MOBILE APPLICATION DESIGN AND TRACKING PLATFORM TO ENGAGE BLOOD DONORS IN THAILAND

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ABSTRACT

Blood shortage raises a significant concern in several nations impacting the lives of those who required blood. The use of the mobile application can help people in need of blood to locate potential donors and encourage users to share their donating appointments, achievements, and accumulate several successful donations via social media networks. This study aimed to design a mobile application and prototype using Figma's prototyping tool. This mobile application is aimed to track blood donors and raise awareness for blood donation. This research used a qualitative method to investigate tracking applications' appropriate design and efficient features. The study successfully obtained insight from 15 interviewees, divided into four diverse groups, including two nondonors, six occasional donors, four experienced donors, and three experts in the information technology field. The findings of the content-based analysis indicated the interface of the proposed application showed positive feedback as the results of user-friendliness and user satisfaction were highly appreciated. This research study could benefit the implementation of a blood donation tracking system in the future.

Keywords: Blood donation, Blood donation application, Mobile application.

1. INTRODUCTION

In health care service, blood is a critical element that affects medical treatment operations and the patient's wellbeing. Unfortunately, blood resources are limited and cannot be reproduced. The only method of blood reproduction is to transfer from one individual to another.

Blood is an essential part of the body. Transfusion of blood is a critical way to remedial body derived from human blood, comprising the plasma-derived medicinal products [1]. Therefore, the value of blood is often overlooked. Significantly, the hypovolemic shock caused by blood loss is regularly encountered after having severe injury [2]. When blood loss has occurred, the human body requires to receive blood from others. Blood donation is the only method to maintain human blood needs. Regularly, the donating blood is the process bring the part of the blood from the vein at 350-450 ml per time or about 6-7% of the total blood volume in the body [3], which the loss of blood in such volume is not affected the circulatory system and not harmful into the human body. Significantly, it will stimulate the bone marrow to work better.

1.1. Blood situation in Thailand

According to the Red Cross Society report [3], blood donation contains 1,109,595 units from 670,869 people compared to 66,186,727 total population. The collecting unit of blood donation is less than the standard of blood donation followed by WHO as each country requires approximately 3% of its population to adequate the blood needs [1]. Moreover, retaining old donors to donate repeatedly 2 to 4 times a year is necessary to promote a continuous blood donation. Blood donation can donate four times a year and not harm the donor body [3]. The statistics on the frequency of blood donation in Bangkok and provinces across the country in 2018 as shown in Figure 1.



Figure 1 The repetition of blood donation in 2018.

From Figure 1, we can see the repetition of blood donated in 2018 [3]. The bar graphs represent the decreasing number of repeat visit donors. The same group of donors donated for the first time at 1,034,688 units, whereas the number of donors who revisited for the second donation was reduced approximately by 73.2% to 277,299 units. Likewise, the number of third-time donors decreased by 52.7% (131,275 units) from the second-time donors. The graphs indicate a very minimal number of the donors who came for the fourth time in 2018, showing as low as 61,710 units which decreased approximately by 52.9% from the last visit (the third donation). Therefore, a significant decrement in repeat visits is evident.

It is a critical issue to obtain more repeat people for blood donations. Globally, 92 million blood donations are made each year, which unpaid volunteers make. However,

Manuscript received on March 28, 2022; revised on May 24, 2022, accepted on May 24, 2022. *Corresponding author E mail: rojjalak.chu@mahidol.edu, Technology of Information System Management Division, Faculty of Engineering, Mahidol University, Thailand.

30 million voluntary donors only give blood once and never return [1]. Likewise, this problem is also an issue with blood donation in Thailand, and the number of blood donors needs to be increased for the blood of the entire population to be used. A prototyped application for blood donation would be available on a mobile platform.

This study aims to promote a regular blood donation culture among Thai donors by developing a mobile application that facilitates the whole blood donation process. Using their mobile phone, donors will receive appointment information, achievements, and the number of blood donated and will be encouraged to share their achievements on social networks with their peers and family members.

2. LITERATURE AND THEORY REVIEW

2.1. Characteristic

The blood donors' characteristics should be analyzed to determine the significant differences between each characteristic, including gender, age, and education. Therefore, this thesis examines the nature of exploration and public awareness of the sample in the context. This study compares the differences in gender, age, and education.

2.1.1 Gender

Several researchers found that gender is one of the influential factors in motivating people to donate blood ([4], [5]). Some studies claim that males are more likely to donate blood than females, with 61.6% and 53.3% [6]. Similarly, Yin[7]; Kano[8]; Roh[9] found that in Eastern region Asian countries such as China, Japan, and Korea, males were a more significant contribution to donating blood than females of all ages. At the same time, Misje et al. [10] conclude that most female donors were more likely to represent first-time donations and fewer repeat donations due to obstacles and discomfort related to donating blood. However, some studies mention that European females had a higher intention to donate blood than males ([4],[11]).



Figure 2 The number of male and female ages range from 17 to 60 years.

In 2018, Blood Donation Thailand found that the number of females aged between 17-60 years old was donated in total 216,309 people, whereas the male donor from 17 to 60 years of age was engaged to donate about 177,671 people 2018 [3]. Consequently, it seems that Thai female is more likely to participate in donating blood than male.

2.1.2 Age

Generally, the eligible age of Thailand blood donors must be between 17 and 65 years; however, the elderly donors may expand at age ranging from 65 to 70 years old every six months since the first donation took place before the age of 60 [12]. Therefore, it is concluded that the age group between 18 to 60 is the majority of blood donors, and also both repeat and regular blood donors are a group of people at age less than 60 [12]. Moreover, due to the increase in the aging population issue, young people will be more encouraged to donate blood in the future to assist the growing need for blood transfusions among older people [13].

2.1.3 Education level

The education level of the donors can impact the attitude toward blood donation. As Alfouzan [4] concludes, those with higher education levels with higher knowledge of blood donation tend to donate blood rather than lower education levels. Hence, it seems that level of education is an essential factor in encouraging individuals to donate blood toward increasing blood inventory. On the contrary, Kalargirou et al. [11] find out that 95.8 percent of the primary education level in Greek were more likely to encourage donating blood as a social well-being perspectives reason. As a result, the research has been conducted according to the education level element to succeed in the expanding number of blood donations in Thailand.

2.2. Motivation

Blood donation Motivators consist of internal and external factors such as attitude, social influences, social responsibility, etc. [14]. The study of motivational determinants of attitude analyzes in term of internal factor that most donors contribute to donate their blood because individuals believe they are doing the right thing. The majority of blood donors' perspectives are more likely to describe their actions as actions that can save people's lives and positively contribute to social relationships with others, including strangers [15]. For external factors, this paper analyzed the effect of some motivators, which are social influences and social responsibility. Societal impacts affect males and females differently. There is a claim that male donors take the opinions of others more seriously than female donors [16][17]. Females, on the other hand, prioritize humanitarian concerns over family and peer opinions [16][17]. For responsibility, taking part in blood donation is for social well-being and helping others, even unknown individuals [15].

2.3. Barrier

The barriers to blood donation have been investigated in many studies [18]. Several barriers include lack of information, unhealthy, never being approached, family or friend issues, fear, the identification of viral status, and non-remuneration [21]. This study reviews the relevant literature, which is perceived risks including fear of needles, fear of pain, policy of pre-donate screening, and inconvenience of donor's clinic. Kotler and Keller [19] stated that six types of perceived risk were associated with blood donation: social risk, function risk, financial risk, physical risk, psychological risk, and time risk. Risk perception in terms of safety is the most critical barrier to blood donation, while fear is the second most concern for not donating[11]. The common fear of blood donations includes fainting, fear of needles, being exposed to a disease, or discovering an illness. Muthivhi et al. (2015) [20] state that many non-donors believe that blood donation is not a safe procedure and consequently reject donating. In contrast, most of the experience donors believe that blood donation is secure without harm or pain[11].

2.4. Communication channels

To acquire blood donors, marketing communication tactics such as advertising, public relations, and direct web marketing are used [18]. The Internet is the most influential medium for blood donation [15]. In Thailand, the Internet and social platform is the easiest way to communicate with many people. The use of the Internet in Thailand, many people have mobile and Internet increase sharply every year. Using an effective communication channel to communicate blood donation will gain more notice and more donors. According to the paper from Ringwald et al., 2010 [13], which announces the 10 Important Factors in Encouraging Blood Donors to Re-Donate, the most significant is to communicate with new blood donors as soon as possible. As a result, the blood donors should never fail to issue a blood donation invitation whenever the donor is once again eligible. The more invites donors receive, the less likely they will cease donating. It is worth noting that donating blood more than four times per year is linked to a higher chance of a Blood donor's behavior [21]. Thanks to modern communication technology, it is possible to stay in close contact with blood donors in some ways. Aside from the traditional formal letter or phone contact, sending an e-mail as the "mainstream communication technique" is a widely recognized option that may be particularly useful in reaching young blood donors. The use of a mobile application to communicate between a blood center and a donor and between donors and their social networks is quite convenient [22]. Donors may post their blood donation stories on Facebook and Instagram, as well as share their blood donation expertise on Twitter. Furthermore, the blood bank may interact directly with donors, such as issuing an alert about a blood scarcity or a specific blood type requirement. When a donor and a blood

center interact on a regular basis, it may assist to improve the frequency of blood donations. Finally, it is critical to remember that contact with the blood donor begins with the initial contribution. As a result, it is important to take steps to educate the workforce. Thank, Inform, and Invite, is a great example of how this may be accomplished.

2.5. Blood donation application

Applying from the paper [22] the most common type of app detected in all the chosen applications is finding centers. They assist users in locating nearby blood drives and donation sites, bridging the gap between blood donors and in-need patients. Five of the applications evaluated assist users in finding donors. The blood donation eligibility applications used in this study compute the next donation's eligibility date and present a set of criteria to help users determine whether they are eligible to donate or not.

In healthcare, Gamification (badges) aims to tap into people's inherent and drive for competition, Achievement, status, altruism, community collaboration, and various other things. Businesses may use the Gamification approach to encourage desirable user behaviors that benefit their brand [23]. Moreover, women desire reliable and evidence-based applications to track their fertility, plan a pregnancy, or use the app as a form of contraception. Their motivations for using menstrual health apps vary, overlap, and change over time [24].

Furthermore, in the covid-19 situation, the vaccine passport will be helpful for traveling around and going aboard. The Thai government has stated that the so-called vaccine passport, also known as a vaccination certificate, would be adopted in Thailand for use with Covid-19 immunization as an official travel document for people who have previously been vaccinated against Covid-19 and are traveling to other countries[25]. Therefore, this proposed application will include this concept.

Factor/Problems	Application Features	Reference
Basic Function	Donor Information	[22]
	Blood Donation History	[22]
Barrier – Time risk	Blood Donation Appointment	[22]
	Find Blood Centers	[22]
	Find donors	[22]
Motivation	Badges	[23]
Donor Characteristics	Menstrual Health	[24]
Barrier - knowledge	Blood donation information	[22]

Table 2 Proposed application feature

The following are the description of the functionalities and related applications used as a consequence of the proposed application:

A. Schedule Blood Donation Appointment allows blood donors to schedule a blood donation appointment on their convenient date, time, and center.

B. Find Blood Centers shows the route between the blood center and the user's current location using the geolocation.

C. Donor Information allows the donor to update their personal information such as Donor ID, blood group type, etc. This also includes the covid-19 vaccine code.

D. Find donors allows the blood requester to directly send a blood request to a blood services organization such as the Philippine Red Cross.

E. Blood Donation History allows the user to view the blood history and blood test results.

F. Badges allow the blood donor to share their successful blood donation on social media platforms like Facebook and Twitter to encourage others to donate blood.

G. Menstrual Health allows the female blood donor to track their period cycle, emotion, flow intensity, and symptoms. This will help females organize ovulation and return to the application at least once a month.

H. Blood donation information Allow the donor to access the data from Red Cross.

2.6. Ontology

Ontology is a philosophy concerning nature and reality's essence, and it nearly always employs an ontology to conclude what it is. Ontology concept is logic and natural relation of objects [26]. To construct an ontology, examine and describe the scope and domain of the ontologies generated, then define classes, subclasses, and relationships between entities. Assigning attributes to classes and forcing subclasses to inherit properties from their corresponding super-classes establish relationships between entities. Ontologies also allow computers to distinguish between different types of data, and inference rules in ontologies allow for creating more complex relationships. After containing all studies, this research will adopt all information to create a proposed research model below.



Figure 3 The proposed conceptual model.

The conceptual model contains four factors of influence, including characteristics, motivation, Barriers, and Communication to understand the blood donation in Thailand. Next, the research will adopt all information to create a concept design of blood donation using ontology to find a concept relationship and build the UX/UI design interface. After that, the evaluation will use the usability test and UI Satisfaction to indicate the result

3. METHODS

3.1 Research Methodology

After we collect important application features from the literature review about the motivation barrier and the primary feature in tracking blood donation platforms. This paper designed a prototype application with the Figma [27] and intended to use the depth interview process to prove all blood donation motivation barriers and features. Follow process is below.



Figure 4 Steps of research methodology.

The research methodology model consists of five steps: produce a taxonomy of user applications, design a user interface, then evaluate it by usability testing. Next, discuss all the results and develop a final conceptual design.

3.2 Usability test/User research

A total of 15 users evaluated the design of the final prototype. Three of the users are IT experts who have an experience of more than five years of. And the other 12 range between the ages of 18 and 60 with various types of donors. Donor types include two non-donors, six occasional donors, and four experienced donors. See more in Table 3. Each user will participate in a depth interview to ensure the application is usable. Data is collected with high security, and all respondents agreed to give true stories and agreed that the result would be anonymous.

Table 3 The	Respondent	's selection	of application	users
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Application users	Μ	F
Non-donor	1	1
Occasionally donor	2	4
Experience donor	2	2

4. RESULTS AND DISCUSSIONS

The results were gathered from a usability test and interview with UX/UI experience and donors who used to date blood and never had experience in blood donation.

4.1. Motivation and barriers to blood donation

From the interview, all participants have a positive attitude toward blood donation, and the results are pretty familiar with motivation and barriers from the literature review as

"Normally, I think the blood donation is a perfect deed. It likes we do a merit, but we can see the result clearly because we see the respondent. I think it is better than doing merit." (P1). So seem likes interviewees agree that blood donation is the right thing to do.

Social media's power was found in the interview as many donors donated after seeing news of blood shortages on social media. as

"I found on social media that there was such a blood shortage. I will decide to donate because I want to give anyway." (P6).

However, the most donor who comes to a blood center used to confront a bad experience about waiting long hours to donate, such as

"On covid-19 situation, I spend time in the Thai red cross center around two or three hours to finish the process" (P3). And "Staff must improve on queue managing" (P6).

Although, donating to mobile services such as malls, offices, or mobile car services can reduce this problem.

Furthermore, filling out many documents created a bad and upsetting experience to blood donors. As the participant P4 and P8 explained that it is not clear on some parts to fill-in the document. Importantly, if they want to donate whole blood and plasma methods, they need to refill the paper again.

A literature review found on time risk that Kotler & Keller (2012) [19] stated people hesitate to waste their time to do something. In the results, the blood donation process in Thailand still has several things about time management to improve.

4.2. Usability test from expert and application user

The three experts completed six tasks (Table 4) as part of the first usability test. They were also observed and timed as part of that process.

Table 4 The task of the usability test

Task	Features	Task
T1	Personal	Find donor id
	information	
T2	Make an	Edit appointment date
	appointment	
Т3	Blood	Find previous details of
	history	blood donation
T4	Find center	Find routing to Siriraj
		hospital
T5	Badges	Check your reward
T6	Knowledge	Find tip before donating

This usability test was conducted in order to determine whether some of the problems identified in the first usability test had been adequately addressed. It also was to see how smoothly the application could be used. These experts did not know anything about the prototype before taking the test. The results of the time experiments can be seen in Figure 5.



Figure 5 The usability time results from experts in a second

The most noticeable difference in the user group where how most of the experts(U1-U3) struggled is T6 to find information about Information toward blood donation. They cannot find it because of the wording 'RED Cross.' It seemed like this would be the feature to link only to the Red Cross. The expert seemed to have a specific idea of where this information would settle. They suggest changing the feature name to FAQ (frequency of ask) instead.

After re-designing experts' feedback, this paper will send out a new design to application users.

Figure 6 illustrates the time spent by interviewees completing each task via a line graph. The figure shows the redundant time to complete each task from items 1 to 6. Therefore, all users can complete the task in a shorter amount of time. The average time, all tasks take less than 5 seconds, which means that the design is very effective in user-friendliness and shows how smoothly the application is utilized.

4.3. Final prototype and Features

This prototype will be developed based on feedback from the expert interview usability tests and



Figure 6 The usability time results from donor users in a second

recommendations from all interviewers. It is developed with the Figma. The prototype has a final feature shown below;

Donor Information (Profile)

Donor information was the first function in the application essential for donors. In Thailand, users of the donation site receive a paper donor card stamped each time they donate. Some donors reported that their cards had been lost on several occasions since it was tedious for them. The application makes it easy for donors, so they won't have to worry about forgetting or losing their cards. A digital database of donor information will include the name, age, gender, height, weight, blood type of the donors, and details of their covid-19 vaccination.

Blood Donation Appointment

Appointments allow the user to book or modify their current appointment. Blood donations are unrestricted and voluntary. Thus, it was critical that existing- and new donors could change their appointment without taking several steps. In this way, the donor process becomes more flexible. Users are not required to call the blood donation site to change the time and date, they can do it themselves with on the application. Moreover, the documentation should be simpler to fill out as it is a digital format. As well as reducing the time spent at the blood center, it will screen



Figure 7 Blood Donation Appointment

donors who can donate first. This will ensure that they do not waste time traveling to the center and being unable to donate. In addition, it will eliminate paper from the blood center. The role of social influence is also quite significant, and social networks are one of the fastest ways to connect with many people. Sharing the appointment with user friends may become more effective in marketing (see Figure 7).

Find Blood Centers

The Find a blood center feature allows the user to find the nearby blood center and available place to give blood. In addition, users can manage the trip and the distance between their location and the blood center in drive mode.

Find donors

Users themselves can make requests for blood. It provides blood type, location, units, and phone number.

The application will send a notification to available donors when blood is requested. This notification allows the recipient either donate blood or share the need for blood on social media.

Blood history

The feature allows users to see the record of their previous donated blood. At first, it shows the total saved a life by the user, calculated from the total donation from the WHO slogan one donated blood saves three lives [52]. Next, it shows the summary of donations for each year. The user also sees blood donation details in each donation and allow them to share their accumulated number of a successful donation on social media

Achievement

The Achievement (Badges) module can be accessed from the front page of the application. This feature allows users to keep track of their rewards of the user's accomplishments through Achievement on the main menu; this feature aims to provide an overview of their rewards. This page allows the user to set a goal for the frequency of their blood donations annually. As the user performs various blood donation activities, different badges are unlocked. On this page, you can find all of the badges. The badge also provides the user with a progress bar; the badges will be unlocked after performing a particular activity, such as making more trips for blood donation, while others must be completed several times. In addition, the user can click on an unlocked badge to get information about that activity and why it is important. It also provided the ability to share badges via social networks

Menstrual health

Donating blood requires healthy donors and high blood values, especially for women. Donors must have normal hemoglobin levels (blood percentage) and ferritin levels to donate. Viewing a fertile period and cycle before the next appointment may help manage them. This facility allows females to monitor their appointments based on their current circumstances, which is the key to implementing this function. The feature will hopefully prevent users from having to skip a donation due to low hemoglobin levels

Blood donation information

A FAQs (frequency ask questions) is a module where users can see the most frequently asked questions about blood donation, like tips about blood donation, how to provide before donating blood, and recovery after the donation. This module also allows users to access the information from the Thai Red Cross

4.4. Recommendations

To design and develop the prototype, both users and experts conducted usability tests and depth interviews. The development process used to design and develop prototypes helped implement blood donation applications prototypes on mobile platforms. Prototypes proved to be crucial in rapidly implementing functionality and receiving feedback from users. For this project to succeed, it needs to be implemented. The organizations that involves blood donation, such as the Red Cross, hospitals in Thailand, the Ministry of Public Health, Bureau of Statistics , and other related organizations could adopt the findings of this research on UX/UI design for further development of the blood donation tracking system on mobile applications. Furthermore, it should focus more on implementation and testing in the medical field.

4.5. Limitation

The research project has several limitations. Due to the limitations, the majority of this study were conducted on computers on both donors and experts. Some scenarios would be needing more interview as it is a deep interview within a small group, there may be less variety of behavior and problem usages. Due to the possibility of problems when the application is launched, this method is not practical. In addition to design iterations with implementations and evaluations with users and medical personnel, further design iterations may be helpful in improving the application accordingly.

5. CONCLUSION

This thesis aimed to investigate whether the blood donation situation in Thailand could be improved by using mobile technology and providing new and existing donors with engaging and supportive design and functionality. A Design framework was applied throughout the entire research project to ensure that an artifact was secure, relevant, and high-quality. According to the feedback from the different participants and the evaluation of the application by application users and usability experts, the final results contribute to the knowledge base, and they are significant. Using Figma (2022), a mock-up application was developed for blood donors in Thailand. A proposed application aims to simplify the process and provide relevant, engaging information to blood donors for their convenience. This paper proposed a conceptual framework for a mobile-based application to facilitate blood services. The proposed system will bridge the gap among blood service facilities, blood donors, find blood donors, track period for women, and all processes related to blood donation. The proposed mobile application will make blood services such as blood donation and requesting blood more effortless and convenient. In addition, the application will collect the information, including symptoms, total blood donations, and the covid-19 vaccine code.

The proposed mobile application will gain more engagement from Thai donors and aimed at achieving more re(turn)-blood donation through the various activities of Thailand Red Cross blood service facilities, such as the blood drives, which can increase their willingness to donate and awareness that there is an immense need for blood; hence, it will finally generate more donations. The proposed system also shows an updated blood history of blood transfusion processes. The proponents plan to implement the proposed Thai blood donation system in the future.

5.1. Future work

The application will be developed to integrate the different functionalities into a fully functional system in the future. In further testing and evaluating the application's concept, the product should be enrolled in a blood donation system to be tested as a test. Medical personnel and staff from the different transfusion divisions must be consulted and initiated to find challenges and solutions to problems not addressed in this research. In addition, this application only addresses the needs of donors. They may be helpful on the other side of the process, such as attracting more first-time donors, managing Blood transfusions, or developing self-monitoring health care services.

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