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Android Application for Managing Urgent Convalescent Plasma Blood Request for COVID-19 Treatment

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Abstract

The emergence of the COVID-19 pandemic has compelled many countries to prioritize technologies that can save lives. While considerable efforts have been directed toward containment and mitigation, relatively less attention has been given to administering urgent requests for convalescent plasma as a treatment for critically ill COVID-19 patients. Passive administration of antibodies from recovered individuals may serve as an effective therapy for those who have not yet developed their own antibody response. Consequently, interest in convalescent plasma has been rising, not only among medical professionals but also among patients' families, particularly in urgent cases. This paper proposes a timeline-based application that addresses the urgent request issue by sorting posts based on a first-come, first-served basis. Through this timeline, individuals searching for donors can easily access donor information and locations. Additional features include a timeline page, search functionality, and a virtual assistant (chatbot) that automatically shares posts to social media without requiring users to exit the app. These enhancements aim to increase the reach and response rate of urgent requests. Previous studies reported that among 40 PSARS patients treated with ribavirin and methylprednisolone, 19 received convalescent plasma, while 21 were administered an additional dose of methylprednisolone. Patients who received plasma therapy demonstrated better recovery and reduced mortality. In light of this, we propose that our Android application can assist in delivering timely support to those in need and potentially save more lives. Furthermore, the app can serve as a model for similar digital solutions.

Keywords

Android application, Blood request, Convalescent plasma, Covid-19 treatment

Introduction

This paper addresses the increasing demand for convalescent plasma in the treatment of COVID-19 patients prior to widespread vaccine distribution. The therapeutic use of convalescent plasma is not a new concept. Historically, it has been employed in managing severe viral infections, including the severe acute respiratory syndrome (SARS), the 2009 H1N1 influenza pandemic,

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Ebola, avian influenza A (H5N1), and others (Rojas et al., 2020). For instance, during the 2003 SARS outbreak in Hong Kong, a study reported that among 1,775 patients, the 80 individuals who received convalescent plasma had a significantly lower mortality rate (12.5%) compared to the overall SARS-related mortality rate of 17% (n = 299). Although the antibody titers and transfusion volumes varied and showed no clear correlation with clinical outcomes, patients who received plasma within 14 days of symptom onset (n = 33) had notably better prognoses, with no adverse events reported (Rojas et al., 2020).

The application of convalescent plasma in treating COVID-19 gained traction after studies indicated a reduction in mortality rates among recipients. For example, Shen et al. (2020) documented the clinical outcomes of five severely ill COVID-19 patients treated with plasma from recovered individuals at the Shenzhen Third People's Hospital in China. Within one week post-transfusion, all patients showed marked improvements, including normalized body temperatures, improved Sequential Organ Failure Assessment (SOFA) scores, enhanced PAO2/FIO2 ratios, elevated neutralizing antibody titers, and negative SARS-CoV-2 results in respiratory samples within 1 to 12 days.

As illustrated in Figure 1, convalescent plasma therapy has shown clinical promise. However, during the pandemic, locating suitable donors proved challenging due to movement restrictions and social distancing mandates. Many patients' families and medical professionals turned to social media to post urgent donor requests, often through story feeds or timeline updates in 2020. This social behavior motivated the development of an alternative digital platform to facilitate communication between potential donors and recipients.

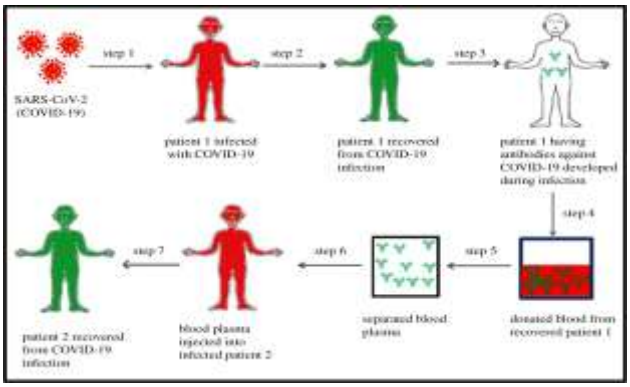

Figure 1. The convalescent plasma treatment for Covid19 patients

In addition to convalescent plasma, there is an ongoing global demand for blood transfusions. With a world population of approximately 7.8 billion, it is estimated that someone requires a blood transfusion every two seconds for conditions such as trauma, surgery, organ transplants, pregnancy complications, and cancer (Selvamani & Rai, 2015). Compounding this issue, stored blood has a shelf life of only 42 days (Trust H, 2019), necessitating a streamlined mechanism to address both regular and emergency blood donation needs.

During the COVID-19 pandemic, fear of gatherings led to a significant decline in donor rates. In Malaysia, for instance, the New Straits Times (2020) reported a 40% drop in national blood bank stock, as noted by Health Director-General Tan Sri Dr. Noor Hisham Abdullah. This

decline underscores the urgent need for an innovative, safe, and accessible solution to facilitate blood and plasma donation during public health crises (Krishnan, 2020).

To address this issue, we propose an Android-based mobile application as a platform that allows donors and recipients to communicate and provide support remotely. The application accommodates both convalescent plasma and standard blood requests for critically ill patients. Given the popularity of Android devices (Statista, 2021), this platform was developed using tools such as Android Studio, Java, JDK, SQL Database, Firebase, and the IBM Watson chatbot. The app features a timeline-based post feed managed through a First Come, First Served (FCFS) algorithm, social media integration, and a virtual assistant capable of answering eligibility questions and guiding users to nearby donation centers. The SQL database stores user profiles and other critical data to ensure efficient matching and communication.

Methodology

A prototype model is employed as a research methodology during app development because of its quick design and the involvement of the target user throughout the process. Figure 2 illustrates the processes of the prototype model.

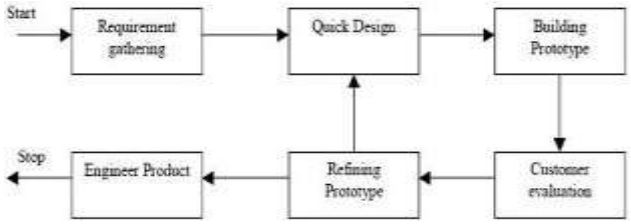

Figure 2. Prototype model

- Step 1 Requirement Gathering: we did the data gathering related to requirements and users' expectations using two methods i.e. interview and questionnaire.
- Step 2 Quick design: we draft the App design based on the requirement analysis and the feedback received from our respondents.
- Step 3 Building prototype: we develop a prototype using wireframing software that includes basic functionalities including timelines.
- Step 4 Customer evaluation: we obtain valuable feedback from the target user for the prototypes that we develop in step 3.
- Step 5 Refining Prototype: We alter the app design after the respondents' evaluation. We perform many cycles of iteration until the requirements are satisfied.
- Step 6 Engineer product: We compile the final version and testing on the functionality of the apps.

Results and Discussion

In this section, we would like to highlight four main features implemented in our app as a result of the social media algorithm that we employed. The four main features are, i.e., city-based timeline, sharing to social media and direct call, searching donors based on country location, and a virtual assistant (chatbot) with a speech-to-text feature.

A city-based timeline enables donors to post their profiles with their availability to help the recipients who need blood or convalescent plasma. At the same time, recipients may view the donors' timelines and respond to the posts. Similarly, the recipients who need blood or convalescent plasma donors may post to the timeline on which donors can respond to the request. The overall algorithm for donors and recipients is depicted in Table 1 below. The graphical user interface of the timeline algorithm is portrayed in Figure 3.

Table 1. Algorithm for donors and recipients

Algorithm for the user.donors	Algorithm for user. recipients

begin
user.donors (registration)
save.data (on)
user.donors (eligibility check)
If virtual.assistant(on) then activated
end_if
if user.donors (pass) then
user. Recipients (view_timeline) enabled
user.donors (posting) enabled
user.donors (share) enabled
user.donors (search) enabled
user.donors (virtual_assistant) enabled
else
exit_app
end
	begin
	User.recipients (registration)
	save.data (on)
	user. recipients (view_timeline) enabled
	user. recipients (posting) enabled
	user. recipients (share) enabled
	user. recipients (search) enabled
	user. recipients (virtual_assistant) enabled
	end

Share to social media is the second feature that allows both donors and recipients to share their posts from our timeline to the preferred social media platform. This feature is depicted in Figure 4. For the search donors feature, it is designed based on country location, which enables both donors and recipients to view and be knowledgeable about the availability of donors in other places by location and specific blood group/type. The interface of the search donors can be seen in Figure 5. The virtual assistant in our app is equipped with a speech-to-text feature to speed up inquiries without having to type them. Users may use their voice, and the app will translate the voice/speech into text. This significantly accelerates the process of finding information or making inquiries. This feature is portrayed in Figure 6.

During acceptance testing, which involves target users, 90% of our respondents find this app to be very useful and able to cater to the urgent need within the timeline. The most valuable feature besides the timeline is the direct sharing to social media platforms. It makes the app current

and reaches many people who need urgent help or search for donors easily. Although the timeline works, city-based users can go visit another city to look for information using the search function.

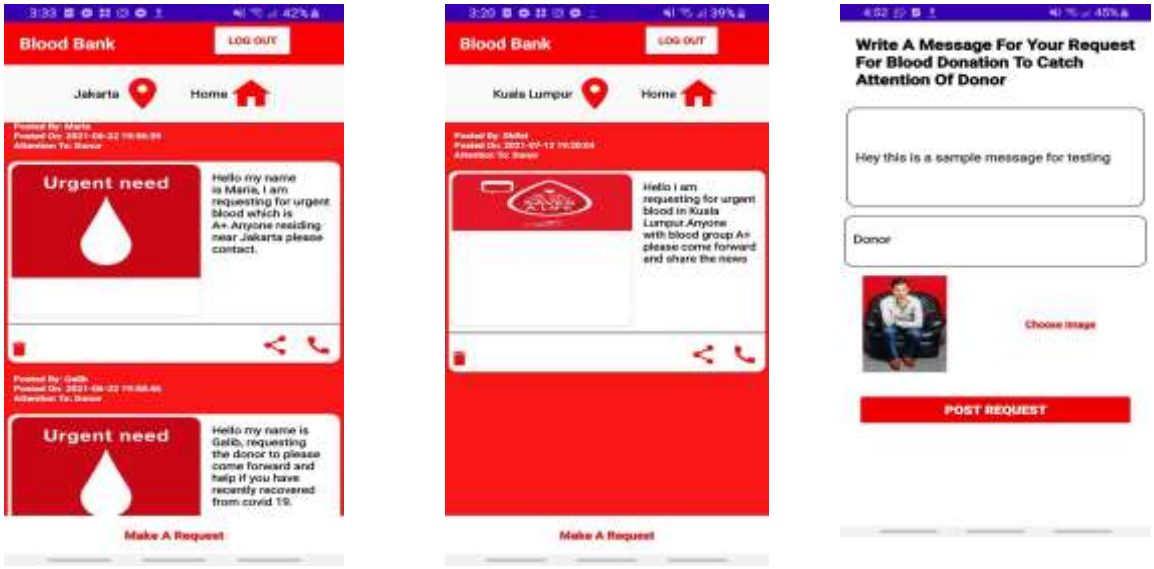

Figure 3. City-based timeline feature

Figure 4. Share to the social media feature

Figure 5. Feature to search for blood donors in cities around the world

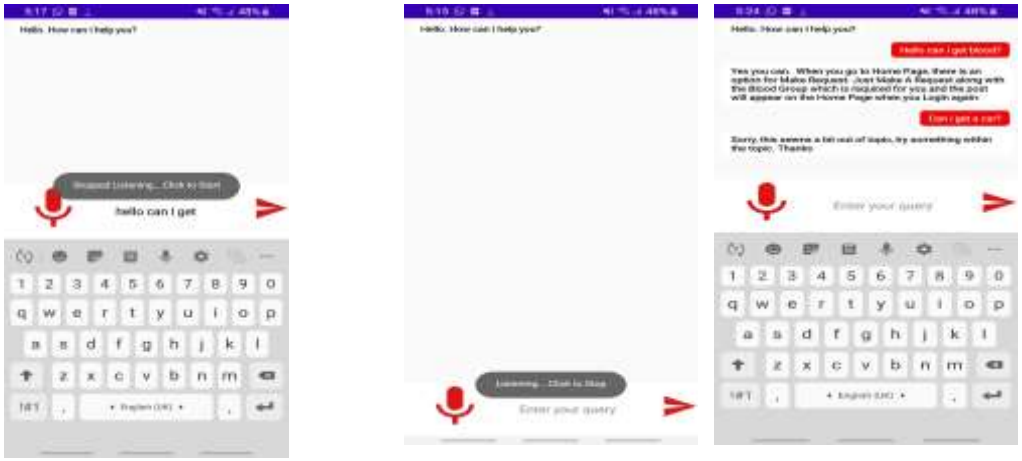

Figure 6. Virtual assistant with speech to text enabled

Conclusion

The research and study in this paper have achieved their objectives to come out with an Android-based application to assist people who urgently need the convalescent plasma blood request. With enhanced features, this app can be a reference model for another similar app that emphasizes speed and flexibility.

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