

Blood Donation Application with Implementation of Machine Learning



Inspiring Excellence

Sadia Nadira Diba | **13201029**

**Department of Computer Science and Engineering
BRAC University**

Supervised by Dr. Md. Ashrafal Alam

Submitted on: 5 April 2018

Declaration

We, hereby declare that this thesis is based on the results found by ourselves. Materials of work found by other researcher are mentioned by reference. This Thesis, neither in whole or in part, has been previously submitted for any degree.

Signature of Supervisor

.....

Dr. Md. Ashraful Alam

Signature of Author

.....

Sadia Nadira Diba

Acknowledgements

Firstly, we would like to thank the Almighty for empowering us to start our exploration and giving us enough passion to successfully conclude it.

Furthermore we offer our earnest and heartiest appreciation to our respected Supervisor Dr. Md. Ashraful Alam for his commitment, direction and support in leading the research and arrangement of the report. His contribution and direction has been of enormous incentive all throughout our thesis.

It would be ungrateful if we don't thank the Blood donation clubs and banks of current time, like Quantum Lab, Bangladesh Red Crescent Society. Their approach for inspiring the young for voluntary blood donation really helped us to understand the power a person has to save others' lives by voluntary blood donation.

Last but not the least, we are grateful to the faculties, seniors, friends and our families who have inspired us all through this journey. We also want to recognize the help we received from various resources over the Internet.

Contents

Declaration	iii
Acknowledgements	iii
List of Figures	v
Abstract	vi
Chapter 1: Introduction	
1.1 Motivation.....	1
1.2 Objective.....	3
1.3 Scope	3
Chapter 2: Literature Review	
2.1 Similar Research	6
2.2 Comparing Our Proposed System with Existing Technologies	8
Chapter 3: Introduction to Machine Learning	
3.1 Implementation of K-NN algorithm.....	9
3.2 Working with Machine Learning	11
Chapter 3: Proposed System Model	
4.1 Architecture	14
4.2 Working Principle	22
4.2.1 Login.....	22
4.2.2 Firebase Register using email & password.....	24
4.2.3 Get Blood or Request for Blood.....	27
4.2.4 Sharing the blood request in the Social Media or via SMS	32
Chapter 5: Experiment	
KNN algorithm implementation.....	33
HMM implementation.....	34
Tensor Flow Implementations.....	34
Weka Classifier and JavaML	35
Storing in Database	35
Chapter 6: Experimental Results and Discussion	
6.1 Goal archived so Far	37
6.2 Average Percentage of Accuracy	37
Chapter 7: Conclusion	
7.1 Concluding Remarks.....	39
7.2 Future Works	40
Reference.....	41

List of Figures

- Fig. 3.1.1: Psudo Code of KNN Algorithm
- Fig. 3.1.2: The Distance functions in KNN Algorithm
- Fig. 3.2.1: Dataset of sample profession
- Fig. 3.2.2: Dataset of sample Institutions
- Fig. 4.1.1 Flowchart with login
- Fig. 4.1.2: Flow chart with Social media
- Fig. 4.1.3: Use case diagram
- Fig. 4.2.1: Flowchart for Registration
- Fig. 4.2.2: Firebase Database
- Fig. 4.2.3: Sequence of the App Window
- Fig. 4.2.4: Login page
- Fig. 4.2.5: Firebase Authentication and Saving user
- Fig. 4.2.6: Registration (phase 1)
- Fig. 4.2.7: Registration (phase 2)
- Fig. 4.2.8: Saving in Firebase Database
- Fig. 4.2.9: Geo fire –Saving latitude and longitude
- Fig. 4.2.10: Requesting Blood
- Fig. 4.2.11: Showing list of matched donors
- Fig. 4.2.12: Sharing by social media
- Fig. 5.1.1: Dataset of sample profession
- Fig. 5.1.2: Dataset of sample workplace and institution
- Fig. 5.2.1 : Filling the registration Form
- Fig. 5.2.2 : Entry and saving in firebase database

Abstract

Blood is one of the most important elements of human body. Blood can be defined as the fluid we have in our bodies that carries oxygen from the lungs to the rest of the body. It also carries waste to be eliminated from the body. We have between 4 and 6 liters of blood in our adult bodies depending on size. Millions of people need blood every year. There are tens of thousands of pints of blood that are needed every day to help people. Due to deficiency of blood a person can suffer from serious health issue and may even die. Medical science cannot produce blood but with the blessing of medical science blood can be transferred from one person to another. A lot of people's lives can be saved if blood donors are easily available.

The blood donation Application we are making puts the power to save lives in the palm of your hand. Donating blood and blood components are easier than ever. A person just needs to have an account in our Blood Donation Application, then he can both donate and request for blood anytime. "BLOOD DONOR" is a free blood Donation app available for Android Smartphone. Blood Donor searches, notifies and connect thousands of blood donors in some simple steps. Blood Donor donation app ensures hassle free blood donation and privacy of a blood donor. Connecting blood donors and needy reduces time which increases the possibility of saving lives and also eliminates the shortage of blood.

Blood donation exclusive app "BLOOD DONOR" is a free location based blood donation app. It is one of its first and only unique applications available with feature of real-time map and machine learning algorithm for finding the best suitable donor. It uses the phone's internet connection to let us search blood donors and recipient.

This Android based mobile application finds the blood donor by GPS location service. The App is also able to find the best matches among the donors available with the help of machine learning algorithms. The algorithms are capable of analyzing the profile of each donor and find the best fit ones with respect to health condition and lifestyle. Moreover, the app is also capable of showing the exact position of the donors in the map who are willing to donate blood. The Blood Donation App will make the easiest and fastest way to get a best match blood donor.

Chapter 1: Introduction

1.1 Motivation

Blood donation is one of the most significant contributions that a person can make towards the society. It is not harmful for an adult person to donate blood. The body of the donor can regenerate the blood within few days. It poses no threat to the metabolism of the body. An ailing body needs blood for various reasons. He may be attacked with anemia, undergone an operation or may meet with an accident. But such a patient may die for want of blood as it is not always available. Even a pregnant mother may need blood in case of emergency situation.

Blood donation in Bangladesh is an activity conducted by several different organizations. As of 2011, about 25% of the nation's blood supply came from voluntary donation, 20–25% from paid donors, and 50–55% from one-time donation for a specific patient.

Blood transfusion service became available in Bangladesh at the Dhaka Medical College Hospital in 1950. Professional blood donors were the mainstay of blood donation in Bangladesh, with 47% of donated blood coming from professional donors as late as the year 2000.^[1] The potential for contamination in the supply, and the need for volunteer donors was well recognized. An estimate from 2011 is that of the 500,000 units of blood required annually, only 25% come from voluntary donation, 20–25% from paid donors, and 50–55% from one-time donation for a specific patient.

The first volunteer blood donation program in Bangladesh was begun in 1977 at Dhaka Medical College, and was organized by Shandhani.[3] Shandhani has now 24 units in different medical and dental colleges. Shandhani is a voluntary institution run by the medical and dental students of Bangladesh. Shandhani is also working for the helpless patient in the community by serving them with drug from the drug bank, donating blood to the thalassaemia patient, giving relief to the flooded and disaster affected people etc.

The International Red Cross and Red Crescent Movement began a blood program in Bangladesh in 1981. Today they operate several centers, using both whole blood and fractionated blood. A 1997 survey of students at the University of Dhaka had found a generally favorable attitude towards voluntary blood donation, and an overwhelmingly unfavorable attitude to paid blood donation, and recommended that a campaign should be

started immediately to increase awareness and participation in voluntary blood donation among the student population.

Badhan is a non-political voluntary blood donors' organization in Bangladesh that was established in 1997. Badhan's first activity was a free blood-group testing program that took place on 24 October 1997 at Shahidullah Hall of the University of Dhaka. Shahidullah Hall is very close to Dhaka Medical College and Hospital, and before that time people needing blood for patients would gather regularly in or near the hall gate, seeking help. Mohammad Shahidul Islam Ripon was the principal originator of the program, along with other students. The blood provided is fresh rather than stored, using a database of people whose blood type has been previously established. The graduate- and postgraduate-level students of Bangladeshi universities and postgraduate colleges are the main participants of the organization.^[8] The organization is active in 14 universities and 29 university colleges. Other activities include raising awareness about donating fresh blood, donating blood voluntarily for patients and helping poor people in time of natural disasters.

We became motivated because of all these voluntary blood donation organization who are trying hard to accumulate donors who are willing to help people. The aim of this Blood Donation Application is to improve the communication with the people who are in need of blood and the persons who are willing to donate blood in few touches of the Smartphone. This location based Blood Donation Application will reduce the barrier between blood donors and the people in sever need of blood. The donors' location can be detected by the app and the best matched donor will be contacted in no time.

According to the research in the year 2000, 47% of the total blood requirement in our country was met by unsafe professional blood donors. In 2011, it came down to 20-25%. Around 362,000 units of blood were collected in Bangladesh in 2009, of which only 29% were from voluntary donors. So, we built this app in such a way that no one will ever need to buy blood from professional, which is a unsafe process.

The best way to get blood is via donation. We believe that if we can bring this huge number of people of Bangladesh under the shade of blood donation process and then it will be a blessing for our society.

1.2 Objective

Our objective is to build a mobile application which will create a huge blood donation community, who will be able to receive and donate blood in the fastest way possible. We want that no Bangladeshi will suffer from lacking of blood. No matter how rare the blood group is an ailing person will always get a match of his or her blood group. The donor and receiver can find each other via the mobile application and the nearest donor with the most similar features will be marked as best match.

1.3 Scope

Around one lakh thalassemia patients in the country need blood regularly, according to Bangladesh Thalassemia Samity. And about 57 thousand bags of bloods are required daily for various causes. According to World Health Organisation, 112.5 million units of blood are collected globally each year. About half of them are collected in high-income countries. Some 74 countries collect over 90 percent blood from “voluntary unpaid blood donors”. However, 71 countries collect more than half of their blood from family/replacement or paid donors, said WHO. So, we want to make blood donation safe and easy and a process to not worry about.

Adequate and safe blood supply has remained a challenge in developing countries like ours. There is a high dependency on family replacement and remunerated blood donors in our environment which carries an attendant increased risk of transfusion transmissible infection. This descriptive type of cross sectional study was conducted at transfusion medicine department of National Institute of Neurosciences & Hospital in Dhaka city during the period January to December 2015 with the aim to assess the awareness about blood donation among donors which includes knowledge and practice of blood donation. A total purposively selected 150 donors were interviewed by using a structured questionnaire which focused on knowledge and practice related variables. The statistical analysis was done by using the SPSS software (Version-21). The associations between the demographic factors were analysed by using the Chi square test and Fishers Exact test. Among 150 donors, 124 (82.7%) were male and 26 (17.3%) were female donors, the mean age of the donors was 28.4 (\pm 7.2) years. 78 (52.0%) donors knew about the interval of blood donation and 84 (56.0%) knew about the age limit for the donation, but 86 (57.3%), 71 (47.3%) did not know the required Hb level to donate blood and volume of blood in each donation respectively. More than half (56.0%) had past history of blood donation and 103 (68.6%) of the donors showed positive effects like a

feeling of satisfaction after blood donation. There were highly significant association found between blood donation and sex (p value.016). A majority (86.9%) of the donors were willing to be regular donors. The donors showed positive effects like a sense of satisfaction after the donation. Creating an opportunity for blood donation by conducting many blood donation camps may increase the voluntary blood donations.

According to Blood Transfusion Service in Bangladesh, Safe Blood Transfusion Programme, currently more than 600,000 units of blood are required annually in Bangladesh and the requirement is gradually increasing. Only 31% of the annual demand is fulfilled from voluntary blood donations, while the rest comes from relatives or replacement donors. The use of blood component is only 17% which is inadequate in implementation of specific use of blood products. Therefore, the improvement of the national blood transfusion service is essential for addressing the challenges arising out of HIV, Hepatitis B & C, and other infectious diseases.

There are about 1.5 million people requires blood regularly. Not all of them get the blood they seek in time. Many people die due to wrong blood donors or lack of donors. So, with an aim of providing an easy-to-use bridge between blood donors and blood seekers in Bangladesh we came up with this project “Blood Donation App”. By this app we can build a network of ethical blood donors who are available whenever an ailing person needs emergency blood. We are using Machine learning Technique to find the perfect matched donor with respect to blood group, medical history and entire profile. And the nearest donor is found out by GPS Location. The donors are investigated on regular basis and their profiles are also updated quite regularly.

YEAR	NUMBER OF BLOOD UNITS COLLECTED
2016	716,326
2015	679,681
2014	651,718
2013	593,774
2012	541,682
2011	415,372

2010	358,067
2009	358,067
2008	369,026
2007	324,005
2006	228,127
2005	203,575
2004	121,993
2003	180,015
2002	170,948
2001	99,653

Table no-1: Blood Collection in previous years (Source: Safe Blood Transfusion program)

Chapter 2: Literature Review

2.1 Similar Research

The main purpose of our project to make a Blood Donation Application that is user friendly and has the intelligence to find the best matches of blood donors by analyzing the nearby donor's profile. We believe that our Blood Donation Application will bring the donors and receives so close that blood donation will no longer be a matter of risk and worries. At the beginning of the project we have researched on some secondary resources based on this. From these sources, we have been able to know the existing functions and determined our work outline.

T.Hilda Jenipha and R.Backiyalakshmi [1], made a cloud based blood donation app and we get to know about this from their paper "Android Blood Donor Life Saving Application in Cloud Computing". Where the contact details will appear in alphabetical order on the screen. In case of urgent blood requirement, one can quickly check for contacts matching a particular or related blood group and reach out to them via Phone Call/SMS through the Blood donor App. Their Blood Donor App provides list of donors in your city/area. According to them, Cloud- based services can prove important in emergency blood delivery since they can enable central and immediate access to donors' data and location from anywhere. Since almost everyone carries a mobile phone with them, it ensures instant location tracking. The location-based app, operational on android platform, will help users easily find donors of matching blood groups in their location and can be accessed via their mobile numbers.

From Shek and Shilpa [2] – the authors of "Android Blood Donor Life Saving Application in Cloud Computing" we can understand, the importance of having blood donation app. According to them, despite numerous significant achievements, the discipline of Supply Chain Management (SCM) is still incapable of satisfactorily addressing many practical, real-world challenges. The user's location will be detected using GPS. If there is need of blood, the donor with the required blood group is identified and notified of the requirement. The project includes algorithm which detects accurate location of the donors, identifies the donors who are available nearby to the location of requester and notifies them. If the identified donors are not available or not willing to donate blood at present then the scope of detection is increased. This is done by increasing the scope of search. Notifying the donor about the need of the blood is the most important task of the system.

Snigdha, Pratiksha, Siddhi, Pranita and Varsha [3] thinks the problem is not insufficient number of donors, but finding a willing donor at the right time. They want to build a network of people who can help each other during an emergency. Their application timely updates the information regarding the donors where the administrator accesses the whole information about blood bank management system. Donor will be prompted to enter an individual's details, like name, phone number, and blood group. In the urgent time of a blood requirement, someone can quickly check for blood banks or hospitals matching a particular or related blood group and reach out to them through the App. Blood bank App provides list of blood banks in an area. They feel that, a large number of blood donors are attracted using an Android application. Since almost everyone carries a mobile phone with them, it ensures instant location tracking and communication. Only a registered person, with willingness to donate blood, will be able to access the service. In this application they are using the GPS technology that was been to trace the way to the blood bank. The user will get the route to reach the desired location and he won't have to ask manually, therefore time can be saved.

Again, from the source[4] a paper called” Blood donation system for online users”, we have known that most of people desire to know about online blood donation to the patients at once. Patients want to get blood to live at emergency time. At present people are needed to know how to contact blood donors online. This system provides how to get blood at their serious time. Matcher system is implemented with Decision Tree and Decision Table by rules. This matcher applies the rules based on Blood Donation in Blood Bank in Myanmar. Information about donors and patients has been reserved in the system so that it is ready to donate blood instantly.

2.2 Comparing Our Proposed System with Existing Technologies

In our Application user Authentication has been done by Google's firebase. So, the database is in cloud. For this app until now, email and Gmail login is enabled. Users will input their details (Blood group, age, name, medical profile, profession, Institution or workplace) and these values will be stored in the database under the name of their profile. Their location will be automatically taken and updated in database when the registration is being done. The location will be taken by GPS. We have also used Geo fire which converts the latitude and longitude to name of places. Google map and place API has been used here. The location will be updated in real time whenever the app is running in the background, if the user moves to different location.

Users will be able to search the blood group of people and see in the Google map that where the persons are located. The best matched person around 5-20 kilo-meter radius will be shown. The best matched persons will be classified by KNN (K-Nearest Neighbour) in machine learning, K-Nearest Neighbours are supervised learning models with associated learning algorithms that analyze data used for classification analysis. Given a set of training examples, each marked as belonging to one or the other of two categories, an KNN training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classifier.

Our application is different than others because it uses machine learning algorithm for detecting the best matched donors. It has also the feature that if a person donates blood one time then he will be not shown in the map for next four months because it's not healthy to donate blood more than once in four months. Our app will filter only those people who are eligible to donate blood according to age and last donated date. Moreover it can share the blood request via various social networks like face book, instagram, twitter etc.

Chapter 3: Introduction to Machine Learning

3.1 Implementation of K-NN algorithm

For classification of the best matched donors we used the k -nearest neighbors algorithm (k -NN). We mainly used k -NN for classifying the donors by profession and institution and job place. Here we will see how the algorithm works and its detailed functionalities.

In pattern recognition, the k -nearest neighbors algorithm (k -NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k -NN is used for classification or regression:

- In k -NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If $k = 1$, then the object is simply assigned to the class of that single nearest neighbor.
- In k -NN regression, the output is the property value for the object. This value is the average of the values of its k nearest neighbors.

KNN makes predictions using the training dataset directly.

Predictions are made for a new instance (x) by searching through the entire training set for the K most similar instances (the neighbors) and summarizing the output variable for those K instances. For regression this might be the mean output variable, in classification this might be the mode (or most common) class value.

To determine which of the K instances in the training dataset are most similar to a new input a distance measure is used. For real-valued input variables, the most popular distance measure is Euclidean distance.

Euclidean distance is calculated as the square root of the sum of the squared differences between a new point (x) and an existing point (x_i) across all input attributes j .

$$\text{EuclideanDistance}(x, x_i) = \sqrt{\sum (x_j - x_{ij})^2}$$

Other popular distance measures include:

Hamming Distance: Calculate the distance between binary vectors.

Manhattan Distance: Calculate the distance between real vectors using the sum of their absolute difference. Also called City Block Distance.

Minkowski Distance: Generalization of Euclidean and Manhattan distance.

There are many other distance measures that can be used, such as Tanimoto, Jaccard, Mahalanobis and cosine distance. You can choose the best distance metric based on the properties of your data. If you are unsure, you can experiment with different distance metrics and different values of K together and see which mix results in the most accurate models.

Euclidean is a good distance measure to use if the input variables are similar in type (e.g. all measured widths and heights). Manhattan distance is a good measure to use if the input variables are not similar in type (such as age, gender, height, etc.).

The value for K can be found by algorithm tuning. It is a good idea to try many different values for K (e.g. values from 1 to 21) and see what works best for your problem.

The computational complexity of KNN increases with the size of the training dataset. For very large training sets, KNN can be made stochastic by taking a sample from the training dataset from which to calculate the K-most similar instances.

KNN has been around for a long time and has been very well studied. As such, different disciplines have different names for it, for example:

For our app we have used $k=7$. The professions and institutions are given a number between 0 to 1. The calculation will be done if match is found nearest among 1 to 5. The maximum occurred number from 1 to 7 will be the best fit. Therefore, the best fitted donors will be shown in ascending order. The prior a person is in the list more suitable he/she is.


```

k-Nearest Neighbor
Classify (X, Y, x) // X: training data, Y: class labels of X, x: unknown sample
for i = 1 to m do
    Compute distance d(Xi, x)
end for
Compute set I containing indices for the k smallest distances d(Xi, x).
return majority label for {Yi where i ∈ I}

```

Fig no 3.1.1: Psudo Code of KNN Algorithm

Distance functions

Euclidean	$\sqrt{\sum_{i=1}^k (x_i - y_i)^2}$
Manhattan	$\sum_{i=1}^k x_i - y_i $
Minkowski	$\left(\sum_{i=1}^k (x_i - y_i)^q \right)^{1/q}$

Fig no 3.1.2: The Distance functions in KNN Algorithm

3.2 Working with Machine Learning

After making the first phase of the application we moved to machine learning. Therefore, in the beginning of the second phase of building the system we opt to integrate machine learning algorithms to classify the data from a donor’s profile. Among many promising algorithms we chose to work with few of them. The first algorithm that we worked with was Hidden Markov Model (HMM).

A hidden Markov model (HMM) is a statistical model that can be used to describe the evolution of observable events that depend on internal factors, which are not directly observable. The hidden states form a Markov chain, and the probability distribution of the observed symbol depends on the underlying state.

In our project, we wanted to use HMM because it can classify the donors by making a network of closely interrelated personalities. Thus, a network is formed which can be represented as the simplest dynamic Bayesian network. Lastly, the chain of states in the Markov Model lead to the optimum possible output. We used java programming language for HMM algorithm.

The Machine Learning Library that we worked with next is TensorFlow . This is an open source library for numerical computation, specializing in machine learning applications which assists in transfer learning mechanism of Inception. **Inception** is a pre-trained Convolutional neural network (CNN) model [5]. We were going to use the Inception v3 network. We trained the last layer of inception to learn about the dataset of the signs we have provided. After making the inception learn about our dataset it could classify the data according to given signs. We used python programming language for working with tensor flow. The dataset was made in csv (Comma Separated Value) format. In the cvs format all the placeholders are for the data and the last one is for label.

At this stage we experimented with another type of machine learning approach. This is known as **Weka Classifier**. Weka is a collection of machine learning algorithms for data mining tasks. The algorithms can either be applied directly to a dataset or called from our own Java code. Weka contains tools for data pre-processing, classification, regression, clustering, association rules, and visualization. It is also well-suited for developing new machine learning schemes.

In weka there are many machine learning algorithms which was able to classify our dataset. But we could also implement the library from own java code. For working with weka we used java programming language.

Lastly, we also tried to classify our dataset with **Java ML**. Java has got a collection of machine learning algorithm which can classify the dataset. But a major issue was that the accuracy level or java ML was not satisfactory. For this we used java programming language.

For our case we used KNN which is the most effective in case of finding result in our application. Because it is more suitable for analyzing our set of data, and finding the distance between the current profile and the profile of the nearby donors.

```

student;.1
teacher;.11
architect;.12
doctor;.13
shopkeeper;.3
banker;.2
nurse;.22
driver;.4
helper;.5
cleaner;.51
service holder;.18
traffic police;.41
software engineer;.14
civil engineer;.15
electrical engineer;.16
textile engineer;.17

```

Fig no 3.2.1: Dataset of sample profession

```

institution x SplashActivity.java x MainActivity.java x DonarListActivity
1 Viqarunnisa Noon School;.1
2 Government Laboratory High School;.12
3 Ideal School and College;.13
4 Rajuk Uttara Model School & College;.14
5 Dhaka Residential Model College;.15
6 Holy Cross Girls High School;.16
7 Rifles Public School and College;.17
8 The Aga Khan School;.18
9 Pledge Harbor School and Sports Academy;.19
10 Scholastica;.195
11 Viqarunnisa Noon College;.2
12 Notre Dame College;.21
13 Shamsul Haque Khan School & College;.22
14 dhaka college;.23
15 city college;.24
16 cambrian college;.25
17 dhaka commerece college;.26
18 holy cross college;.27
19 trust college;.28
20 B A F shaheen college;.29
21 residential model college;.295
22 university of Dhaka;.3
23 brac university;.31
24 ahsanullah university of science and technology;.32
25 national university;.33
26 North south university;.34
27 daffodil international university;.35
28 east west university;.36
29 jagannath university;.37
30 university of asia pacific;.38
31 jahangirnagar university;.39
32 Evangel Architect;.4
33 DHAKA DESIGNER;.41
34 Sthapati Associates Ltd;.42
35 Dream Touch Architects Ltd;.43
36 iNEXterior Bangladesh;.44
37 J.A. Architects;.45
38 Synthesis Architects;.46
39 Bashirul Haq & Associates Ltd;.47
40 Vistaara Architects Private Limited;.48
41 Form.3 Architects;.49
42 Dhaka Shishu Hospital;.51
43 Dhaka Medical College Hospital;.52
44 Bangladesh ENT Hospital;.53
45 S.P.R.C & Neurology Hospital;.54
46 Dhaka Central International Medical College;.56
47 Labaid Specialized Hospital Kalabagan;.57
48 Japan Bangladesh Friendship Hospital;.58
49 Dhaka Eye Hospital;.59
50 Holy Family Red Crescent Medical College;.594
51 MH Samorita Hospital & Medical College;.597

```

Fig no 3.2.2: Dataset of sample Institutions

Chapter 4: Proposed System Model

The model we are making is mostly based on android and cloud database. The user authentication process is google's firebase and the database is also the same. For searching and classifying we have used the KNN algorithm.

4.1 Architecture

The main architecture of the application consists of some activities of the android app and the components with which it is built. Such as the Firebase database, the Geofire for saving and updating latitude and longitude. Picasso image loader and also image cropper. And mostly the machine learning algorithm running underneath.

4.1.1 Complete Flowchart with login:

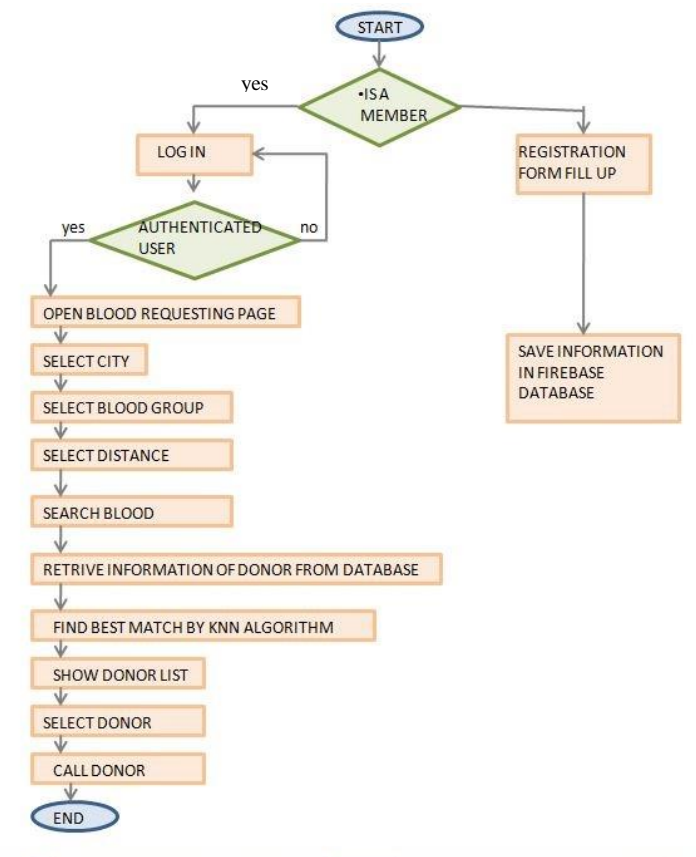


Fig no 4.1.1: Flowchart with login

At first it needs to be seen whether a person is registered or not. If a person is registered then he can login in my email and password. But if the person is not logged in then he can't be logged in until he fills up the registration form.

When the person logs in then he can see the blood registration page. He then enters the blood group a person need and the distance and the city from where a person is seeking the blood. The after clicking search the KNN algorithm starts and it helps to find out the best matched list from the database. Then the requester can select a person from the list and call the donor to make an appointment.

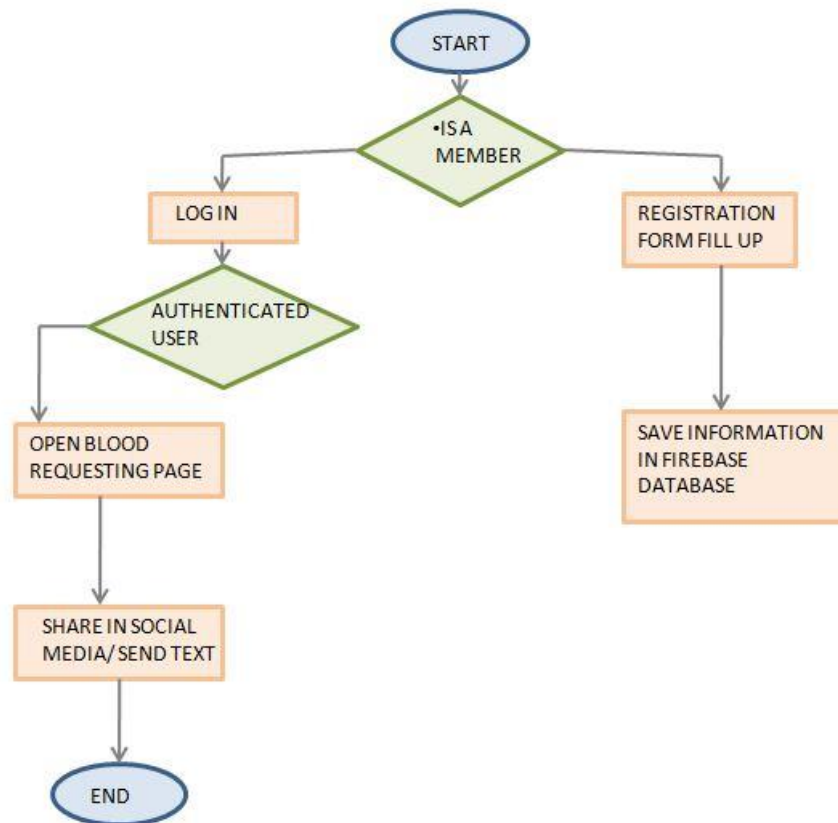


Fig no-4.1.2: Flow chart with Social media

Here after login the person wants to post in the social media or send a text message. The above flowchart shows that.

4.1.2 Usecase Diagram:

The use case diagram shows the roll of each actors. Both the Acceptor and Donor has to go through Registration login and logout. The acceptor while accepting blood can select

blood group, select distance and search blood. After that he/she can also call the donor from the list and also share the request for blood in social media. The donor after donating the blood will update the last donation date in his profile so that no one calls the donor for the next 4 months as he is not eligible for donation for next four months.

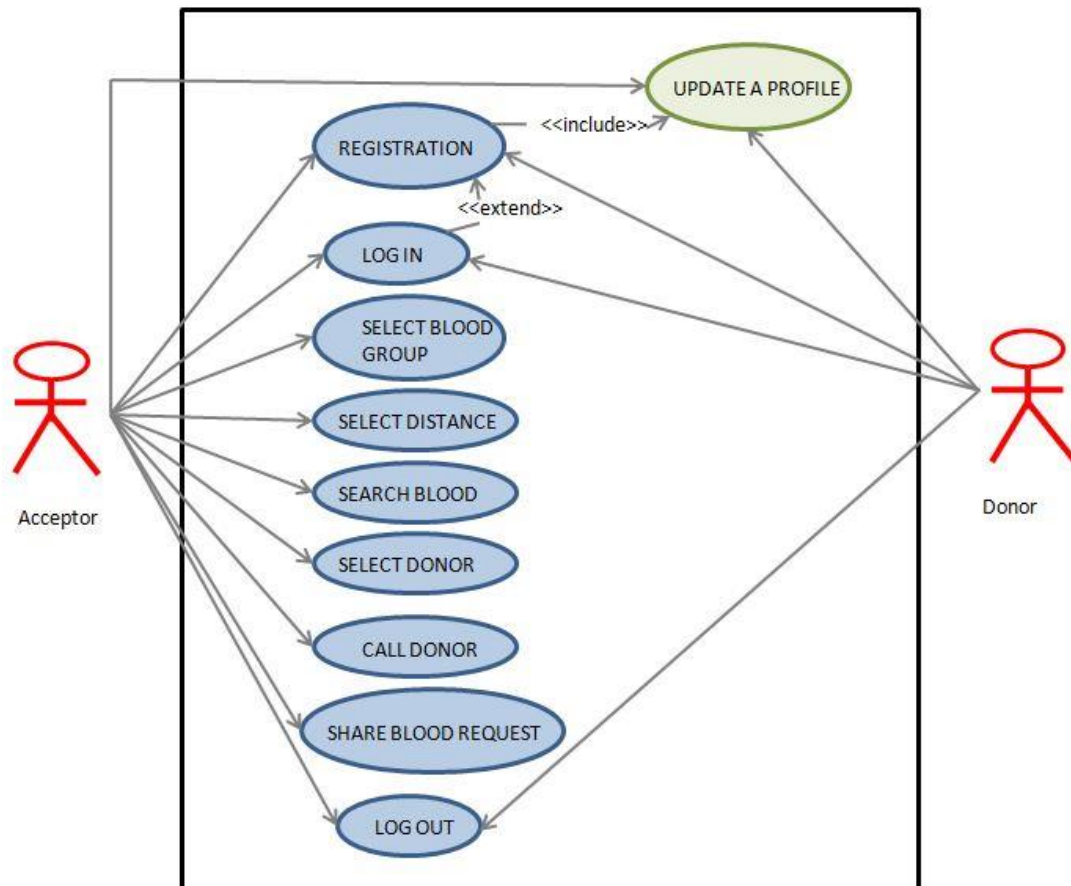


Fig no-4.1.3: Use case diagram

4.1.3 Flowchart For Registration

This is the flowchart for registration. The person who wants to be a member of this blood donation community also needs to fill up the registration form. A person can't login if he is not

registered. Therefore take the name of the user. It also takes the password of the user. It makes sure the password is strong enough by checking it has eight characters or not. It also take the email address and makes sure the email address is in correct format. It takes the gender profession, address and also the institution or the workplace someone is currently working. If any of the field is empty the registration will not be completed and will send error.

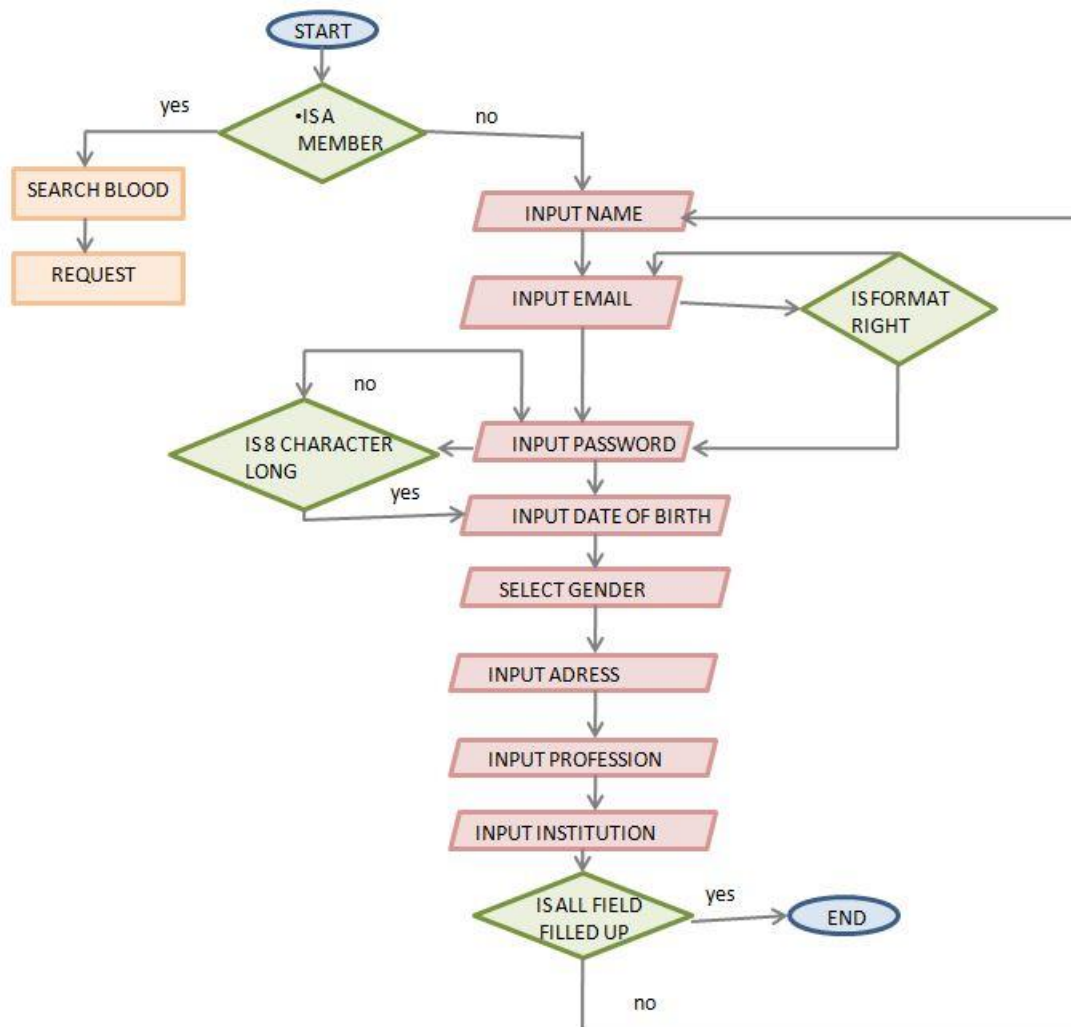


Fig no-4.2.1: Flowchart for Registration

There are few components which are the major part for building this app. Some of them are discussed below.

4.1.4 Firebase (Cloud based Database)

Firestore is a technology that permits you to make applications with no server-side programming so that development turns out to be quicker and easier. It works as realtime

database as it stores and sync data between users and devices in realtime using a cloud-hosted, noSQL database. Updated data synchronizes across connected devices in milliseconds, and data remains available if your app goes offline, providing a great user experience regardless of network connectivity. It also has cloud storage and hosting functionalities.

In our project, the application sends data to firebase database and these data are retrieved via the same android application which is also connected to the same firebase database.

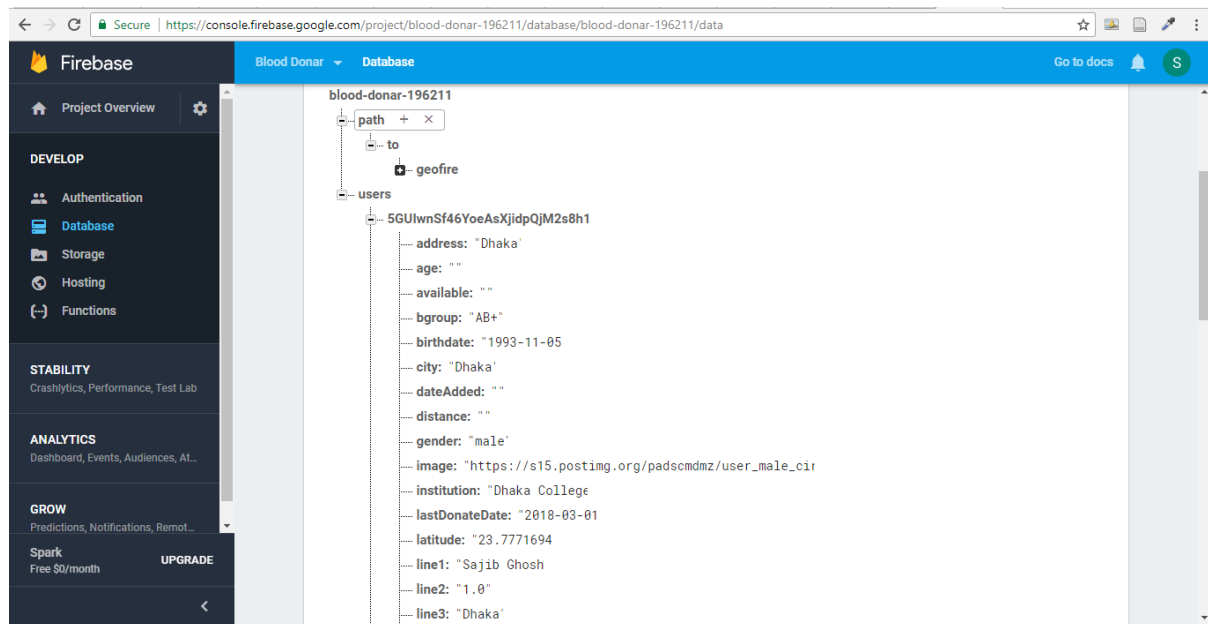


Fig no-4.2.2: Firebase Database

4.1.5 Geofire of Firebase

GeoFire is an open-source library for Android/Java that allows you to store and query a set of keys based on their geographic location.

At its heart, GeoFire simply stores locations with string keys. Its main benefit however, is the possibility of querying keys within a given geographic area - all in realtime.

GeoFire uses the Firebase database for data storage, allowing query results to be updated in realtime as they change. GeoFire selectively loads only the data near certain locations, keeping your applications light and responsive, even with extremely large datasets.

GeoFire is designed as a lightweight add-on to the Firebase Realtime Database. However, to keep things simple, GeoFire stores data in its own format and its own location within your Firebase database. This allows your existing data format and security rules to

remain unchanged and for you to add GeoFire as an easy solution for geo queries without modifying your existing data.

4.1.6 Google Maps and Places API

Google APIs is a set of application programming interfaces (APIs) developed by Google which allow communication with Google Services and their integration to other services. Examples of these include Search, Gmail, Translate or Google Maps. Third-party apps can use these APIs to take advantage of or extend the functionality of the existing services.

The APIs provide functionality like analytics, machine learning as a service (the Prediction API) or access to user data (when permission to read the data is given). Another important example is an embedded Google map on a website, which can be achieved using the Static maps API Places API[2] or Google Earth API.[3]

4.1.7 Butterknife for View Binding

ButterKnife is a view binding library that uses annotation to generate boilerplate code for us. It has been developed by Jake Wharton. It makes your code less and more clear. It is time saving to write repetitive lines of code. To avoid writing repetitive code just like `findViewById(R.id.yourview)`, butterknife helps you to binds fields, method and views for you.

4.1.8 Picasso Image Loader

Picasso is a third party library. We can achieve our task without using a 3rd party API as well. But if we will use a 3rd party library like Picasso then we will achieve our goal in few lines of code. So if we will not use a 3rd party library then we would need

1. Very large amount of code to be written
2. We have to write another logic to implement caching. Caching is very important to make the application faster.
3. We also have to deal with memory while writing the code.

But if we will use Picasso then all the above mentioned things would be taken care of by Picasso.

4.1.9 Cropper (3rd party library)

It is a powerful (Zoom, Rotation, Multi-Source), customizable (Shape, Limits, Style), optimized (Async, Sampling, Matrix) and simple image cropping library for Android

4.1.10 Sequence of Activities

All the activities and fragments are shown in the figure below. It demonstrates from which window to which window does the app follows. These are the real images taken from the app to understand the flow of work easily.

At first the login page opens where there are options to login if someone is a member or is someone is not a member he can register to become a member. There is also password recovery method for someone who has forgotten the password.

If a person wants to register as a new member he has to press the register as new user. Then he needs to fill up a form with his personal data. These data are stored in the database of firebase as real time data. A person can also set up a profile picture for his profile. The image is taken by 3rd party library picassa. Then in the next page of registration a person needs to select the blood group he has and the last day he donated blood.

The registration process is complete here. Next the person can send request for blood. To search donor he needs to select the blood group he is searching, the location around which he will need blood and the distance from that location.

Next if he presses the button for search the best matched people according to KNN algorithm will be shown in a list. The person can view the profile and real time location by pressing any donor's name from the list. Then he can make direct call to the donor if he is willing to donate blood.

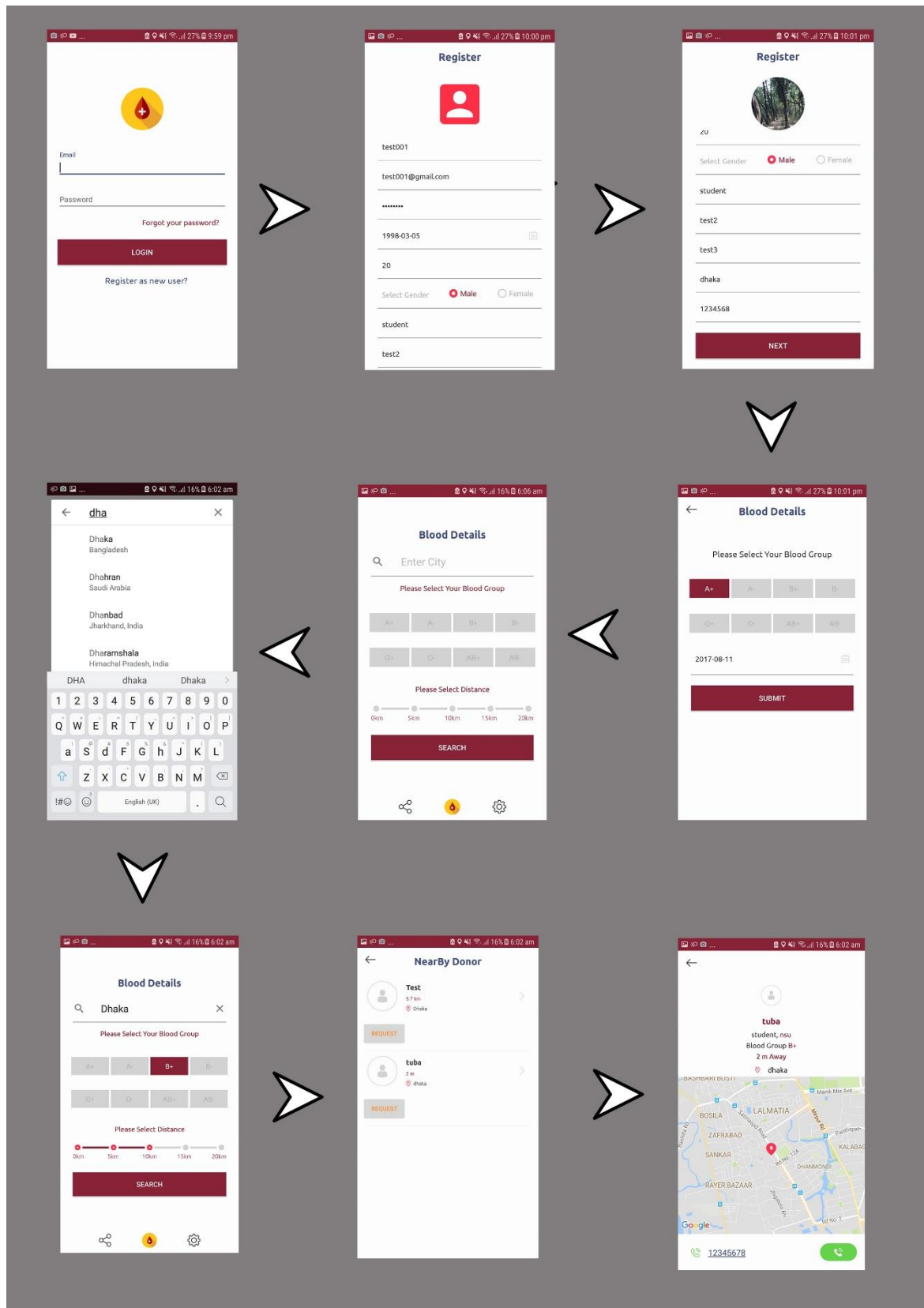


Fig no-4.2.3: Sequence of the App Window

4.2 Working Principle

The working principle of the application is has some steps. The login phase, registration phase, searching phase, saving in the database and retrieving the data from the server and showing the best match in the list. Here we will show all the step by step.

4.2.1 Login

Here, both doner and reciver has to login through the app. The email id and the password related to the same account is the main way to longin. The database has the authenticated password and account id which is here the email id. The informations are fetched from the dtatbase nad matched. If not matched then the authentication will be failed and the person cant login.

In firebases authentication section the names and passwords are saved. In fig -4.2.4 the authenticated users are shown, how can login.

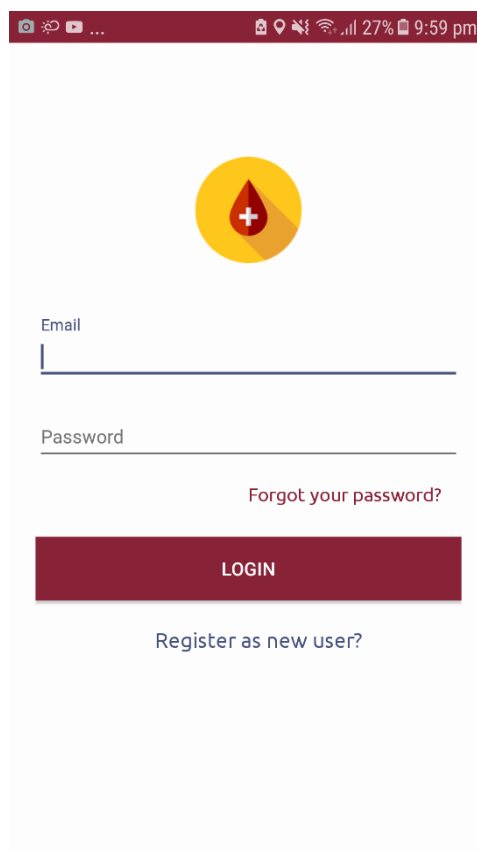


Fig no-4.2.4: Login page

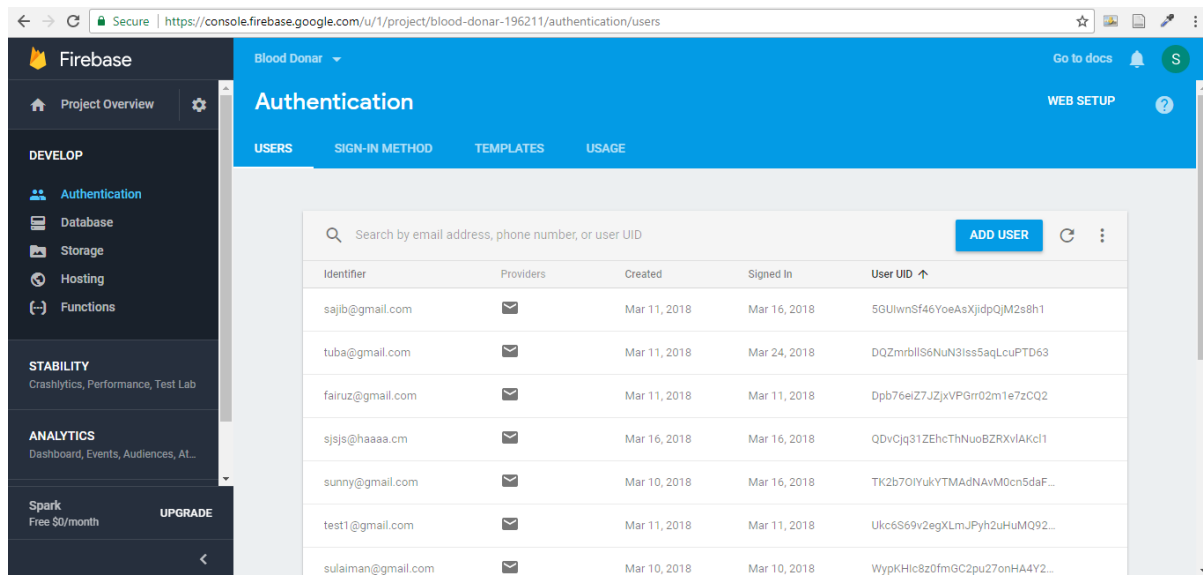


Fig no-4.2.5: Firebase Authentication and saving user

The code of login is discussed below. We have to open **Fragment_Login** class.

- Bind the view using **ButterKnife** (
 - @Bind(R.id.edt_full_name)
CustomEditView edtFullName
 - @Bind(R.id.edt_pass)
CustomEditView edtPass
 - @Bind(R.id.btn_login)
CustomTextView btnLogin

Here in the above code the name and password is taken for logging in. the submit button will be clicked.

- @Override


```
public void onScreen3SubmitClick(boolean isFromRegister) {
    openMainActivity(isFromRegister,true);
}
```

- openMainActivity method will open the MainActivity after that.

```
private void openMainActivity(boolean b, boolean b1) {
    Intent mIntent= new Intent(this,MainActivity.class);
    mIntent.putExtra("isFromRegister",b);
    startActivity(mIntent);
}
```

```
finish();  
}
```

And in the above code it has shown what happen after clicking the submit button. It opens the main activity of the app where the person can send request for the donor.

4.2.2 Firebase Register using email & password

The registration of the app both the donor and the acceptor is done by Google's firebase. All the information are saved in the database. And the email and password is saved for authentication.

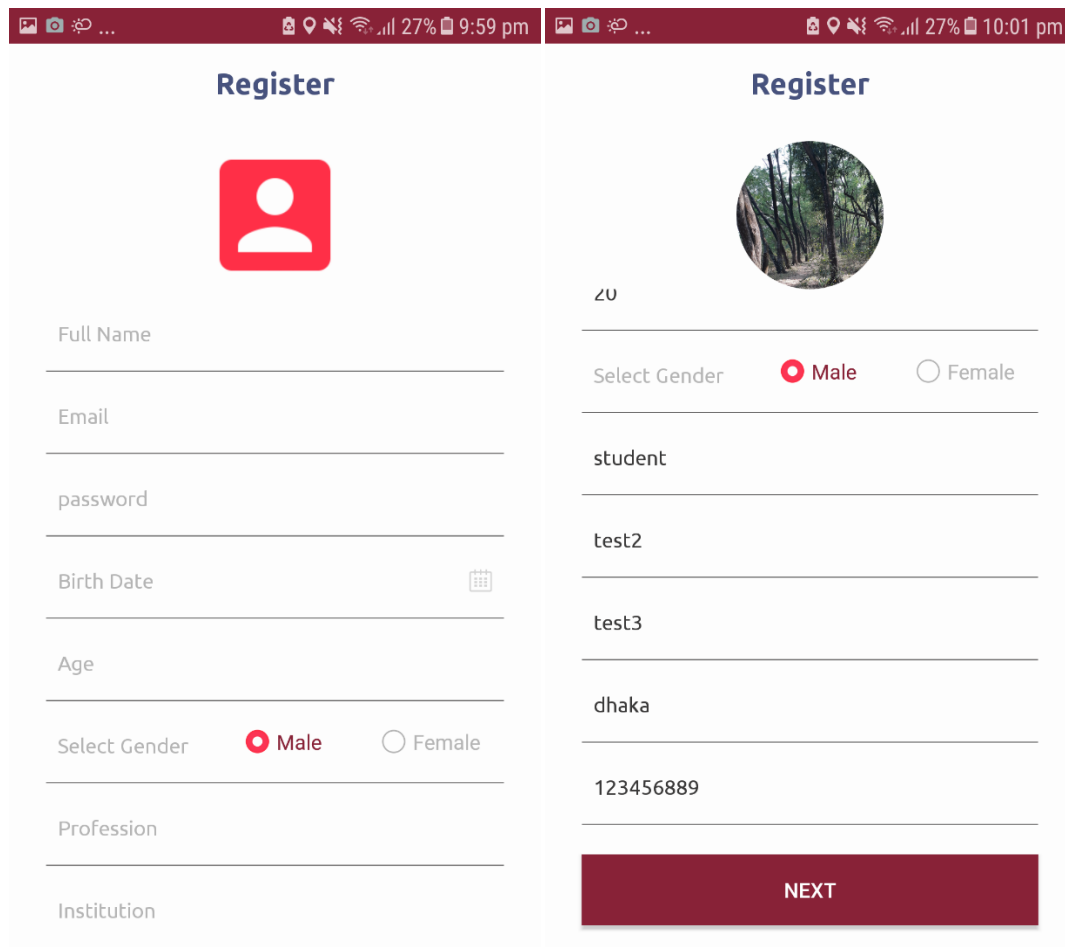


Fig no-4.2.6: Registration (phase 1)

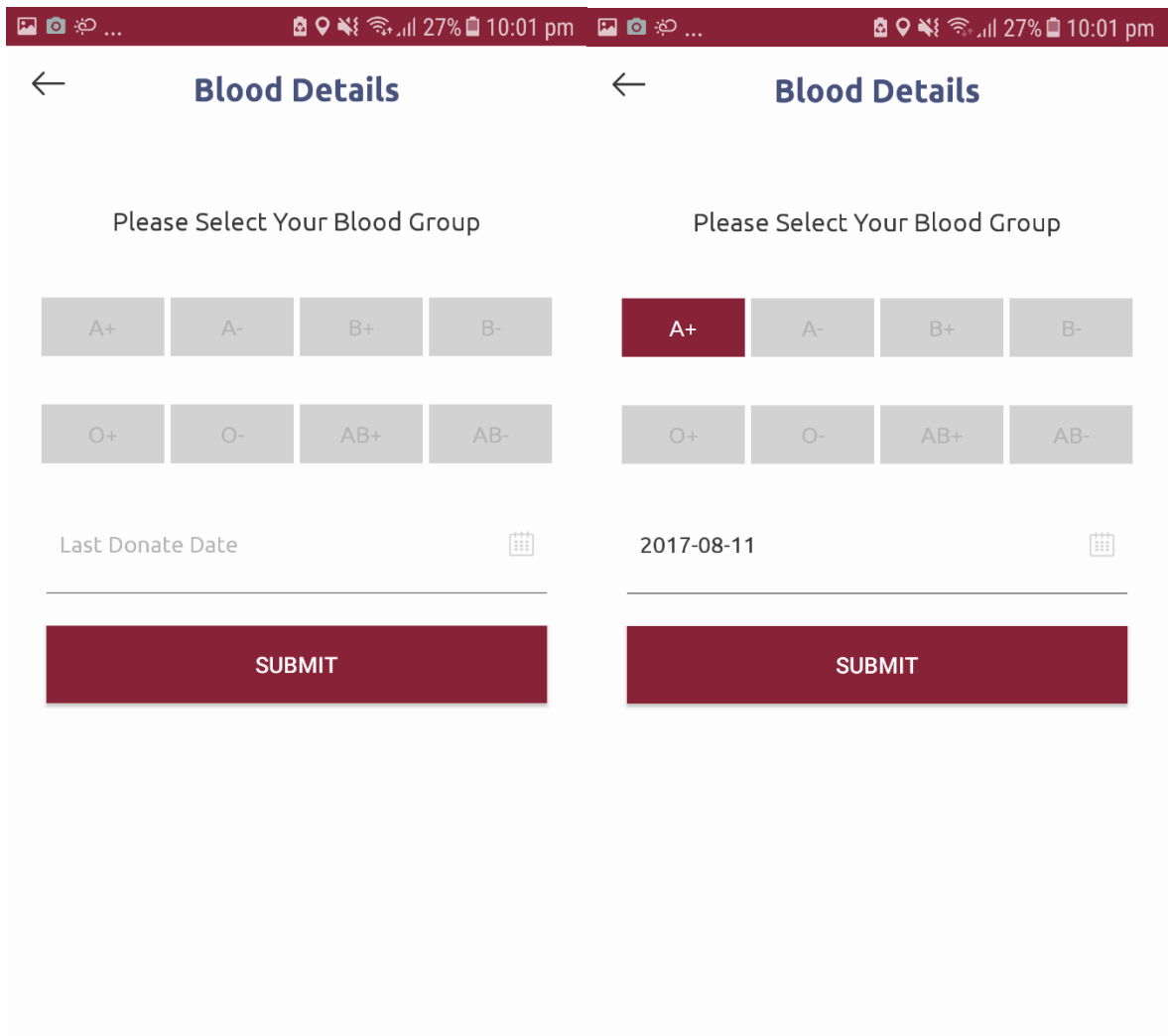


Fig no-4.2.7: Registration (phase 2)

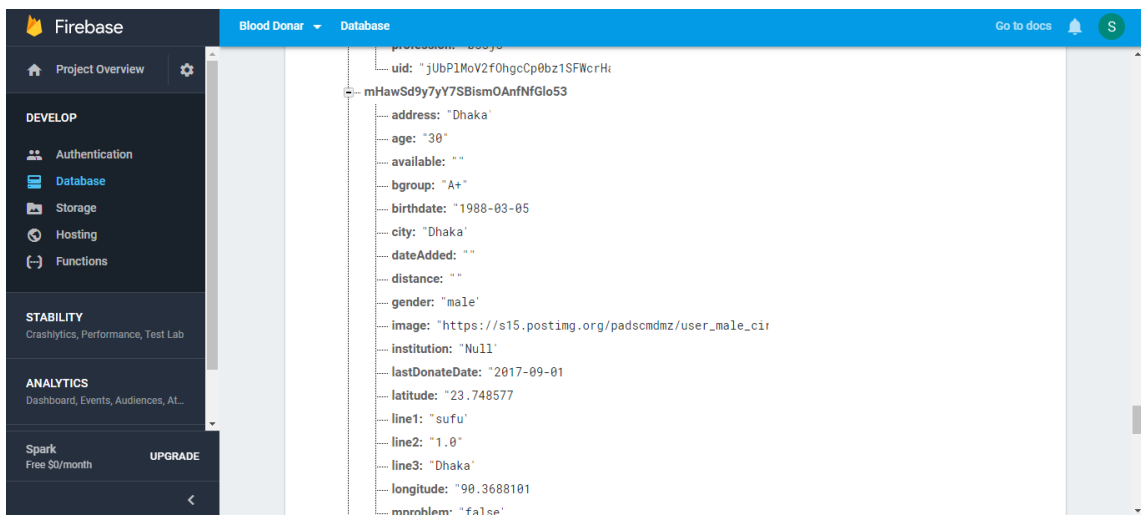


Fig no-4.2.8: Saving in Firebase Database

The registration has two parts, The first one is filling up the personal data. The second part is saving the blood group and the last date when a person has donated blood. All these data are saved in firebase database.

- @Override

```
public void moveToNextScreen(UserRegistration mUser) {
    getListener().onScreen2RegisterNextClick(mUser);
}
```

Method **Fragment_Register** class which will call **getListener().onScreen2RegisterNextClick(mUser);** method on **SplashActivity** and will load **Fragment_Register_2** screen.



Fig no-4.2.9: Geo fire –Saving latitude and longitude

Here you can see that each user's latitude and longitude is set with user id for geofire use. This location be updated in the runtime when the user moves or changes his or her location. To check if a write was successfully saved on the server, you can add a `GeoFire.CompletionListener` to the `setLocation` call -

`mDatabase.child("users").child(userid).setValue(mUserRegistrationFireBase)` this line saves the data against userid in users node. After successful user creation `getListener().onScreen3SubmitClick(true)` method will be called on `SplashActivity` and this method will call `MainActivity`.

```

• private void openMainActivity(boolean b, boolean b1) {
    Intent mIntent= new Intent(this,MainActivity.class);
    mIntent.putExtra("isFromRegister",b);
    startActivity(mIntent);
    finish();
}

```

This method will take us to the main screen.

4.2.3 Get Blood or Request for Blood

In this portion the person can request for blood by selecting the blood type and location of the blood. And he should also give a fixed distance like 5 to 20 km. Within this place radius the blood will be searched.

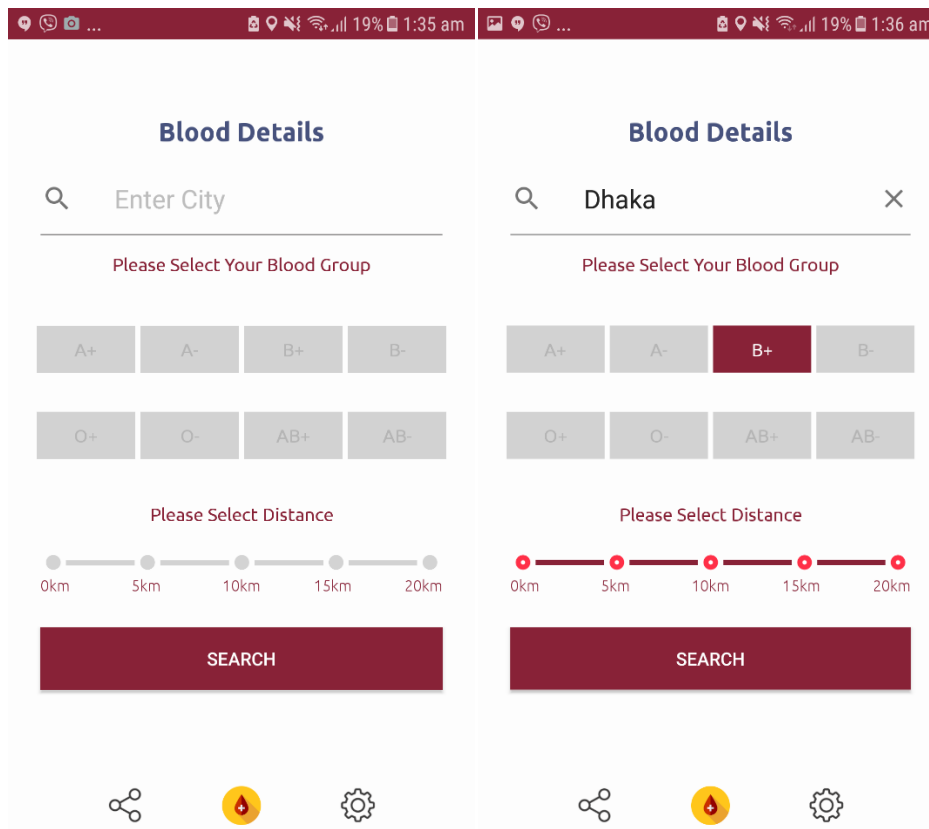


Fig no-4.2.10: Requesting Blood

This is our main class where we will query blood donar in a particular area and in a particular distance. This class has 3 major sections

- `placeAutocompleteFragment = new SupportPlaceAutocompleteFragment();`
`AutocompleteFilter typeFilter = new AutocompleteFilter.Builder()`
`.setTypeFilter(AutocompleteFilter.TYPE_FILTER_CITIES)`
`.build();`
-

This is from google places API which provide us to search any place names. Here we can Filter by these following categories.

```
public static final int TYPE_FILTER_NONE = 0;  
public static final int TYPE_FILTER_GEOCODE = 1007;  
public static final int TYPE_FILTER_ADDRESS = 2;  
public static final int TYPE_FILTER_ESTABLISHMENT = 34;  
public static final int TYPE_FILTER_REGIONS = 4;  
public static final int TYPE_FILTER_CITIES = 5;
```

We have used this because we want to search blood donar in any location. My location may be in some other place and I need blood in another place. That's why we have used the place names here.

placeAutocompleteFragment.setOnPlaceSelectedListener(Fragment_GetBlood.this); method will return us the selected place. On this method

```
@Override  
public void onPlaceSelected(Place place) {  
    placeAutocompleteFragment.setText(place.getAddress());  
  
    mAddress = new RestaurantAddress();  
    //mAddress.setName(place.getName() + "");  
    mAddress.setAddress(place.getAddress() + "");  
    mAddress.setLatitude(place.getLatLng().latitude + "");  
    mAddress.setLongitude(place.getLatLng().longitude + "");  
    mAddress.setPlaceId(place.getId());
```

```
ctvCity.setText(place.getAddress());
```

```
addressSelectionUseCase.fetchPlaceDetails(mAddress);  
}
```

Here, we will get the latitude and longitude of a place. Then we have the Blood group selection options. Here we can select any blood group.

@Override

public void onBloodGroupButtonSelected(int id) method will return us the selected blood group and we will use this blood group in our search results.

- Then we have the distance selector. We can select a distance from here.
- On **btn_search**

```
getListener().onNearByDonorClick(bGroup, dist, mAddress.getLatitude(),  
mAddress.getLongitude()); method will be called and this will MainActivity's
```

@Override

```
public void onNearByDonorClick(String bloodGroup, String dist, String lat,  
String logi) {  
openDonateActivity(bloodGroup, dist, lat, logi);  
}
```

- **onNearByDonorClick(String bloodGroup, String dist, String lat, String logi)** method will call **private void openDonateActivity(String bloodGroup, String dist, String lat, String logi)** method and **DonateActivity** will be opened.
- In **DonateActivity** class **if (getIntent().hasExtra("DONATE"))** will indicate that it is from **NearbyDonar Search** and **NearByMaster2** class will be opened. This class will then load the **NearByListFragment** class.
- **NearByListFragment** is an **AbstractRecyclerViewFragment** which has an **AbstractRecyclerViewAdapter** adapter to show the nearby donars in list.
- In **NearByListFragment**

public void calls(int page, int totalItemCount) method we make a geofire query. This geofire query will return us the nearby keys at your selected place and selected distance. This geofire query takes 3 parameters. **new GeoLocation(Double.parseDouble(lat),**

Double.parseDouble(logi)), Double.parseDouble(dist) and return us the keys in this location.

When we get the key which is the **userId** key in firebase we query in firebase to get the user information. Then we check the user's last blood donate date and blood group. If the blood group matches our selected blood group and last blood donate date is > 120 days that is 4 months then we add the user in our arraylist. We then call this method

@Override

public void setAdapter(List<UserRegistrationFireBase> mObject

This method will set the **NearByUserAdapter** as the adapter of this recyclerview and nearby users will be shown in the list.

When a donar is selected from the list it firstly selects by this method

- **@Override**

```
public void onItemClick(int position, Object object) {  
    UserRegistrationFireBase dummy= (UserRegistrationFireBase) object;  
    ((DonateActivity)getActivity()).onNearByDonorClick(dummy);  
}
```

Method is called on **NearByMaster2** class. And this method will call the **DonateActivity's onNearByDonorClick(UserRegistrationFireBase dummy)** and **NearByDetails2** class will be opened for showing a donar's details. But before that the knn algorithm is run which shows the best matched donors for the given acceptor.

The donors will be shown in a list like follows. And if an item of the list is clicked we can see his exact location now and his profile information.

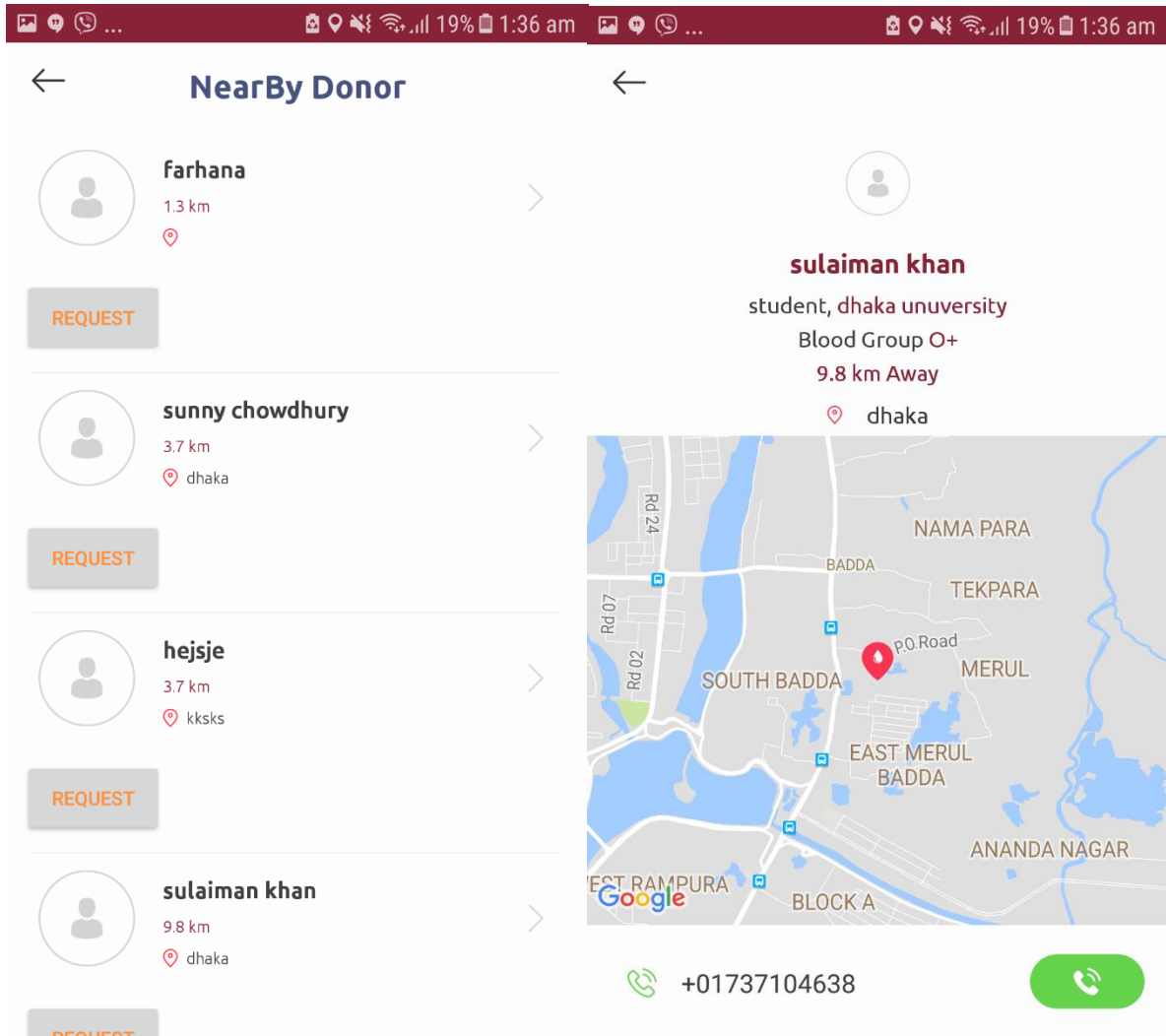


Fig no-4.2.11: Showing list of matched donors

After that we can call the donor or more than one donors we like and we can make a personal appointment to them.

4.2.4 Sharing the blood request in the Social Media or via SMS

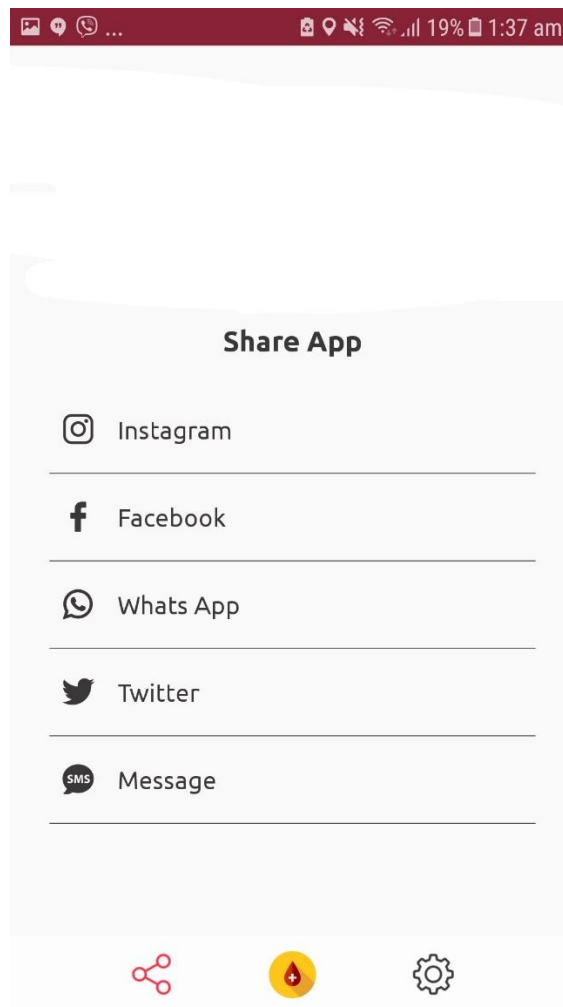
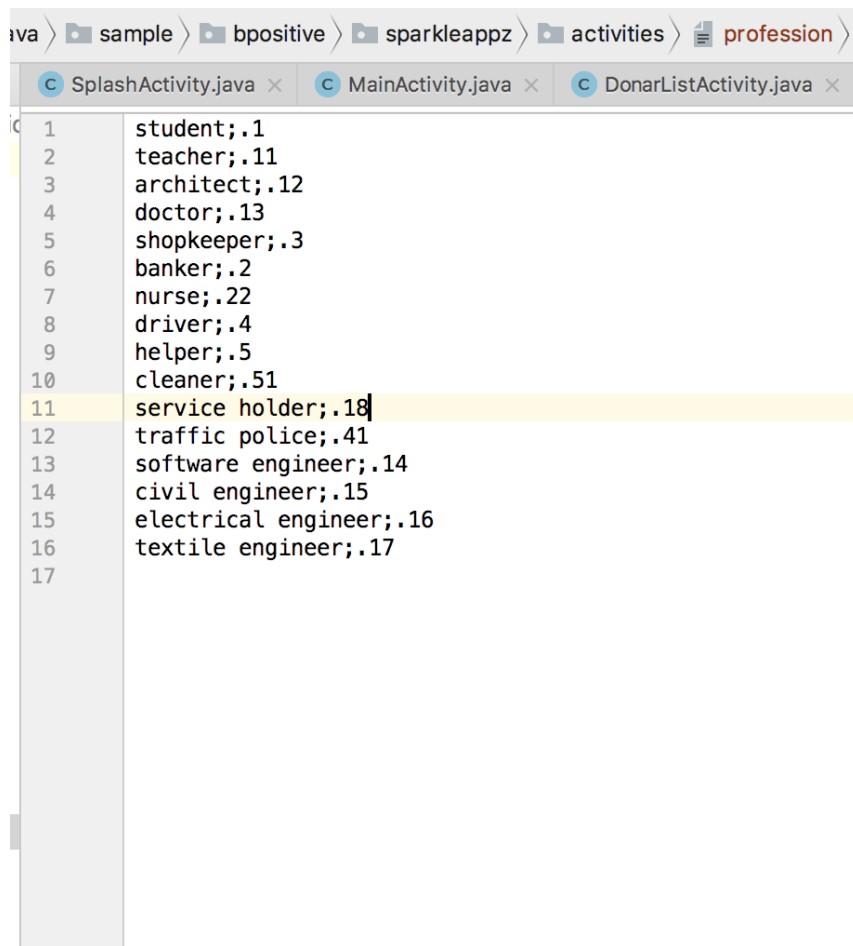


Fig no-4.2.12: Sharing by social media

Chapter 5: Experiment

5.1 KNN algorithm implementation

We used machine learning algorithm, the KNN algorithm which was easier and more effective in our case. So it was 70% successful. And we continued to work with this algorithm. This algorithm is able to find the best matches more precisely than any other algorithm. We made a dataset for the institutions near Dhaka and some workplaces near Dhaka. Then the profile is matched with the current users profile to find the Eucledian distance. The lesser the distance is the more preferable the person is as a donor. In the figure below is shown the sample professions and institutions.



```
ava > sample > bpositive > sparkleappz > activities > profession >
 SplashActivity.java x MainActivity.java x DonarListActivity.java x
1 student;.1
2 teacher;.11
3 architect;.12
4 doctor;.13
5 shopkeeper;.3
6 banker;.2
7 nurse;.22
8 driver;.4
9 helper;.5
10 cleaner;.51
11 service holder;.18
12 traffic police;.41
13 software engineer;.14
14 civil engineer;.15
15 electrical engineer;.16
16 textile engineer;.17
17
```

Fig no- 51.1: Dataset of sample profession

```
institution x SplashActivity.java x MainActivity.java x DonarListActivity
1 Viqarunnisa Noon School;.1
2 Govenment Laboratory High School;.12
3 Ideal School and College;.13
4 Rajuk Uttara Model School & College;.14
5 Dhaka Residential Model College;.15
6 Holy Cross Girls High School;.16
7 Rifles Public School and College;.17
8 The Aga Khan School;.18
9 Pledge Harbor School and Sports Academy;.19
10 Scholastica;.195
11 Viqarunnisa Noon College;.2
12 Notre Dame College;.21
13 Shamsul Haque Khan School & College;.22
14 dhaka college;.23
15 city college;.24
16 cambrian college;.25
17 dhaka commerece college;.26
18 holy cross college;.27
19 trust college;.28
20 B A F shaheen college;.29
21 residential model college;.295
22 university of Dhaka;.3
23 brac university;.31
24 ahsanuallah university of science and technology;.32
25 national university;.33
26 North south university;.34
27 daffodil international university;.35
28 east west university;.36
29 jagannath university;.37
30 university of asia pacific;.38
31 jahangirnagar university;.39
32 Evangel Architect;.4
33 DHAKA DESIGNER;.41
34 Sthapati Associates Ltd;.42
35 Dream Touch Architects Ltd;.43
36 iNEXterior Bangladesh;.44
37 J.A. Architects;.45
38 Synthesis Architects;.46
39 Bashirul Haq & Associates Ltd;.47
40 Vistaara Architects Private Limited;.48
41 Form.3 Architects;.49
42 Dhaka Shishu Hospital;.51
43 Dhaka Medical College Hospital;.52
44 Bangladesh ENT Hospital;.53
45 S.P.R.C & Neurology Hospital;.54
46 Dhaka Central International Medical College;.56
47 Labaid Specialized Hospital Kalabagan;.57
48 Japan Bangladesh Friendship Hospital;.58
49 Dhaka Eye Hospital;.59
50 Holy Family Red Crescent Medical College;.594
51 MH Samorita Hospital & Medical College;.597
```

Fig no 5.1.2: Dataset of sample workplace and institution

5.2 HMM implementation

We worked with machine learning algorithm like HMM to classify the data received from registration of profile. This algorithm was used to detect states of the donor and thus supposed to make a bayesian network of possible states and one state lead to another making it more probable of getting the desired donor. But we omitted BSL and we did not such complex algorithm. Thus using HMM was not successful.

5.3 Tensor Flow Implementations

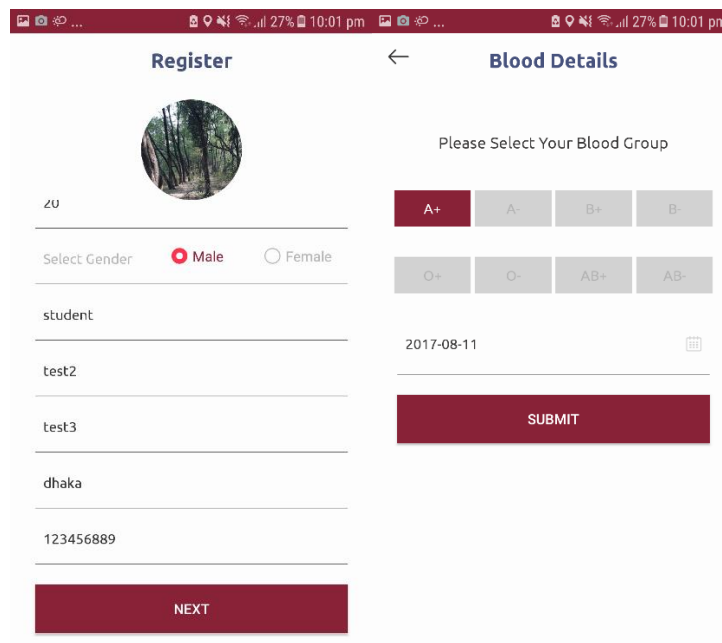
We used tensor flow to classify the datasets we made from flex movement. But we could not continue with that. At first we thought that we would write our own server scripts and the python code form tensor flow can be integrated with it. But then we started to work

with firebase server. And we also made java based android application. So we could no more work with python codes. So we needed to leave the tensor flow library. Though tensor flow was an efficient one but it was not of our work. Thus using tensor flow was unsuccessful.

5.4 Weka Classifier and JavaML

We initially wanted to use weka and javaML library after being failed with python. The classifier was supposed to be useful but it was tough for the arduino to send an huge string and that would be classified in the mobile end. So we started classifying in the arduino end and did not need any java based machine learning classification algorithm. We can say that it was also a failed approach.

5.5 Storing in Database



The image shows two screenshots of an Android application. The left screenshot is titled "Register" and shows a registration form with the following fields: a profile picture (a circular image of a forest), the name "zu", a gender selection (radio buttons for "Male" and "Female", with "Male" selected), and text input fields for "student", "test2", "test3", "dhaka", and "123456889". A red "NEXT" button is at the bottom. The right screenshot is titled "Blood Details" and shows a form for selecting a blood group. It includes the instruction "Please Select Your Blood Group" and buttons for "A+", "A-", "B+", "B-", "O+", "O-", "AB+", and "AB-". A date field shows "2017-08-11" with a calendar icon. A red "SUBMIT" button is at the bottom.

Fig no-5.2.1 : Filling the registration Form

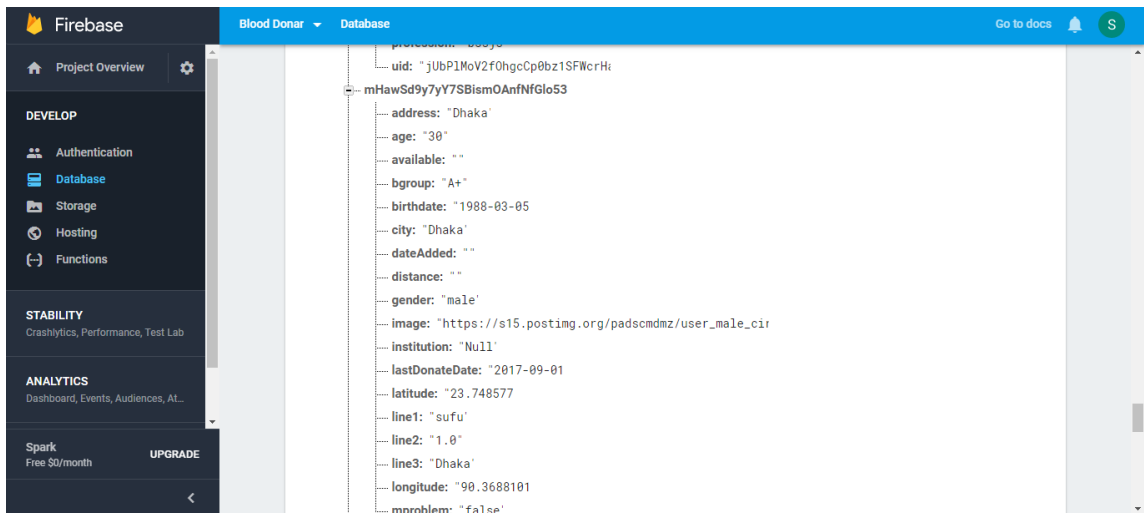


Fig no-5.2.2 : Entry and saving in firebase database

Chapter 6: Experimental Results and Discussion

6.1 Goal archived

1. User Authentication with firebase. Here email and Google login in enabled.
2. Users will input their details (Blood group, age, name) and their location will be automatically taken and updated in database.
3. When any users will move while the app is running their location will be changed by GPS and updated in the database.
4. Users will be able to search the blood group of people and see in the google map that where the persons are located.
5. They can contact with the person nearest to them by tapping with the icon in the map and after that if you long press the map the selected person will be called.
6. All the persons location will be updated consistently in real time to detect the persons correct location.

6.2 Average Percentage of Accuracy

All the activities and fragments are working smoothly. It can move from a window to window where the app follows.

At first the login page opens where there are options to login if someone is a member or is someone is not a member he can register to become a member. There is also password recovery method for someone who has forgotten the password. This page is working fine and the user authentication is also working well because if a person provides wrong email address and password he can not login.

If a person wants to register as a new member he has to press the register as new user. Then he needs to fill up a form with his personal data. These data are stored in the database of firebase as real time data. A person can also set up a profile picture for his profile. The image is taken by 3rd party library picassa. Sometimes there is problem with picassa loading and saving the image. Then in the next page of registration a person needs to select the blood group he has and the last day he donated blood. This page is also working smoothly.

The registration process is complete here. Next the person can send request for blood. To search donor he needs to select the blood group he is searching, the location around which he will need blood and the distance from that location.

Next if he presses the button for search the best matched people according to KNN algorithm will be shown in a list. The person can view the profile and real time location by pressing any donors name from the list. Then he can make direct call to the donor if he is willing to donate blood. Here also the donor can be reached by calling. So we can say that the app is working fine in terms of accuracy.

We have calculated the distance metrics according to the sum of the Euclidean formula

$$d = \sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

Average percentage of accuracy based on the first five donors on the list:

$$(60+100+100+60+60)/5 = 76\%$$

This is a rough calculation because I have not taken much data and the dataset is also limited. If I could accumulate more data then more precise result could be shown.

Chapter 7: Conclusion

7.1 Concluding Remarks

The aim of this Blood Donation Application is to improve the communication with the people who are in need of blood and the persons who are willing to donate blood in few touches of the Smartphone. This Location based Blood Donation Application will reduce the barrier between blood donors and the people in sever need of blood. The donors' location can be detected by the app and the best matched donor will be contacted in no time. So our research paper's objective is to build a community of blood donor and to make sure that we can come forward to donate blood as it can make sure the return of a dying man again into the light of life.

The blood donation Application we are making puts the power to save lives in the palm of your hand. Donating blood and blood components are easier than ever. A person just needs to have an account in our Blood Donation Application, then he can both donate and request for blood anytime. "BLOOD DONOR" is a free blood Donation app available for Android Smartphone. Blood Donor searches, notifies and connect thousands of blood donors in some simple steps. Blood Donor donation app ensures hassle free blood donation and privacy of a blood donor. Connecting blood donors and needy reduces time which increases the possibility of saving lives and also eliminates the shortage of blood.

Blood donation exclusive app "BLOOD DONOR" is a free location based blood donation app. It is one of its first and only unique applications available with feature of real-time map and machine learning algorithm for finding the best suitable donor. It uses the phone's internet connection to let us search blood donors and recipient.

This Android based mobile application finds the blood donor by GPS location service. The App is also able to find the best matches among the donors available with the help of machine learning algorithms. The algorithms are capable of analyzing the profile of each donor and find the best fit ones with respect to health condition and lifestyle. Moreover, the app is also capable of showing the exact position of the donors in the map who are willing to donate blood. The Blood Donation App will make the easiest and fastest way to get a best match blood donor.

7.2 Future Works

The Blood Donor App puts the power to save lives in the palm of your hand. Donating blood and platelets is easier than ever. Find nearby Red Cross blood drives, schedule appointments, earn rewards from premier retailers, and follow your blood's journey from donation through delivery (when possible), and create or join a lifesaving team and track its impact on a national leader board. The future plan is this:

1. Send Push Notification to the persons who are selected and then if the person accept the request another notification will be sent to the sender and connection will be established.
2. There will be a request and accept button for sending and receiving push notification.
3. All the nearby Hospitals will be shown in the app
4. The whole blood donation profile will be saved in the database.

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