in 2022. By the time the project was restarted in 2023 all the accounts associated with the Firebase project had been disabled by the university. Attempts were made to recover access to the previous students' accounts, but these were unsuccessful and resulted in significant delays. All Firebase database and project settings needed to be recreated in a new Firebase project.

5.3 Maintainability

Since development work on the Milk Matters project has been done in batches over the last 4 years, with significant times of no development, the Flutter version and many of the app dependencies were significantly out of date. This results in an app that is difficult to maintain and update.

6 PRELIMINARY RECOMMENDATIONS

For the case of the Milk Matters project, an ICT development project continued over multiple postgraduate years by different students, challenges have arisen. The following recommendations may help to prevent these challenges from occurring in future work.

- Admin or Owner access should be granted to at least one project supervisor or staff member who is expected to remain in relationship with the university and therefore retain access to all project related accounts. They would then be able to grant access to any future students working on the project.
- All project related information, such as application signing keys, should be stored in a secure online location, with supervisor access.
- Permission to use personal contact information, such as email address and contact number, should be requested from students working on a project that will be continued in the future. This would allow for previous students to be easily contacted regardless of their post-university activities.

7 ANTICIPATED OUTCOMES

7.1 System

This project is expected to produce a system that is approved by and used by Milk Matters. The cross-platform system will continue to be developed using the flutter framework with Google Firebase used to host the application and provide analytics.

The mobile application will allow for improved tracking of milk donations by the donor and give them greater access to educational content, depot locations and communication channels with Milk Matters. Donors will also be provided with positive feedback relating to how many life-saving feeds their milk has provided. Milk Matters will benefit from improved communication with their breastmilk donors and notifications that aid logistics of milk collection from their depot sites.

7.2 Expected Impact

The increase in accessibility to information, feedback and communication through the mobile application is expected to improve donor experience, with the hopes that this results in either an increase in the number of breastmilk donors or lengthens the duration of donation.

The open-source code can be used to impact milk banks globally, by implementing similar systems for their own organizations.

An improved understanding of co-design and the related challenges in the small NGO setting, particularly with university-led projects, could lead to improved co-design practices and increased uptake, usage and sustainability of future projects.

7.3 Key Success Factors

This project's success will be measured on the following factors:

- Milk Matters is satisfied to deploy the system for public download by donor mothers
- Both donor users and staff users feel that the system is user-friendly
- Both donor users and staff users feel that the system is valuable

- Usage logs show that users continue to use the system, without further input from the researcher

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