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Blood In Need: An Application for Blood Management

Anindya Nag[1], Bijoy Kumar Nath[2], Riya Sil[3] and Pretam Chandra[4]

[1]Science, Engineering and Technology School, Khulna University
Khulna -9208, Bangladesh
anindyanag58@gmail.com

[2] School of Engineering and Technology, Adamas University,
Adamas University, Kolkata- 700 126, India
bijoykumarnath999@gmail.com

[3] School of Engineering and Technology, Adamas University,
Adamas University, Kolkata- 700 126, India
riyasil1802@gmail.com

[4] School of Engineering and Technology, Adamas University,
Adamas University, Kolkata- 700 126, India
pretam591@gmail.com

Abstract: **The most important substance in a human body is blood. Blood is required for treatment of accidental injuries, burns, diseases like Haemorrhagic, Anaemia, Leukaemia's, Thalassemia's and Haemolytic ailments. In most of the cases, the loss of life might occur due to absence of this element. One blood donation can save up to three lives, according to DeSimone. Hence, voluntary donation is the only way of accumulating blood at safe storage to meet emergency requirements for saving lives. According to a report, in every 2 seconds someone in the U.S. needs blood or platelets. Blood transfusion is used to address this condition, and in order to do so, it is critical that the receiver and the suitable blood donor are in close proximity. Therefore, it is very essential to develop an interface which meets both the interests. The key purpose of the proposed work is to create an application which very easily connects a blood seeker to a blood donor. The fundamental goal of this application is 'Life Sharing', a significant technology advancement in the medical industry, in order to conduct a location-based search for blood donors in times of need and so save time and 'Life'. In situations of emergencies, the application truly serves as a life saver. Also, providing chatbot support on social media so that consumers can receive an immediate response and aid with subsequent inquiries. The app is built with Firebase, a cloud-based platform that includes a real-time database, authentication, and storage. Donors can use the Blood Donation Application to register, update their information, and check the availability of blood in their area. Blood seekers can request blood based on the type of blood needed and the location, and donors are notified of the hospital's need and location. The Blood Donation Application will be able to manage serverless computing with Firebase Cloud Functions, allowing for quick and cost-effective processing of donor and seeker requests. With the help of users' survey, authors have evaluated the application and discovered that users have found it simpler, more efficient and effective to use in facilitating blood donations. According to our findings, the Blood Donation Application can be a useful tool for improving the coordination and supply of blood donations, thus saving more lives.**

Keywords: Intelligent Chatbot, Blood Donor, Android Application, Blood, Artificial Intelligence, Blood Bank Management.

I. Introduction

Blood donation and patient monitoring are two of the most crucial applications in the medical industry as it is required on a regular basis. Blood donation involves the collection of blood from a donor, which can help to treat various medical ailment [1]. The usability and efficiency of such systems have gained significance as different health informatic solutions become more accessible. Social Organizations can help patients who need blood to fill out a blood donation application. The creation of a device as such aims to reduce the need for rushing blood collection. In case of an emergency, patients' families can easily arrange for blood using this technology while staying with the patient, thus saving time as compared to collecting the blood physically [2]. Mainly, there are two different individuals in the process of blood donation: *1)* One, who wants to donate blood and *2)* the second, is the person who needs blood [3]. The following part discusses about the topics in details:

1) Blood Donors: Persons who are always ready to donate blood on urgent requirement basis. With the applications' assistance, the needy persons can immediately give them a direct call for urgent help.

2) Blood Needy Persons: Needy persons can utilize this application in the right way. They can directly call from the blood donors list to the nearest available persons to donate blood and help quick rescue in case of emergency situations. They can also drop messages and communicate with donors with chat messaging features.

A. Types of Chatbots

Chatbots can be divided into the following three categories according to the workflow they use.

1) Menu Based Chatbots

Decision trees are the underlying logic behind chatbots that are driven by menus. Hierarchies are utilized to obtain the subsequent stage of input from the user, and as a result, they categorize the subsequent best action based on the input that is obtained from the user [4]. These kind of chatbots are only able to handle basic searches, hence they are unable to handle advanced searches that involve several factors. However, they can handle simple searches successfully. However, the menu-based chatbots have a disadvantage when it comes to the number of clicks that are required to obtain the information that is desired from the bot. In order to obtain the needed information, it requires the greatest number of flows out of the three types of chatbots that have been covered in this study [5].

2) Keyword Based Chatbots

The recognition of keywords is the basis for the operation of these types of chatbots. After receiving input from the user, it will initially attempt to map that information to an already existing set of keywords. If a match is discovered, the appropriate logic will then be carried out [6]. The consumer will have the impression that the chatbot understands them thanks to this form of chatbot. On the other hand, all it does is pick out the keywords from the user's statement. When there is a plurality of terms and a single keyword can be interpreted in multiple ways, keyword-based chatbots are unable to function properly. Such as the case with the quest for blood stock and the search for blood donation camps. Both of these purposes make use of similar operative words, such as "blood" and "search." The frequently asked questions (FAQs) pertaining to blood donation also contain a large number of keywords that are widespread [7].

3) Contextual Based Chatbots

Chatbots that comprehend the context of the conversation are the most advanced type of chatbots. Thus, contextual chatbots can understand the context of the dialogue. These bots make use of Machine Learning (ML) and Artificial Intelligence (AI) to recall conversations with particular users so that they can learn and advance over the course of time. When the necessary information becomes available, these chatbots will fill in the slots, and then they will use those same spaces to understand the context of the conversation. Therefore, the user is benefited because the bot is able to comprehend the context of the conversation, follow its natural flow, and remember the information it has been given by the user [8]. A frequent example of the flow of the conversation includes user asking the contextual chatbot about the availability of B-positive blood in Dhaka, Bangladesh. The bot will respond with a list of blood banks that are already stored in the database. The next step is for the user to type in and in Khulna, Bangladesh? The bot comprehends that the user is inquiring about the availability of B positive blood group [9].

B. Problems and Challenges

The primary objective of this article is to develop a chatbot for health informatics solutions. In the next two sections authors have discussed about Blood Bank Management System. Blood search, in the past, was generally done on the web using the drop down select type technique, that was not very effective as it is to type random queries in chatbot [10]. When users only want the answer to one of the questions, they do not want to read through the entire set of questions. Hence, in order to cut down on the amount of time, effort, and complexity that users experience, a system that is capable of being interactive and providing relevant information by comprehending the language of the user, who may or may not be accustomed to using the system, is required [11]. As a result, we advise employing chatbots for the purpose of interacting with users, responding to their questions and addressing their concerns so that they can obtain information or receive assistance while using the system [12].

In the process of creating the bot, one of the challenges was to recognize the users' statements that has similar meaning. For example, the lines "Look for blood in Dhaka" and "I am looking for blood banks in Dhaka, Bangladesh" may utilize different word choices, but the user means the same in all respect. In both instances, the user is interested in searching for blood donation opportunities in Dhaka [13].

Another significant obstacle was to ensure that the questions in the 'frequently asked questions' section were mapped correctly. Since at the starting, Frequently Asked Questions (FAQs) are restricted, but eventually it expands with time along with the expansion of the application's user base. Since there are just a few questions at the beginning of the dataset, it is challenging to appropriately relate the user's query to the question that is the closest match in the dataset [14].

C. Key Features of "Blood IN NEED" App

This sub-section discusses about the key features of the application which includes: (i) Chat messaging between blood donors and blood needy people. (ii) Donors can get the location from the application and can find the shortest path to the destination. (iii) App will send notification to the donor after 120 days of the last donation date. (iv) Two situations Category: Emergency and Donate on Time. Both have individual request feeds. (v) Request Edit, Delete & Donation Complete and Pending Features are available. (vi) Users can turn off Message, Request and App notification. (vii) Users can set available or not available if donor is not ready for donation. (viii) No one can call or send a message to the donor if the donor is not available. (ix) Calling features are available which will redirect to the main call of the phone. (x) Users will get Division wise blood request notification and will receive message notification. (xi) If a user wants to post blood requests for other divisions, then users need to change the Division in profile setting. (xii) After Setting last donation date, the application will automatically show the next available date for blood donation which will be after 120 days.

The user has to set the date which will be suggested by the application. Users will get a reminder notification for donating blood again [15].

Section – 2 provides a literature survey on healthcare through chatbot models. Section – 3 gives the description of the methodology we adapted for implementing our application. Section 4 - thoroughly explains the proposed model. Section -5 gets a detailed idea of the results and performance analysis. Section – 5 concludes the paper with a direction to future scope of this research work.

II. Literature Survey

The authors have presented a thorough overview of the various conversational agents within the healthcare domain in this section.

Chung, K., el al. (2018) [16] in his article proposed a healthcare service using chatbot and has a knowledge base that is stored in the cloud. The technique that has been suggested is a mobile health provider in the form of a chatbot. Its purpose is to provide prompt treatment in reaction to accidents that may occur in day-to-day life, as well as in response to changes in the circumstances of patients who have chronic diseases. When considered the fact that its use can be facilitated by using linkages with the major social network service messengers, well-known users can easily gain access to and purchase a variety of fitness services. The architecture that has been provided paves the way for a natural connection between humans and robots, which is necessary for the implementation of an eco-friendly chatbot healthcare service.

B.M. Shashikala et al., (2018) [17] developed a web-based application of a Blood Donation Management System (BDMS). This application is responsible for managing the record of donors. A web-based user interface is utilized in the construction of a blood database. A central server is used for the storage of the information that has been gathered. A mobile application is used to provide notification by text message in order to establish a communication link between the recipient and the donor. This method is based on the strategy of sending bulk messages and is sent using the bulk message dispatch methodology. The recipient can get in touch with the donor by making use of the information that is already provided. Only registered users can search for information regarding blood donors using the mobile application. The primary goals of this system are to make it simpler to search for potential blood donors in the event of an emergency and make it possible to establish a direct connection between the recipient and the donor.

Divya, S. el al., (2020) [18] in their paper developed a chatbot that was developed for medical applications. When it comes to parsing inquiries, the bot employs a hierarchical approach. They promote a chatbot that looks for free-form natural language inquiries made by its users in search of blood and services related with it, such as a listing of blood banks, live bloodstock, blood donation camps, and other similar resources. The portion that manages the frequently asked questions (FAQ) is one of the two components that make up a chatbot. The other component is the custom area, which is designed to field questions from individual users.

Chaturvedi, A., el al., (2018) [19] proposed a medical chatbot with the goals of lowering costs associated with healthcare and improving access to relevant medical information. Using artificial intelligence, a medical chatbot that can identify illnesses and provide fundamental information about them before contacting a human physician is the goal of the concept that has been proposed. It is only when a chatbot can identify a variety of illnesses and deliver fundamental information on those illnesses that its actual utility will become obvious. Some chatbots perform the function of scientific reference books, which enables the individual who is afflicted to gain a deeper comprehension of their condition and make positive strides toward bettering their health. Patients can have a text-to-text conversation with a diagnosis bot about their health concerns, and the bot will provide them with a customized diagnosis based on the symptoms they describe.

Xiaojiang, D., et al., (2014) [20] this application comes with an appendix that has a list of desktop applications and is accessible through EFS. This software contains a disclosure that contains material that is protected by reproduction rights, and that material is included in a component of the software. To be more specific, the computer program listing appendix and maybe other sections of the application may also recite or contain source code, facts, or other functional text. For all intents and purposes, the information is hereby incorporated by reference into this application in the same manner as if it had been set forth in its entirety here. The owner of the copyright does not object to the facsimile copy of the practical text; but, in any other circumstance, all copyright rights are reserved.

Bing Nan et al., (2009) [21] designed the web-enabled and mobile-based application of the Blood Donation Management System that demonstrates its ability to effectively manage day-to-day transactions. This application generates an electronic piece of information on the donor as well as the organization that is pertinent to the process of blood donation. This software has been utilized for a variety of purposes, including the registration of details regarding blood issued, blood collection, and all donors. Once registration is finished, a user has graduated to the status of donor. In this section, a contributor will be given the opportunity to open an account by supplying fundamental information such as an email ID and a password. Their account information can be amended by them as long as their mobile number, username, and profile image are kept up to date.

Roh et al., (2005) [22] in their article discussed the potential blood donors who have expressed interest in giving blood and who are able to validate the system. They have the option of removing their account entirely from the system if that is what is desired. In this application, the admin role serves as the primary authority and allows users to be created, deleted, and edited as necessary. A user can search for a donor directly from the homepage of the website. This application gives you the ability to search for things like a blood bag, a doctor, a patient, or a donor, as well as other distinguishable variables. Using a dynamic search, the information about the donor will be displayed based on the location that is closest to them and the date that their blood donation will expire.

III. Methodology

A. Level 2 Data Flow Diagram

Before developing and designing any system, a developer needs to first break it into modular parts so that we can create something that is both functional and efficient. The information flow within the Blood In Need App is broken down and explained with the use of a data flow diagram. The flow diagram explains several app modes present in the program. The flowchart provides an explanation of the flow that is step-by-step in nature. The flowchart provides an explanation of the functionalities available in each of the distinct modes [23].

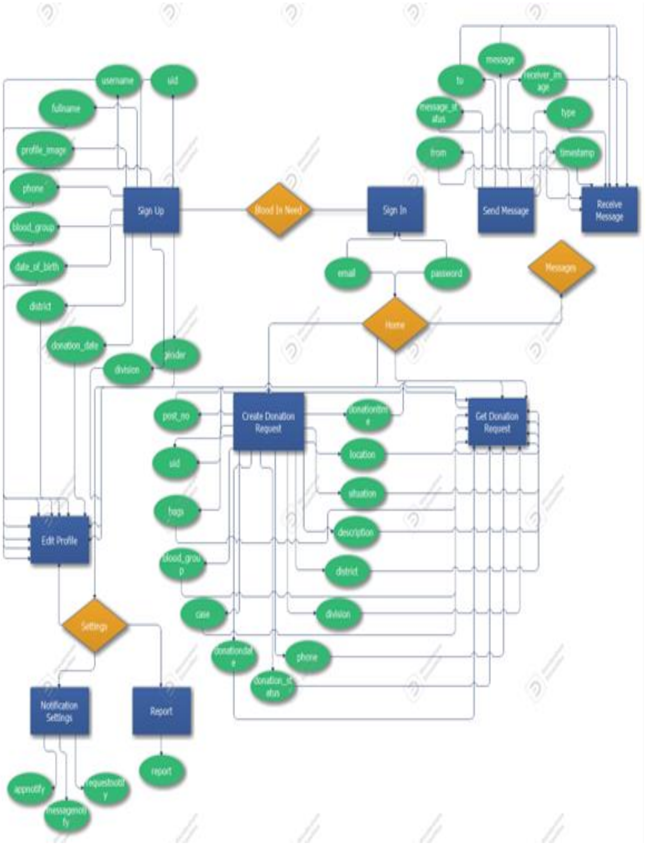


Figure 1. Level 2 Data Flow Diagram of Blood in Need App

B. Use Case Diagram of Blood IN NEED App

A use-case diagram is a graphical representation of a software application's or system's functional requirements. It describes the actions that are performed and the system's responses to those actions. It provides an overview of the interactions between actors (users, systems, or external devices) and the application. The following are the main elements of a use-case diagram [24]:

Actors: Actors are the users or external systems that interact with the application. They can be represented by stick figures, and each actor has specific roles and responsibilities in the application.

Use Cases: Use cases represent specific interactions or tasks that the actors perform within the application. They describe the system's behaviour when an actor triggers an event. Use cases are represented by ovals or ellipses [25].

Relationships: The relationships between actors and use cases describe how the actors interact with the application. The most common relationship is the association relationship, which indicates that an actor is associated with a particular use case. Other relationships include the include and extend relationships, which show that one use case is part of another use case or extends another use case [26].

System Boundary: The system boundary is a rectangle that defines the scope of the application. It includes all the actors, use cases, and relationships within the application [27].

Use-case diagrams are useful in defining the requirements of the application and can be used to communicate with stakeholders to ensure that the application meets their needs. They can also be used to identify potential errors or gaps in the application design and can help in the planning and development of the application [28].

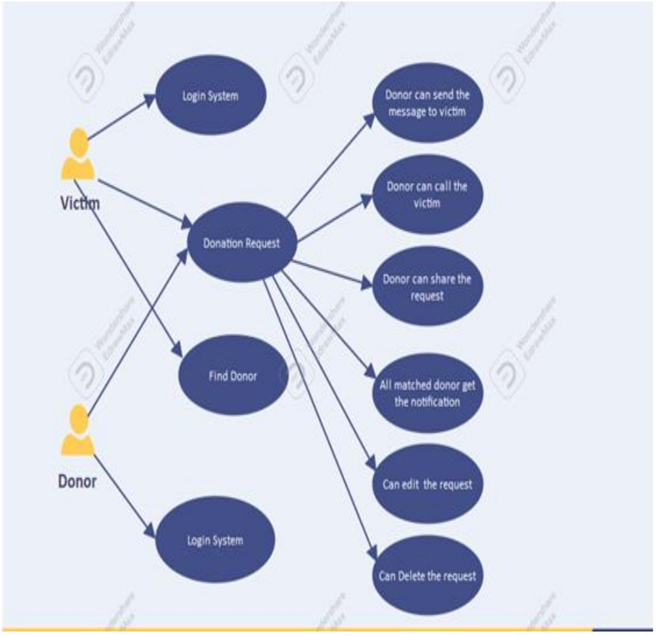

Victim
Donor
Login System
Donation Request
Find Donor
Login System
Donor can send the message to victim
Donor can call the victim
Donor can share the request
All matched donor get the notification
Can edit the request
Can Delete the request

Figure 2. Use Case Diagram of Blood In Need App

IV. Proposed Model

Donor Registration Process: The donor registration process begins when a donor registers for the blood donation program. The donor's personal information, such as name, age, gender, contact details, and blood type, is collected and stored in the donor database [29].

Blood Donation Process: When a donor is ready to donate blood, they go to a blood donation canter. At the canter, their information is verified, and the donor is given a health check-up. If the donor is eligible to donate blood, a new record is created in the blood donation database, including details such as the date, time, and location of the donation, as well as the type of blood donated [30].

Blood Donation Status Update: Once the blood has been donated, the donor database is updated with the details of the donation, and the blood availability status is updated accordingly. If a seeker requests the same blood type in the future, the system will know the blood is no longer available and will not suggest it as a match [31].

A. Level 1 Data Flow Diagram of Blood in Need App (Victim Part)

In the beginning the Victim finds donors according to his/her blood type and location with need status. Blood IN NEED app takes the request for the query and sends a response of the availability of donors accordingly. Once, the donor confirms the request, after that person receives the notification of the request, he/she can send a direct message to the blood seeker, and the process moves forward [32].

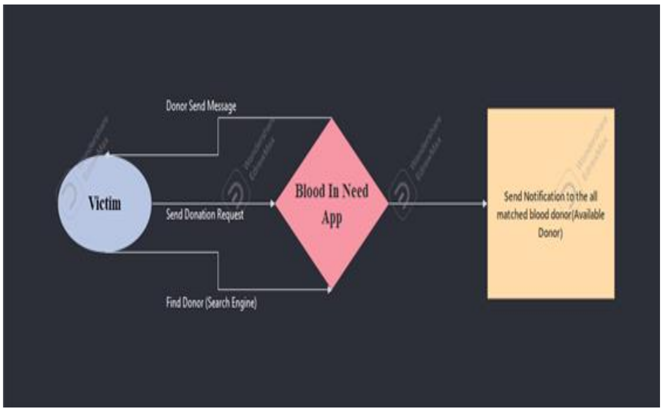

Donor Send Message
Victim
Send Donation Request
Blood In Need App
Send Notification to the all matched blood donor(Available Donor)
Find Donor (Search Engine)

Figure 3. Level 1 Data Flow Diagram of Blood In Need App (Victim Part)

B. Level 1 Data Flow Diagram of Blood In Need App (Donor Part)

The donor can call the victim directly as both of their numbers are available in the app itself, once he/she receives the notification of the message request from the victim. Below Figure shows the same [33].

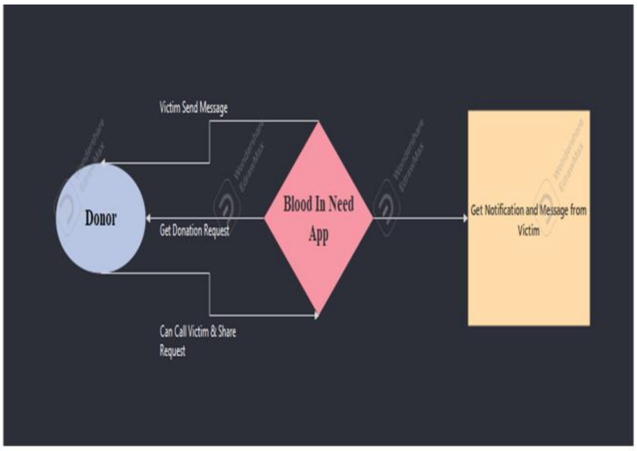

Victim Send Message
Donor
Get Donation Request
Blood In Need App
Get Notification and Message from Victim
Can Call Victim & Share Request

Figure 4. Level 1 Data Flow Diagram of Blood In Need App (Donor Part)

Overall, the data flow diagram shows how the application collects and stores donor and blood donation information, checks for blood availability, and facilitates communication between blood seekers and donors in real-time to ensure a continuous supply of blood for those in need [34].

C. Technologies used for the System Design

The following parts provide an overview of the technology that was utilized in its entirety [35-36]:

(a) Hardware Requirements:

(1) Processor: Intel core i3 or any higher processor
(2) Keyboard: QWERTY keyboard
(3) Hard Disk Drive: 64GB
(4) Memory: 4 GB RAM or more

(b) Software Requirements: Android Studio 4.2.1 - Android Studio is the Integrated Development Environment (IDE) that is officially recommended for use with Android. Apps for Android can be developed with the help of IntelliJ IDEA. In addition to the powerful code editor and development tools provided by IntelliJ, Android Studio contains a number of extra features that, when used together, will help you develop Android applications more quickly. Some of these features are as follows [37-38]:

(1) A build system that is based on Gradle, which is configurable.
(2) An emulator that is both fast and packed with features.
(3) A unified development environment for all Android devices.
(4) While your program is running, select "Apply Changes" to make modifications to the program's code and resources without having to restart it [39].
(5) You may use code templates and the GitHub connection in order to facilitate the construction of common app features and the importation of sample code.
(6) Lint tools to find problems with performance, usability, version compatibility, and other factors.
(7) Support for NDK in addition to C++ [40].
(8) Compatibility with Google Cloud Platform is built in, making it easy to connect Google Cloud Messaging with App Engine [41].

Tablets and other devices that are powered by Android are very popular among tech nerds. Because of its open-source infrastructure, it simplifies the process of developing mobile applications [42]. App developers also have the ability to immediately publish their apps without any additional hassle. Due to the spectacular expansion of the Android platform, an increasing number of developers are getting involved in the creation of mobile applications for the Android system [43].

When it comes to Android, two of the most popular development environments are Eclipse and Android Studio. Why would we work with Android Studio when we could use Eclipse? It's not hard to get the hang of it. The intention behind the establishment of the studio was to quicken the process of developing Android applications.

If you are seeking for a solid integrated development environment (IDE), Android Studio is the way to go [44-45]. As more and more time has gone, Eclipse has become progressively out of date. In addition, because to the fact that it is unable to compete with Studio, Eclipse is frequently referred to as a "Student-Project IDE."

The following are a few reasons why Android Studio is a superior option than other available choices for making things simple and easy to comprehend [46].

(1) System Reliability: When compared to Android Studio, Eclipse is a more comprehensive integrated development

environment (IDE) and a core Java-based program. In order for it to function properly, a significant increase in both the amount of RAM and the performance of the CPU is required [47].

(2) If the necessary prerequisites are not fulfilled in Eclipse, the software will fail to function properly and crash [48].

(3) On the other side, Android Studio has fewer flaws than its competitors. In comparison to Eclipse, its performance is more consistent. When compared to Eclipse, Android Studio has fewer needs for your computer's OS. Android Studio is intuitive to work with [49].

(4) Java Code Auto-Completion: Eclipse and Android Studio both come equipped with an automatic completion feature for Java code. On the other hand, it has come to light that the code completion capability of Studio is significantly more advanced than that of Eclipse. The code completion feature of Eclipse can at times be a little confusing, and it regularly fails to produce appropriate results [50].

Android Studio was developed as a means of offering precise solutions in recognition of the significance of a developer's code completion [51].

(c) Programming Language: Java

Android has become one of the most popular operating systems for smartphones in recent years. There are millions of programs available to download and use on mobile phones of all different makes, models, and brands at this point in time. Android applications are typically crafted with Java, which is a widely recognized programming language [52]. It is a complicated question to try to answer why Java is utilized in the creation of Android. Java is utilized throughout the development process of androids for a multitude of reasons [53].

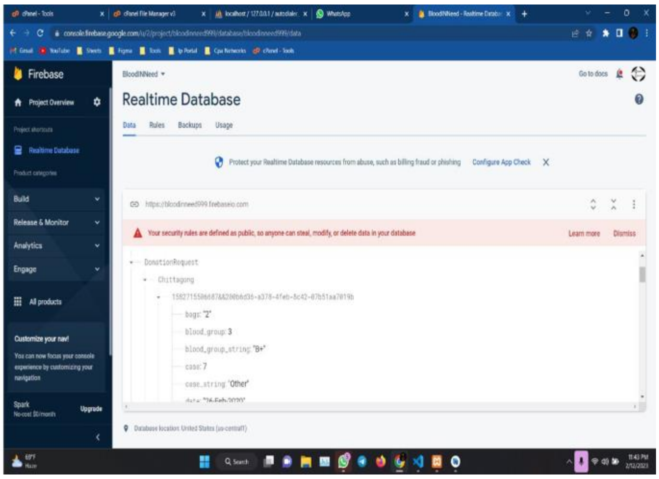
The primary purpose behind the development of Android was to produce a platform-indifferent application environment that could function on any kind of device. Because we are aware that Java had this quality, it was selected as the platform on which Android will be developed. Android applications are executed on a modified version of the Java virtual machine, also known as the JVM. This virtual machine is known as the Dalvik VM [54]. The Android application can be executed on any device as long as it has the Dalvik virtual machine installed. Android applications can be created and run in an environment that prioritizes high performance and is independent of any particular platform in this way. Developing software using an object-oriented approach is an excellent strategy. The oops idea is fundamental to the programming language Java. Android is extremely dependent on Java ideas like classes and objects, in addition to having a number of other deficiencies [55].

Java comes packaged with an extensive collection of reusable library components. Using the resources provided by these libraries is a simple process. The Android Software Development Kit (SDK) comes with a collection of standard Java libraries [56]. They include things like data structure, mathematical calculations, the implementation of graphics, and networking functionalities, among other things. These Java libraries make all of our other tasks much simpler and more efficient. The building of Android applications can be made more quickly and with less effort using this way if Java is used [57]. Android was developed to function properly on a diverse selection of hardware environments. As a direct consequence of this, architectural neutrality is not only required but also highly desired. When the Android code has been written, the software needs to be built and then optimized so that it can run smoothly on a variety of different devices. Because Java is not dependent on a specific platform, it is frequently utilized in Android programming [58].

D. Firebase

A suite of backend services is offered by Firebase, a platform for developing mobile and online applications, to assist developers in more rapidly and easily creating and deploying high-quality apps. The range of services provided by Firebase includes real-time databases, cloud storage, authentication, hosting, cloud functions, and more [59]. These services can be utilized singly or in combination. Developers can store and sync data in real-time across all clients, including mobile and web apps, thanks to Firebase's real-time database. User-created content, such as pictures, videos, and audio files, can be safely and conveniently stored in the cloud. The authentication service provides simple login methods, such as sign-in via Google, Facebook, or Twitter, in addition to email and password [60].

A global CDN and SSL support are provided by Firebase hosting, which enables developers to swiftly launch and host their online apps. Developers can create serverless functions with the cloud functions service that automatically scale based on usage. A/B testing, analytics, and machine learning are just a few of the additional features that Firebase provides [61]. Due to its simplicity, scalability, and connectivity with other Google services, Firebase is a preferred option for those who create mobile and online applications. Developers can concentrate on making fantastic user experiences rather than worrying about backend infrastructure thanks to its comprehensive solution for building and managing complicated mobile and web applications [62].



Realtime Database

Protect your Realtime Database resources from abuse, such as billing fraud or phishing

https://bloodinneed999.firebaseio.com

Your security rules are defined as public, so anyone can steal, modify, or delete data in your database

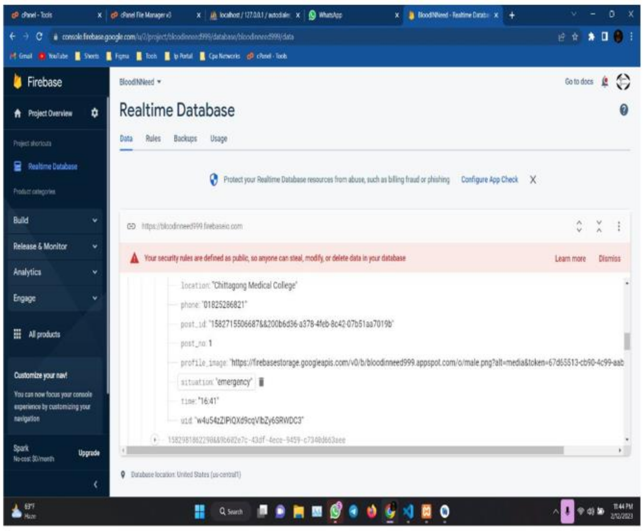
```
DonationRequest
  Chittagong
    1582715586687&&200b6d36-a378-4feb-8c42-67b51aa7019b
      bags: "2"
      blood_group: 3
      blood_group_string: "B+"
      case: 7
      case_string: "Other"
      date: "26-Feb-2020"
```

Database location: United States (us-central1)

Customize your nav!

You can now focus your console experience by customizing your navigation

Figure 5. Firebase Realtime Database for a Donation Request made in our "Blood IN NEED Application" is shown. We can see that the request was made in the Chittagong region in Bangladesh.



Protect your Realtime Database resources from abuse, such as billing fraud or phishing

https://bloodinneed999.firebaseio.com

Your security rules are defined as public, so anyone can steal, modify, or delete data in your database

```
location: "Chittagong Medical College"
phone: "01825286821"
post_id: "1582715506687&&200b6d36-a378-4feb-8c42-07b51aa7019b"
post_no: 1
profile_image: "https://firebasestorage.googleapis.com/v0/b/bloodinneed999.appspot.com/o/male.png?alt=media&token=67d65513-cb90-4c99-aab
situation: "emergency"
time: "16:41"
uid: "w4u54zZlPiQXd9cqVlbZy6SRWDC3"
1582981862298&&9b682e7c-43df-4ece-9459-c7348d663aee
```

Database location: United States (us-central1)

Figure 6. Firebase Realtime Database for a Donation Request made in our “Blood IN NEED Application” is shown. We can see that the request was made in the Chittagong Medical College region. The status of request, phone number etc. of the blood seeker is clearly visible.

The significant area of a Firebase includes:

1*) Firebase Authentication*: Firebase Authentication is a service provided by Firebase that allows developers to easily add user authentication to their mobile and web applications. Developers can simply add user authentication to their mobile and online applications using Firebase Authentication, a feature offered by Firebase. Developers may add a variety of sign-in options for users of their apps with Firebase Authentication, including email and password, Google, Facebook, Twitter, and more [63]. With built-in functionality for performing routine identity management activities like password resets, email verification, and two-factor authentication, Firebase Authentication offers safe authentication. In addition, the service provides sophisticated security tools like Firebase Auth Emulator, which enables developers to test authentication processes without contacting the Firebase servers, and Firebase Security Rules, which enables developers to create rules that enforce access restrictions for their Firebase data [64]. Other Firebase services, such as Firebase Realtime Database and Firebase Cloud Storage, seamlessly connect with Firebase Authentication. Additionally, it interfaces with external tools like Google Analytics, enabling app developers to quickly monitor user behaviour within their creations. In conclusion, Firebase Authentication offers programmers a quick and secure solution to include user authentication into their mobile and web applications. It is a well-liked option for developers who wish to build and deploy high-quality apps quickly and efficiently due to its easy connection with other Firebase services [65].

2) Firebase Realtime Database: A cloud-hosted database service called Firebase Realtime Database enables developers to store and synchronize data in real-time between clients, like mobile and web applications. A NoSQL database, like the Firebase Realtime Database, does not use tables or rows like conventional relational databases do. In contrast, the Firebase Realtime Database stores data in a JSON-like format, enabling quick and effective data querying. Each piece of information is kept in a tree-like structure as a pair of keys and values. Firebase Realtime Database allows developers to store and retrieve data in real-time, which ensures that any changes made to the data are immediately reflected across all clients. By the usage of the Firebase Realtime Database, offline data access and synchronization with online data are made possible for mobile and web applications that prioritize offline use [66]. Additionally, it has strong security guidelines that let developers manage who has access to and may edit their data. Android, iOS, HTML, and Unity are just a few of the platforms and programming languages supported by the Firebase Realtime Database [67]. It also interfaces with additional Firebase services, like Firebase Authentication, Firebase Cloud Functions, and Firebase Cloud Messaging, giving developers access to a whole backend solution. In conclusion, Firebase Realtime Database offers programmers a quick and adaptable cloud-hosted database solution that allows real-time data synchronization and offline data access for mobile and online apps. It is a popular option for developers who want to build and deploy high-quality apps quickly and easily because of its seamless connectivity with other Firebase services and simple-to-use SDKs [68].

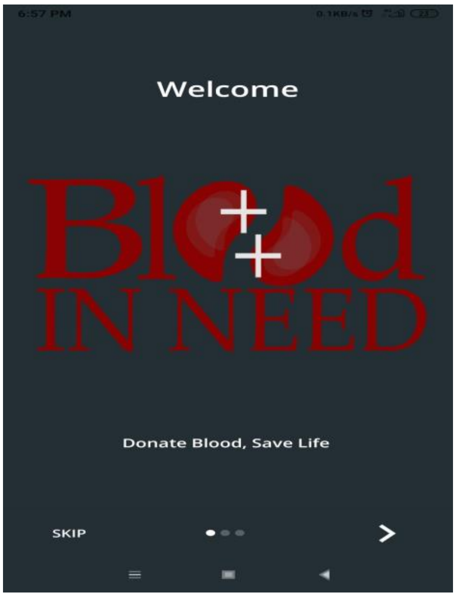
3) Firebase Storage: Firebase Storage is a cloud-based storage solution provided by Firebase that allows developers to store and serve user-generated content in their mobile and web applications, such as images, videos, and audio files. Firebase Storage is a powerful and cost-effective solution for storing any type of file in a reliable and scalable manner. Firebase Storage includes a number of features, such as file uploading and downloading, metadata management, and security rules to control file access. The service enables developers to easily upload files from their applications to the cloud and then access them from anywhere, on any device, using a web browser. It also provides efficient file streaming and serving, allowing for quick and seamless user experiences. A comprehensive solution for creating and administering sophisticated mobile and online apps is provided by the integration of Firebase Storage with other Firebase services, such as Firebase Authentication and Firebase Realtime Database. Additionally, it provides SDKs for a variety of programming languages and operating systems, including Android, iOS, Web, and Unity. Due to Firebase Storage's excellent scalability, developers may store as much data as necessary and only pay for the storage they really use. Furthermore, it has a very high level of dependability, ensuring that users always have access to data, even during periods of high traffic or system downtime. To summaries, Firebase Storage is a powerful and cost-effective solution for storing and serving user-generated content in mobile and web applications. Its integration with other Firebase services and simple SDKs makes it a popular choice for developers who want to quickly and easily build and deploy high-quality apps [69].

4) Firebase Cloud Functions: Firebase Cloud Functions is a serverless computing service offered by Firebase that enables developers to run server-side code in response to events in their Firebase project without the need to manage server infrastructure. Developers can use Firebase Cloud Functions to focus on writing code to handle specific use cases rather than worrying about the underlying infrastructure. Firebase Cloud Functions offers a scalable and cost-effective solution for running backend code in response to events such as data addition or modification in the Firebase Realtime Database or file upload to Firebase Storage. Developers can use JavaScript, TypeScript, and other supported languages to write functions, and they can use the full power of the Node.js ecosystem to build custom logic that responds to events in their Firebase project. Developers can create effective serverless apps that can scale to manage any workload with ease thanks to Firebase Cloud Functions' support for integrations with other Firebase services like Firebase Realtime Database, Firebase Authentication, and Firebase Storage. Developers may quickly test their code in a local setting using Firebase Cloud Functions by using the Firebase Emulator Suite, which enables developers to test their functions locally before deploying them to the cloud. Developers can rapidly find and resolve problems with their serverless functions thanks to the robust monitoring and logging features offered by Firebase Cloud Functions. To summaries, Firebase Cloud Functions offers developers a scalable, cost-effective, and simple serverless computing solution for creating powerful backend logic that responds to events in their Firebase project. Its integration with other Firebase services, as well as its simple testing and monitoring capabilities, make it a popular choice for developers looking to build and deploy high-quality serverless applications quickly and easily [70][71].

V. Results and Analysis

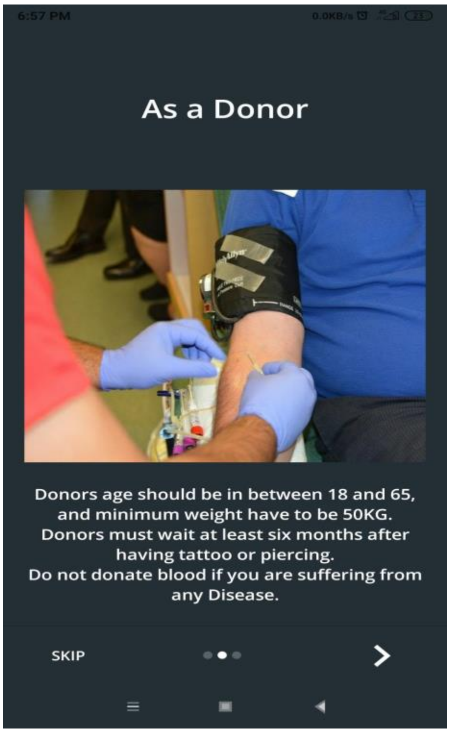
In this section, authors have analyzed the results that “Blood IN NEED” app generates, along with appropriate screenshots and figures.

Figure 7. The Logo of Blood IN NEED App


Welcome

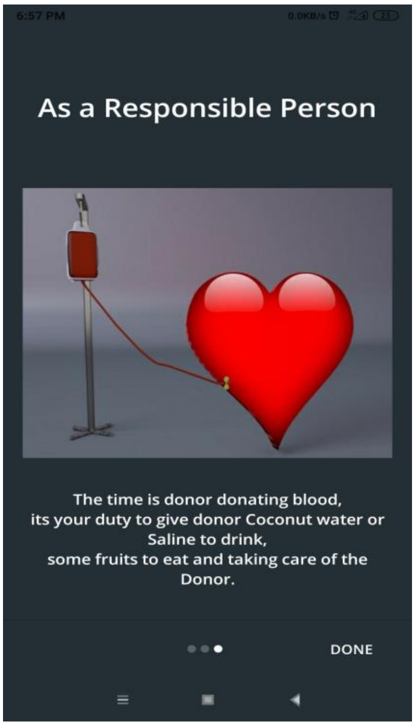
Donate Blood, Save Life

Figure 8. Welcome Menu of Blood IN NEED App


As a Donor

Donors age should be in between 18 and 65, and minimum weight have to be 50KG.
Donors must wait at least six months after having tattoo or piercing.
Do not donate blood if you are suffering from any Disease.

Figure 9. This screen shows instructions that Blood Donors should keep in mind before donating their blood



As a Responsible Person

The time is donor donating blood,
its your duty to give donor Coconut water or Saline to drink,
some fruits to eat and taking care of the Donor.

Figure 10. The next screen tells, the responsibility of a person towards Blood Donors.

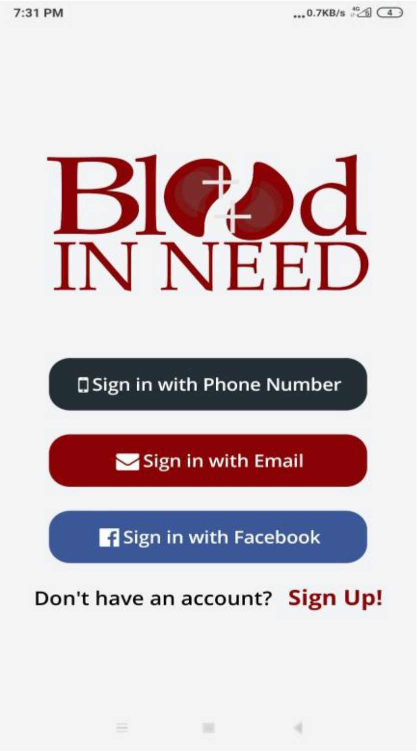
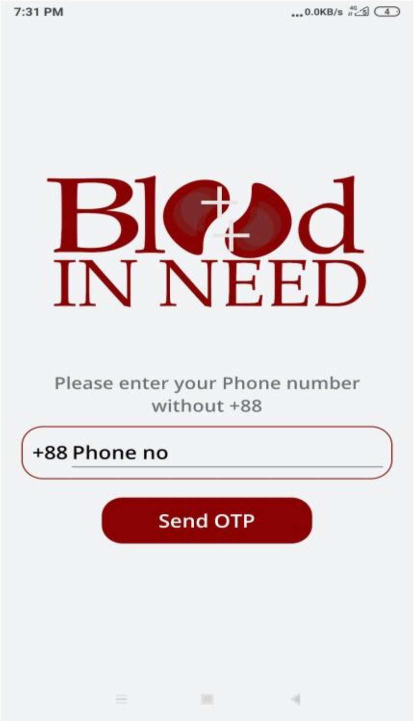


Figure 11. Account Creation Menu with 3 options of Signing in and an option of Signing Up if not registered previously.



Please enter your Phone number without +88

+88 Phone no

Figure 12. On click over 1st option - Sign in with Phone Number this screen appears

Here, a valid Bangladeshi phone number must be entered.

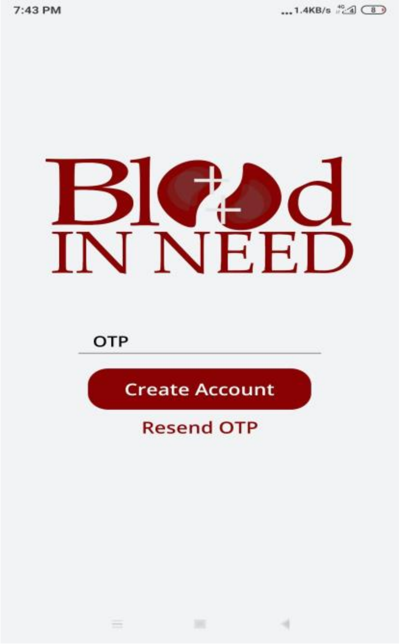
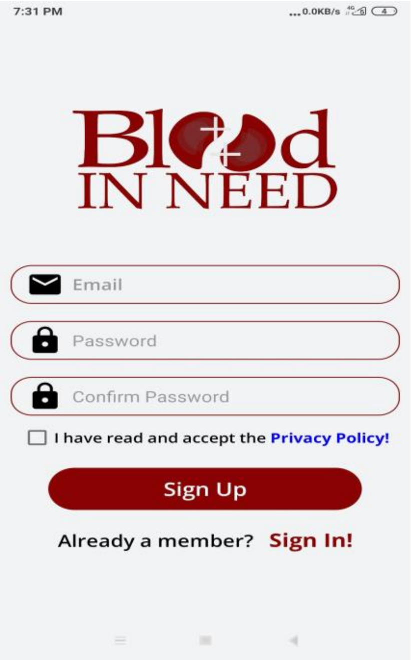


Figure 13. Once, phone number is inputted, an OTP is sent to the respective mobile number.

Users should type the same OTP carefully to successfully create an account.



7:31 PM ...0.0KB/s

Blood IN NEED

Email

Password

Confirm Password

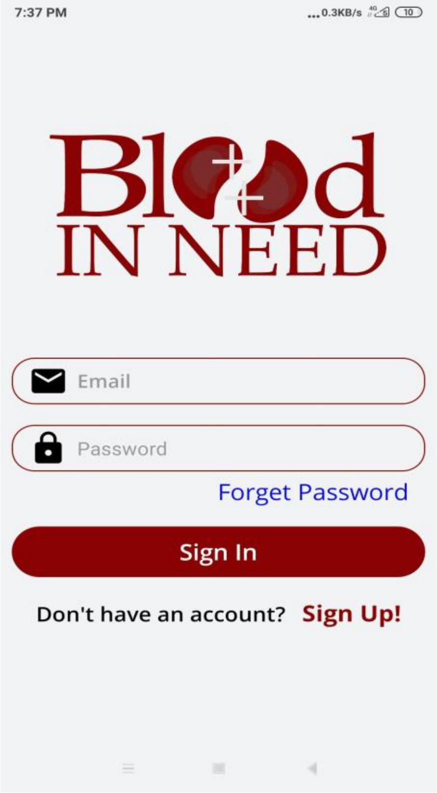
□ I have read and accept the **Privacy Policy!**

Sign Up

Already a member? **Sign In!**

Figure 14. This screen shows signing in while clicking over 2nd option - Sign in with email.

Here, a valid Email Id should be entered along with a strong password.



7:37 PM ...0.3KB/s

Blood IN NEED

Email

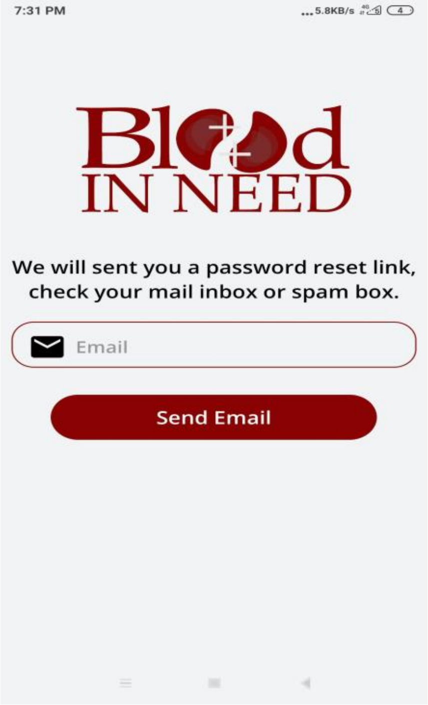
Password

Forget Password

Sign In

Don't have an account? **Sign Up!**

Figure 15. After verification of Email Id, the same email Id with respective password needs to be filled to Sign In to the application.



7:31 PM ...5.8KB/s

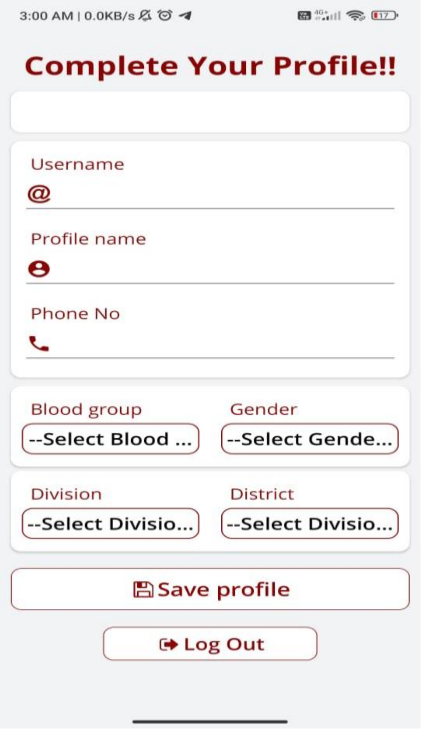
Blood IN NEED

We will sent you a password reset link, check your mail inbox or spam box.

Email

Send Email

Figure 16. In case the user forgets the password of their respective account, a password reset link will be sent to the same registered email id.



3:00 AM | 0.0KB/s

Complete Your Profile!!

Username

@

Profile name

Phone No

Blood group --Select Blood ...

Gender --Select Gende...

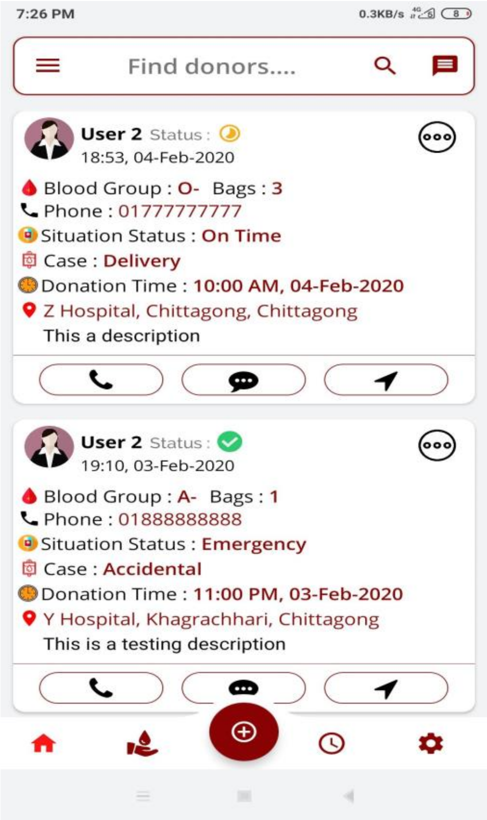
Division --Select Divisio...

District --Select Divisio...

Save profile

Log Out

Figure 17. Once signed-up the user will be logged in to their respective account after which they have to complete their profile on filling appropriate information as depicted.



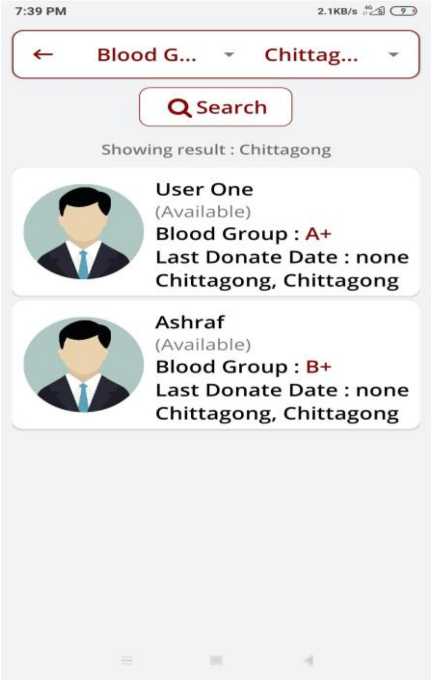
7:26 PM 0.3KB/s

Find donors....

User 2 Status :
18:53, 04-Feb-2020
Blood Group : O- Bags : 3
Phone : 01777777777
Situation Status : On Time
Case : Delivery
Donation Time : 10:00 AM, 04-Feb-2020
Z Hospital, Chittagong, Chittagong
This a description

User 2 Status :
19:10, 03-Feb-2020
Blood Group : A- Bags : 1
Phone : 01888888888
Situation Status : Emergency
Case : Accidental
Donation Time : 11:00 PM, 03-Feb-2020
Y Hospital, Khagrachhari, Chittagong
This is a testing description

Figure 18. Name, location, blood group, phone number etc. of the users in need of blood are shown in this screenshot.



7:39 PM 2.1KB/s

Blood G... Chittag...

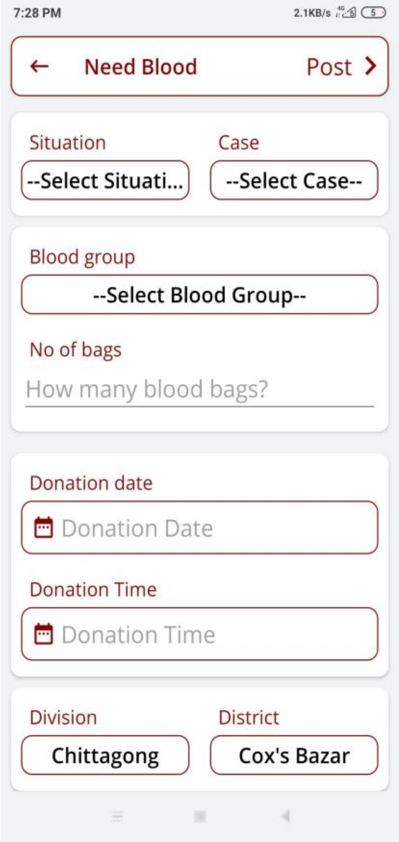
Search

Showing result : Chittagong

User One
(Available)
Blood Group : A+
Last Donate Date : none
Chittagong, Chittagong

Ashraf
(Available)
Blood Group : B+
Last Donate Date : none
Chittagong, Chittagong

Figure 19. On click of the Search icon on top of the screen, a user can search for Donors after entering the Blood Group and the location as per his/her needs.



7:28 PM 2.1KB/s

Need Blood Post

Situation: --Select Situati...
Case: --Select Case--

Blood group: --Select Blood Group--

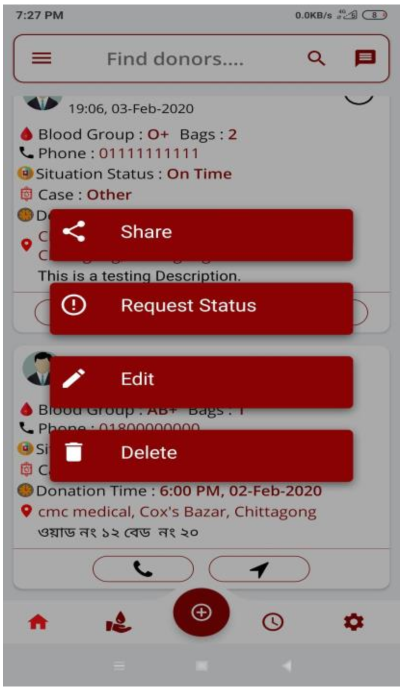
No of bags: How many blood bags?

Donation date: Donation Date

Donation Time: Donation Time

Division: Chittagong
District: Cox's Bazar

Figure 20. A User can also register his/her request of blood needs on click over the '+' icon, by filling in the required details.



7:27 PM 0.0KB/s

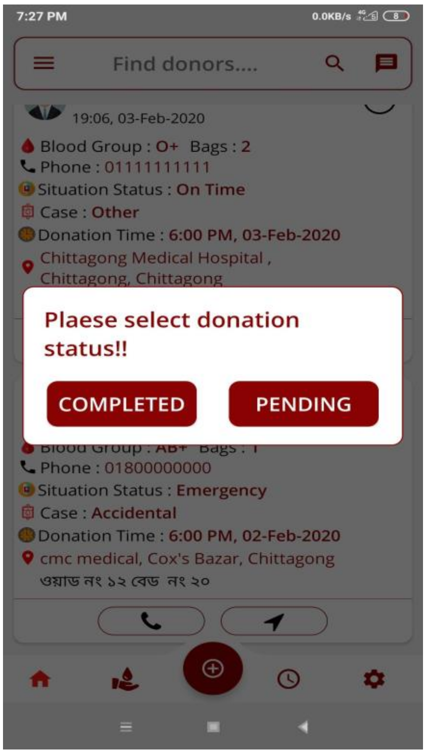
Find donors....

19:06, 03-Feb-2020
Blood Group : O+ Bags : 2
Phone : 01111111111
Situation Status : On Time
Case : Other
This is a testing Description.

Share
Request Status
Edit
Delete

Blood Group : AB+ Bags : 1
Phone : 01800000000
Donation Time : 6:00 PM, 02-Feb-2020
cmc medical, Cox's Bazar, Chittagong
ওয়াড নং ১২ বেড নং ২০

Figure 21. A User can share/edit/delete their request of blood needs on click of the respective buttons. They can also check the status of the request they made.

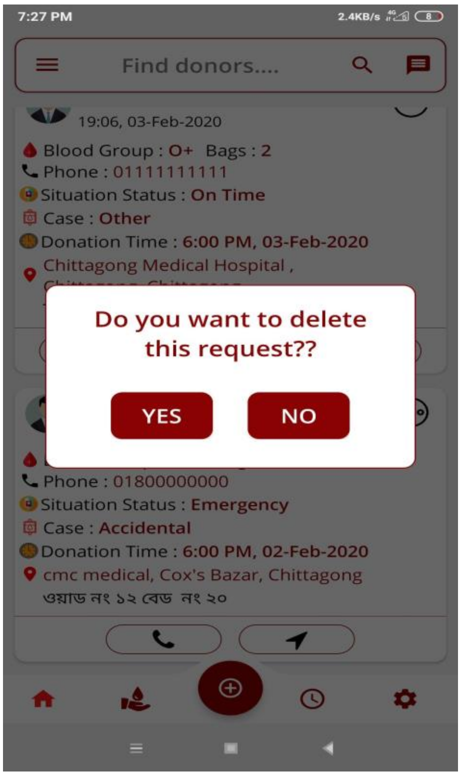


19:06, 03-Feb-2020
Blood Group : O+ Bags : 2
Phone : 01111111111
Situation Status : On Time
Case : Other
Donation Time : 6:00 PM, 03-Feb-2020
Chittagong Medical Hospital , Chittagong, Chittagong

Plaese select donation status!!

Blood Group : AB+ Bags : 1
Phone : 01800000000
Situation Status : Emergency
Case : Accidental
Donation Time : 6:00 PM, 02-Feb-2020
cmc medical, Cox's Bazar, Chittagong
ওয়াড নং ১২ বেড নং ২০

Figure 22. User can select and update the donation status of being ‘Completed’ or ‘Pending’

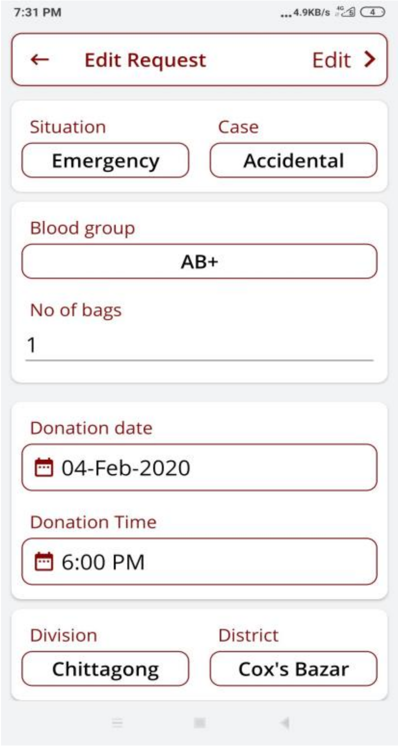


19:06, 03-Feb-2020
Blood Group : O+ Bags : 2
Phone : 01111111111
Situation Status : On Time
Case : Other
Donation Time : 6:00 PM, 03-Feb-2020
Chittagong Medical Hospital ,

Do you want to delete this request??

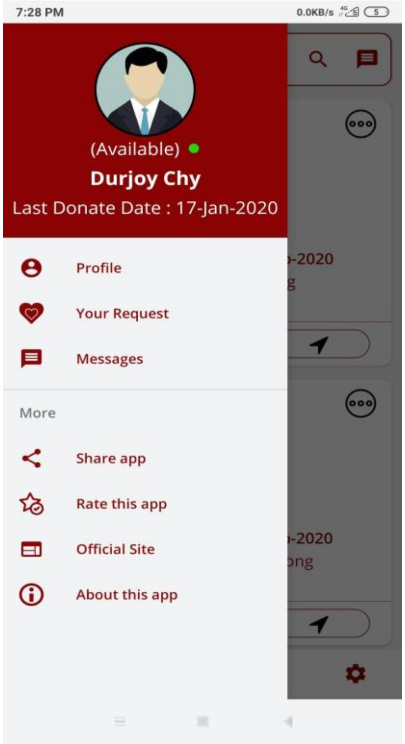
Phone : 01800000000
Situation Status : Emergency
Case : Accidental
Donation Time : 6:00 PM, 02-Feb-2020
cmc medical, Cox's Bazar, Chittagong
ওয়াড নং ১২ বেড নং ২০

Figure 23. Blood Request can be deleted



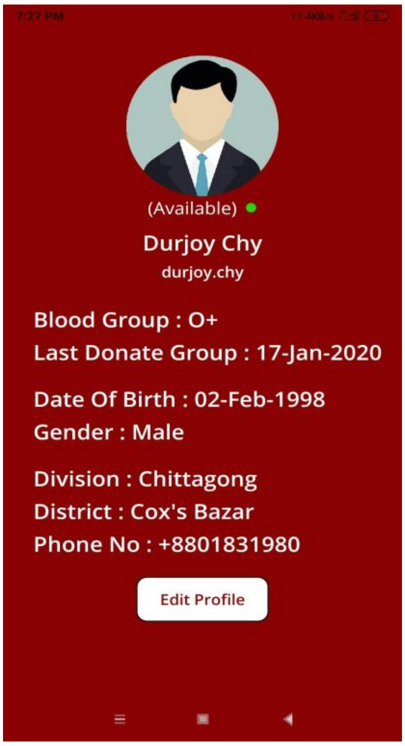
Situation: Emergency
Case: Accidental
Blood group: AB+
No of bags: 1
Donation date: 04-Feb-2020
Donation Time: 6:00 PM
Division: Chittagong
District: Cox's Bazar

Figure 24. Blood Request can be edited, if any changes are needed to be made by clicking over the Edit button from Figure 19.



(Available)
Durjoy Chy
Last Donate Date : 17-Jan-2020

Figure 25. Here account details of a registered user are shown, where vital information related to his personal information and blood donation are listed.



7:27 PM

(Available) ●

Durjoy Chy

durjoy.chy

Blood Group : O+

Last Donate Group : 17-Jan-2020

Date Of Birth : 02-Feb-1998

Gender : Male

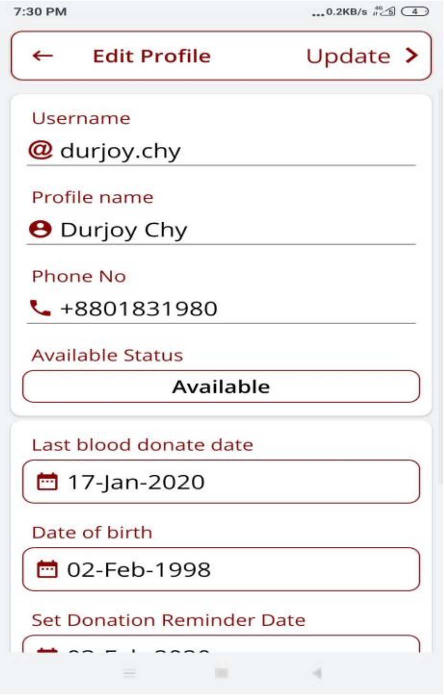
Division : Chittagong

District : Cox's Bazar

Phone No : +8801831980

Edit Profile

Figure 26. A User can check his information and in case of any discrepancy he/she can Edit Profile his/her profile as well.



7:30 PM

← Edit Profile Update >

Username

@ durjoy.chy

Profile name

Durjoy Chy

Phone No

+8801831980

Available Status

Available

Last blood donate date

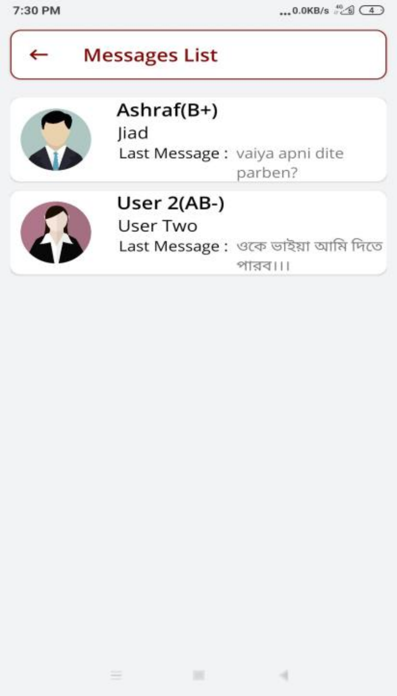
17-Jan-2020

Date of birth

02-Feb-1998

Set Donation Reminder Date

Figure 27. Edit Profile screen where details can be re-entered for a particular account.



7:30 PM

← Messages List

Ashraf(B+)

Jiad

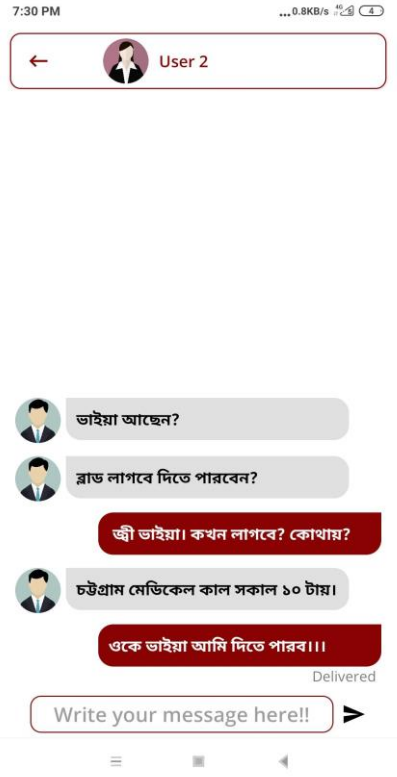
Last Message : vaiya apni dite parben?

User 2(AB-)

User Two

Last Message : ওকে ভাইয়া আমি দিতে পারব।।।

Figure 28. The message icon as per Figure 5.10 has the functionality of allowing the blood seekers directly text message with their donors. This screen shows the Messages List of a registered user.



7:30 PM

← User 2

ভাইয়া আছেন?

ব্লাড লাগবে দিতে পারবেন?

জ্বী ভাইয়া। কখন লাগবে? কোথায়?

চট্টগ্রাম মেডিকেল কাল সকাল ১০ টায়।

ওকে ভাইয়া আমি দিতে পারব।।।

Delivered

Write your message here!!

Figure 29. A chat demo is shown with User 2 from the previous figure.

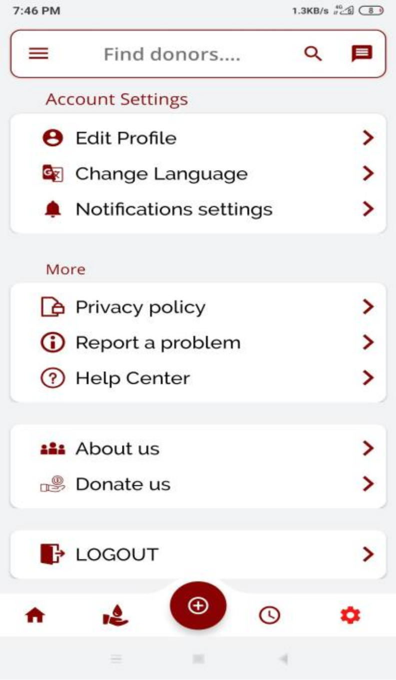
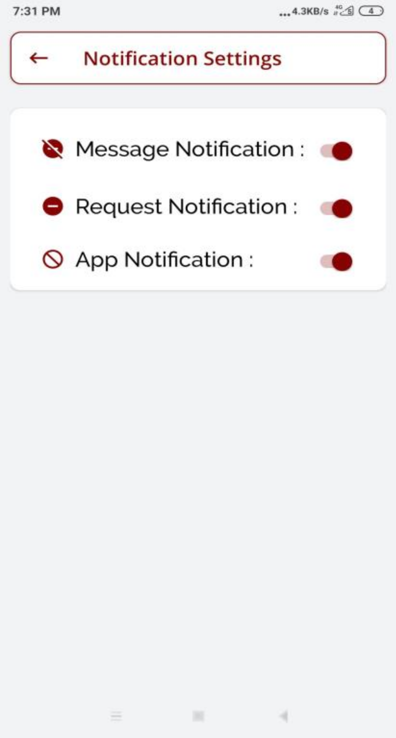


Figure 30. This screen pops up when the Settings icon is clicked at the extreme right of the taskbar.

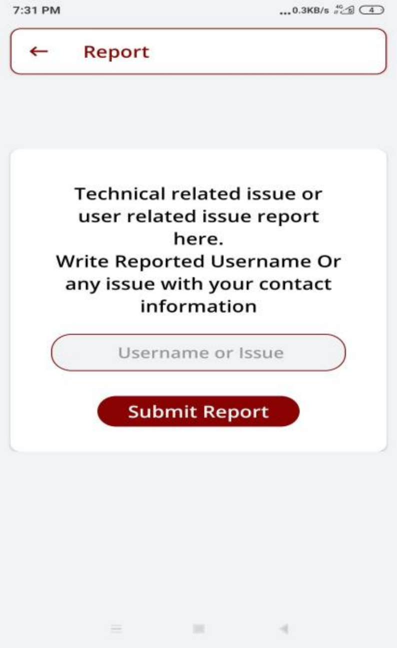


Message Notification : ●

Request Notification : ●

App Notification : ●

Figure 31. User can change their Notification Settings as shown.



Technical related issue or user related issue report here.
Write Reported Username Or any issue with your contact information

Figure 32. Technical issues can be directly reported to the app developers by entering the issue or username.

VI. Conclusion

The development of a blood donation application as such has the potential to significantly improve the process of blood donation by increasing accessibility, efficiency, and convenience. The proposed application can help to reduce the barriers that prevent individuals from donating blood and increase the pool of potential donors. The integration of features such as appointment scheduling, reminders, and rewards can further incentivize individuals to donate blood regularly. The use of such an application can also streamline the blood donation process by improving the coordination and communication between blood banks, donors, and recipients. Overall, the development and implementation of a blood donation application can have a significant impact on the availability and accessibility of blood for patients in need, ultimately saving lives and improving healthcare outcomes. Thus, the proposed application for blood management aims to play a critical role in saving people's lives and reduces panic in emergency situations. It can be used on any android or iOS devices, making the blood-searching procedure simple.

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