DEVELOPMENT OF BLOOD DONOR APPLICATION USING GEOFENCING AND FIREBASE TECHNOLOGY ON ANDROID PLATFORM

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ABSTRACT

This study aims to make it easier for patients to find blood donors in an emergency, and make it easier for people to find out about blood donation and blood stock activities at PMI in Bandung. In this study interviews were conducted with the community and patients who were in need of blood donors to get things clearly needed in this study. In software development geofencing technology is used so that someone who gets a notification needs blood donors, only around the coverage that is not too far from patients who are looking for donors and firebase technology to add other supporting features. Based on the results of the questionnaire on 10 people who were looking for blood donors and 35 people in the general population, it was found that 90% of 10 people stated that this application could make it easier to find blood donors in an emergency and 86% could find donors more easily than searching on other social media. For the general public, 94% of the 35 people of this application can make it easier to find out information about the activities and blood stocks that are in PMI Bandung. Thus, this blood donor application can be used by the general public, especially the people who are in the city of Bandung.

Keywords: Blood Donation, Blood Stock, Blood Donation Schedule, PMI Bandung City, Geofencing, Firebase.

1. PRELIMINARY

Blood Donation is to carry out humanitarian activities in terms of donating blood to other people through blood tapping, at this time many people who need blood donors in an emergency, if they don't get donors quickly they will have fatal consequences for these patients. By conducting interviews with the hospital, PMI and patients who are in need of blood donors were informed that if the blood type needed by the patient is empty at the hospital or PMI, the family is advised to join in looking for someone who is interested in blood donation. At present to find donors the patient's family broadcasts the information to social media, which results in the information not being conveyed to people due to the large amount of other information available on social media, and obtained from 113 correspondents about 69% said it was difficult to find donors from social media.

PMI City of Bandung held a mobile blood donor for the community to donate blood aimed at helping someone in need. Sometimes people do not know about the mobile blood donor schedule conducted by PMI Bandung City. Based on the results of a survey conducted on the community, there are currently many people who want to donate blood to help people in need, but in 113 people around 67.3% said that it was difficult to find information on blood donor schedules held by PMI Bandung City. Currently the blood donation schedule is on the official website of PMI Bandung City, however, with the results of interviews with the community, saying that it is easier if there is a notification on their smartphone if there is a mobile blood donor schedule.

In research on finding the nearest tourist location using geofencing technology, where geofencing works as a limiting range of information to be provided, it was produced in this study that geofencing technology can help people get info on the closest tourist location to its location [1]. Research on online registration that uses Firebase Authentication technology, the technology provides good security and makes it easier to verify the account on the application, it is generated in the study that users can feel safe about the data registered in the application [2]. Firebase Cloud Messaging can easily spread information to every user quickly, in research on providing information from lecturers of all students quickly, resulting in that the technology can quickly disseminate information to many users of the application [3].

Based on these studies, information is generated that can support the research on the development of blood donor applications, which this study aims to make it easier to find donors for patients who are in need of blood donors and make it easier for people to find out about blood donor activity schedules and blood stocks at PMI City of Bandung. At the testing phase of the community, 90% of the responses agreed that the blood donor application could help get donors, and 94% agreed that this application

could provide information easily PMI Bandung blood donation and blood stock activities, but there were obstacles when needed patients are rare blood groups.

So from that it can be concluded that this application can make it easier for patients to get the closest donors to their location, and can make it easier for the general public to find information on mobile blood donor schedules conducted by PMI Bandung City, and find out information on blood stocks at PMI Bandung on smartphones they.

2. LITERATURE REVIEW

2.1 Geofencing

Geofencing works by utilizing the GPS component as a virtual geographic boundary. The geofence program allows smartphone users who use these features to determine virtual points that convey signals if the GPS-equipped device crosses the boundary of the virtual fence, both in and out of the specified fence line. This geofencing application feature can involve other services such as Google Earth, to determine the virtual fence line, or be determined in the form of a longitude and latitude [4].

Picture 1

Geofence can also be set by the system that is on the user's smartphone. This technology makes it possible to choose the address or location of the place where you want to trigger certain warnings or push notifications where the application is programmed to trigger actions based on other actions [5].

2.2 Haversine Method

This method is for calculating radius notifications which will later be used as the specified distance to get notifications from other users. Haversine Formula is a method for knowing the distance between two points by calculating that the earth is a field that has a degree of curvature. The Haversine Formula method calculates the distance between 2 points based on a straight line length between 2 points on longitude and latitude [6].
Here's the form of the Haversine Formula Formula:

$$\Delta lat = lat2 - lat1$$
$$\Delta long = long2 - long1$$
$$a = sin\left(\frac{\Delta lat}{2}\right)^2 + cos(rad\ lat1) * cos(rad\ lat2) * sin\left(\frac{\Delta long}{2}\right)^2$$
$$c = 2\ asin(a)$$
$$d = R * c$$

Information :
R = the radius of the earth is 6371 (km))
Δlat = the amount of change in latitude
$\Delta long$ = longitude change magnitude
c = axis intersection calculation
d = distance (km)
1 $derajat$ = 0.0174532925 rad

2.3 Firebase

Firebase was first established in 2011 by Andrew Lee and James Tamplin, Firebase itself is BaaS or Backend as a Service which is currently owned by Google. Firebase is to simplify work in making mobile-based applications. With the presence of Firebase, making programmers can focus on developing applications without having to give a big effort to the backend business [7].

Some of the features that Firebase has are as follows:

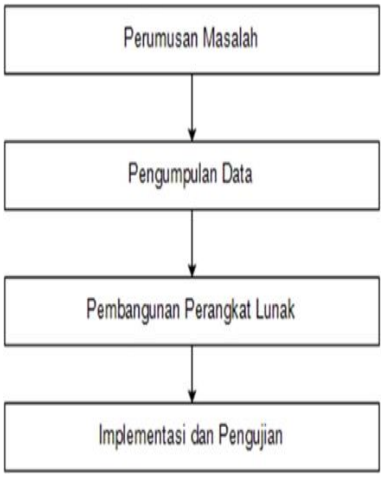
1. *Firebase Analytics.*
2. *Firebase Cloud Messaging*
3. *Firebase Authentication.*
4. *Firebase Remote Config.*
5. *Firebase Real Time Database.*
6. *Firebase Crash Reporting.*

2.4 Android

Android is a popular smartphone at this time, the operating system used by Android is open source based on Linux, the Android operating system was released in 2007 together with the establishment of the Open Handset Alliance. Android has a very good OS and has an intuitive interface with flexible functions. Therefore Android continues to update so that the system can compete with its competitors [8].

3. RESEARCH METHODOLOGY

The research methodology is a way to find out the results of a specific problem. This study uses a descriptive method with a qualitative approach that aims to get things that are needed in this study clearly by conducting interviews and questionnaires then analyzed to provide arguments against what is found in the field and associated with relevant theoretical concepts [9]. The flow of research conducted is:



Picture 2

3.1 Method of collecting data

The data collection methods used in this study are as follows:

1. Literature Study

Data collection by studying the sources of literature include the results of research, reference books, journals and readings that have to do with the research title.

2. Observation

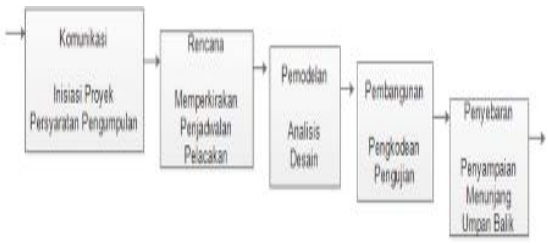
The observation method is to collect information through direct observation of the community and PMI of the City of Bandung.

3. Interviews and Questionnaires

The method of collecting data by interview gave 9 questions to the community who were donating blood and gave 5 questions to the PMI party and the questionnaire gave 8 questions and 1 suggestion to the wider community to obtain information as the basis for application development.

3.2 Software Development Method

The method for building this application is the Pressman waterfall method, Roger S. Because the construction of this system is done sequentially. Modeled with activities as follows [10].



Picture 3

1. Communication

The communication phase in this research is the stage of analyzing the needs for the system to be built on the community and the stage where data collection is conducted by meeting with the PMI and the hospital.

2. Plan

At this stage continued from the communication stage, where the results of data collection of user needs will be used as a reference to the development of blood donor applications and how this application will be tested.

3. Modeling

This stage is the stage where an analysis of the needs of the application to be made, as well as conducting an analysis of what can be accepted by the user.

4. Development

This stage is the coding phase of the application and the stage of translating the user requirements that have been obtained. This stage is the stage to realize user needs into coding. After the coding is complete, testing of the system will be carried out by the programmer, which aims to find errors in the system before the application is distributed to the user.

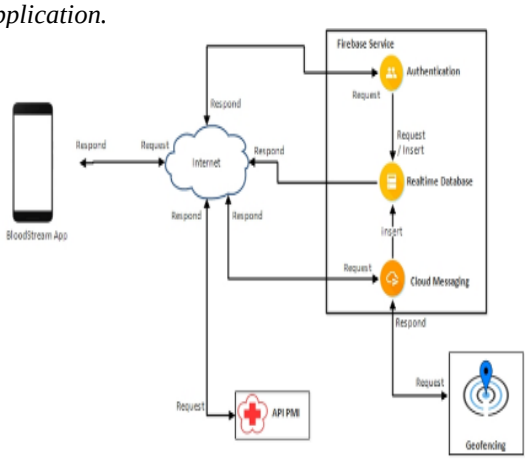
5. Spread

This stage can be said to be final in making a system. After doing analysis, design and coding, the finished application will be given to user users. Then the application that has been built should be carried out periodically so that the application can develop.

4. RESULTS AND DISCUSSION

4.1 Analysis of System Architecture

Architectural analysis aims to identify the system architecture to be built. Next is the System Architecture used in the construction of this application.



Picture 4

The following is an explanation of Figure 4: System Architecture:

1. The whole system uses services that are in Firebase and communicates via the internet. The mobile application is built with the Flutter framework.

2. The mobile application requests data to the Firebase service and API from PMI via the internet. Data requested includes blood stock data, and blood donor activity data. Blood stock data and blood donor activity data are obtained from the PMI API.

3. Blood request data is obtained from other users who request blood. After the user requests blood, some users with a specified radius using Geofencing get notifications through firebase cloud messaging.

4. For users who have registered in the application, for login users to use an active mobile number, if the user has not registered on the application then the user will be directed to register or register in the application, the user uses the mobile number that will be authenticated by firebase authentication.

5. The data requested by the application is obtained in the available database, the data is in the form of user data, blood demand data, respondent data, blood stock data, and blood donor schedule data.

The details of the various firebase services used include:

1. Authentication

This service aims to facilitate users in registering and logging in. Firebase Authentication can use Google, Twitter, Facebook, GitHub, and cellphone numbers. The system to be built uses authentication with a mobile number. The choice of using a cellphone number is because it is also for information when the user requests blood, so that he can be contacted immediately when there is another user who will donate his blood.

2. Realtime Database

The Firebase Realtime Database is a NoSQL database that is hosted in the cloud, which can be used to store and synchronize data between users in real time. So when there is a change in every data that is in the database, the data will immediately change on the user side. This database is used to store all data used for applications, including user data, blood demand data, blood stock data, and blood donor schedule data.

3. Cloud Messaging

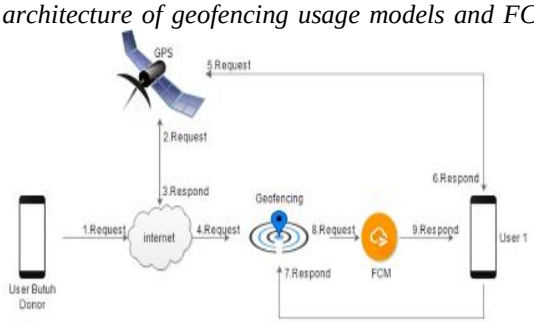
This service is used to send notifications to users. Notifications that will be sent to the user's mobile phone include when there is a new blood request or there is a new mobile blood donor schedule from PMI. For functional blood requests beforehand, first be filtered based on the distance using geofencing.

4.2 Technology Analysis

Technology analysis is used to find out the process flow of a technology that is used can be applied to the application that was built. The development of this application uses technology that can support use for end users. The technologies used in this research include Geofencing, Firebase Authentication, Firebase Realtime Database, Firebase Cloud Messaging and Haversine Formula methods.

4.2.1 Geofencing Technology Analysis and FCM

Analysis of the use of Geofencing technology and FCM such as in Figure 5 the architecture of geofencing usage models and FCM



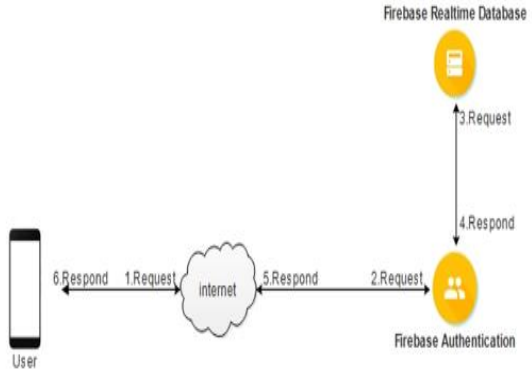
Picture 5

1. *The following is an explanation of Figure 5 of the Geofencing and FCM usage model architecture:*
2. *1. Users who are in need of blood donors send information through the internet network and request latitude longitude to find the location of their smartphone on maps to serve as a starting point.*
3. *2. To get the latitude longitude smartphone location, the user needs a blood donor, the system will request GPS technology.*
4. *3. The GPS will respond to the location of the smartphone. The user needs a blood donor by sending latitude and longitude as the starting point.*
5. *4. The starting point will be a request for the geofencing system that has been determined by its distance radius, as the midpoint in the geofencing.*
6. *5. User 1 to get a notification must be registered with latitude and longitudy, smartphone user 1 will request GPS so that the location of user 1 is detected in the geofencing system that has been determined by users who are in need of blood donors.*

7. *6. GPS will respond and send latitude longitude from user location 1.*
8. *7. Latitude longitude from user 1 will be detected from the geofencing user who is in need of a blood donor.*
9. *8. If the location of user 1 is within geofencing, the system will request FCM to send notification to user1.*
10. *9. FCM will respond to send notifications to user 1.*

4.2.2 Analysis of Firebase Technology

The following is the use of Firebase Authentication technology and Firebase Realtime Database to log in and register, as shown in figure 6:



Picture 6

1. *Firebase Authentication and Firebase Realtime Database*
2. *Explanation of figure 5 as follows:*
3. *1. To login or register, the smartphone will request via the internet network.*
4. *2. After the user enters a mobile number, the system will request Firebase Authentication to log in or register.*
5. *3. Firebase Authenticatication will request the Firebase Realtime Database to check whether the user's mobile number is registered or not yet registered.*
6. *4. Firebase Realtime Database will respond to mobile numbers registered or not registered to Firebase Authentication.*
7. *5. Firebase Auth will respond sending a verification code to the user.*
8. *6. If the user has registered, the system will respond and be directed to the home screen, and if the number is not registered, the system will respond to the registration form.*

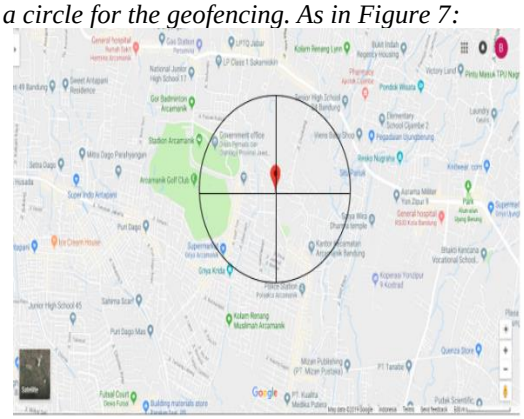
4.2.3 Analysis of the Haversine Formula Method

Each user requests blood, the system will send notifications to other users with a predetermined distance tolerance. For example, a user who requests blood with a blood clot A is located at latitude -6.913590 and longitude 107.681356. When other users registered in the database can be seen in Table 1:

Table 1

User	***Latitude***	***Longitude***	***Gol Darah***
User 1	*-6,91403*	*107,68107*	*A*
User 2	*-6,91228*	*107,68005*	*B*
User 3	*-6.922426*	*107.670202*	*A*
User 4	*-6.925077*	*107.672327*	*A*
User 5	*-6.927366*	*107.682523*	*O*
User 6	*-6.918827*	*107.683022*	*AB*

Users who request blood can be used as a starting point or midpoint for the use of geofencing with a predetermined radius, described in the form of a circle for the geofencing. As in Figure 7:



Picture 7

Then the calculation of the distance between pickup locations will be carried out using the Haversine Formula method. The Haversine Formula method calculates the distance between two points based on a two-point straight line on longitude and latitude. For example, the user coordinates that make blood requests become lat1 and long1, and User 1 becomes lat2 and long2.

Following are the Haversine Formula Calculation:

User1 *= lat1 = -6,913590*
long1 = 107,681356
User2 *= lat2 = -6,91403*
long2 = 107,68107

$$\boldsymbol{\Delta lat} = lat2 - lat1 = \text{-7,67945E-06}$$

$$\boldsymbol{\Delta long} = long2 - long1 = \text{-4,99164E-06}$$

$$\boldsymbol{a} = sin\left(\frac{\Delta lat}{2}\right)^2 + cos(rad\ lat1) * cos(rad\ lat2) * sin\left(\frac{\Delta long}{2}\right)^2$$

$$= sin\left(-7{,}67945E - \frac{06}{2}\right)^2 + cos(-0{,}120664909) * cos(-0{,}120672588) * sin\left(-4{,}99164E - \frac{06}{2}\right)^2 = 2{,}0759E - 11$$

$$\boldsymbol{c} = 2\ asin(a)$$

$$= 2\ asin(2{,}0759E - 11) = 9{,}1124E - 06$$

$$\boldsymbol{d} = R * c$$

$$= 6371 * 9{,}1124E - 06 = \mathbf{0{,}05805511\ km}$$

Then the results of these calculations user 1 get a notification from the user who is in need of blood, because the geofencing radius of the user needs a blood donor is 1 km and the distance from the calculation results is 0.058 km, resulting in 1 km> 0.058 km. In determining the geofencing radius is given a minimum distance of 1 km and a maximum distance of 15 km, because the outermost distance of the city of Bandung is 14.28 km calculated from the starting point located in RSHD City of Bandung.

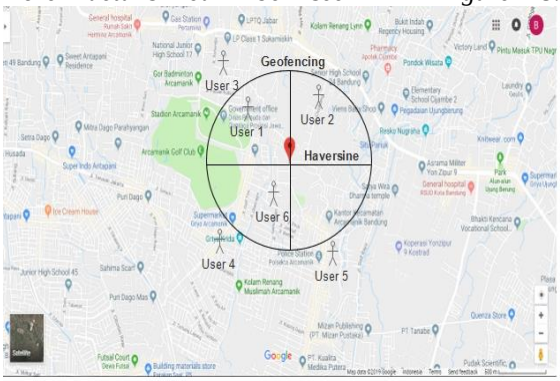
Picture 8

The above calculation is done for all existing users, the results will be like table 2.

Table 2 Haversine Formula Calculation Results

User	*Latitude*	*Longitude*	*Jarak*
User1	*-6,91403*	*107,68107*	*0,058 km*
User2	*-6,91228*	*107,68005*	*0,205 km*
User3	*-6.922426*	*107.670202*	*1,577 km*
User4	*-6.925077*	*107.672327*	*1,621 km*
User5	*-6.927366*	*107.682523*	*1,538 km*
User6	*-6.918827*	*107.683022*	*0,611 km*

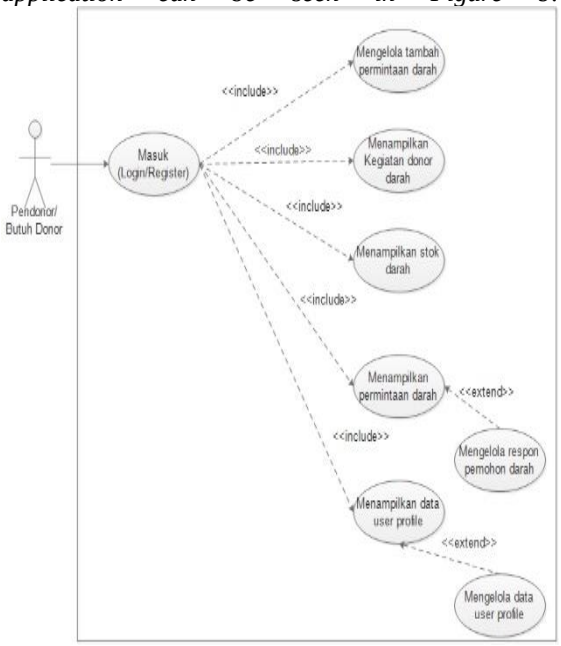
If the tolerance of the distance is a maximum of 1 km, then those who receive notifications are User 1, User 2, and User 6 only, for more details can be seen in Figure 8.



Picture 8

4.3 Functional Needs Analysis

Use case diagrams are used to describe the relationships that occur between actors with activities on the system. Use case diagrams explain what processes occur in the system and how they relate to actors. The use case diagram in this application can be seen in Figure 9.



Picture 9

4.3 Testing

The results of the examination are to show the results of the tests that have been carried out on the community, the tests carried out objectively in other words this test is a direct test in the field or a test conducted to the community. This test uses a questionnaire to the general public and people who need blood donors at the hospital.

The following is a statement to donor seekers and 10 responses from blood donor seekers were obtained.

Table 3 Results of the Donor Search Questionnaire

Statement 1: can make it easier to find donors				
SS	*S*	*R*	*TS*	*STS*
7	*2*	*0*	*1*	*0*
*Result = (45/(10*5))* 100% = 90.0%*				
Statement 2: can help find donors, rather than looking for media socialization				
SS	*S*	*R*	*TS*	*STS*
5	*3*	*2*	*0*	*0*
*Result = (43/(10*5))* 100% = 86,0%*				

Here are the results of questionnaires for 35 people in the general public

Table 4 General Community Questionnaire Results

Statement 1: can make it easier to find out about the schedule of PMI Bandung blood donor activities				
SS	*S*	*R*	*TS*	*STS*
25	*10*	*0*	*0*	*0*
*Result = (165/(35*5))* 100% = 94,28%*				
Statement 2: can make it easier to know the blood stock at PMI in Bandung				
SS	*S*	*R*	*TS*	*STS*
24	*11*	*0*	*0*	*0*
*Result = (164/(35*5))* 100% = 93,71%*				
Statement 3: can make it easier to find information on PMI in Bandung City compared to the PMI website				
SS	*S*	*R*	*TS*	*STS*
9	*23*	*0*	*3*	*0*
*Result = (137/(35*5))* 100% = 78,28%*				

5. CONCLUSIONS AND RECOMMENDATIONS

The conclusions and suggestions obtained from the results of the study are:

5.1 Conclusion

1. *Based on the results of research and testing that has been done, the conclusions are as follows:*
2. *1. Blood Donation Application can make it easier to find donors in an emergency, but there are obstacles when one patient needs a rare blood type. Because in that area no one has blood type according to what the patient needs.*
3. *2. The Blood Donation application can make it easier for the general public to get information on blood donor schedules and find out the blood stock in PMI Bandung City.*

5.2 Suggestion

Based on the results of research and testing carried out there are suggestions that can be given to add things to the development of this Blood Donor application. These suggestions are as follows:

1. Cooperating with the central PMI party, so that the blood stock and activities of PMI can become information for the wider community. Not only those who are in the city of Bandung, but people outside the city of Bandung can find out information in each region.

2. Working closely with government agencies on issues that have registered donor IDs at PMI, so that donor IDs are compatible with users to be safer.

3. To prevent irresponsible users, users' security problems in registering for the application, it is recommended to add ID card ID numbers that can be connected to the PMI server, so that donors and donors need to be verified first.

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