Blood Donation System using Geo-Tracking and Machine Learning

Sumit Shriram Sable
Department of Computer Engineering
PVPIT
sumitsable012@gmail.com

Suhas Jadhav
Department of Computer Engineering PVPIT
suhasjadhav9583@gmail.com

Abhishek Prashant Ghaisas
Department of Computer Engineering
PVPIT
ghaisasabhishek22@gmail.com

Anshuman Bhende
Department of Computer Engineering PVPIT
bhendeanshuman@gmail.com

Abstract - This paper addresses blood donation by making use of advanced technologies to make the process easy and efficient. It emphasizes the importance of tailored systems and highlights successful studies implementing innovative solutions. Incorporating various technologies like Geographical Tracking and Machine Learning, the project explores various prediction algorithms and libraries used to build an efficient, innovative, and easy-to-use solution. The paper aims to demonstrate and explain in detail the various tools and techniques used to attempt to bring this idea to fruition, and the benefits that the usage of this technology has brought to the table not only for us as developers, but for the potential users of this app as well.

Key Words: API, Java, Python, Geo-Tracking, Machine Learning, Deep Learning, Maps

INTRODUCTION

Blood donation is a process of utmost importance in the medical world. It is done by people out of the goodness of their hearts, which can be vital to help save a life, especially in emergency situations. From the donor to the doctors to the recipients, everyone takes a great deal of care and effort to make sure the process goes smoothly. However, the system currently in place is not the smoothest itself. A lot of time goes into contacting possible donors and making sure the donors get to the right place at the right time.

While the system that is currently used in India, that is, the E-Raktakosh Website, allows fast registration and login process, it lacks real-time geographical tracking for the donors to reach the hospital safely and quickly, as well as for the hospitals to know where the donor is. Additionally, the website lacks the ability to recommend to you which donor from all possible ones to contact, so the hospitals are still stuck trying to manually determine who to call. Our project aims to tackle both these problems.

Our app uses Maps API for real-time geographical tracking, not unlike how customers know how long it would take for their food to be delivered or for their cab to arrive. This feature would help the donor reach the right destination well in time, thanks to the Maps API. Our app would also use prediction models built using Machine Learning algorithms to help the recipients determine the best donor to call out of all potential blood donors in the vicinity. This feature would help save valuable time which the hospital staff can use instead for more important work rather than manually calling all donors. The app would allow donors and recipients to register very easily, and this information would be securely stored in our real-time database provided by Firebase. This app is but a small effort to help all hard-working and highly skilled medical professionals save a few more lives than they already do.

RECENT WORK

1. “Blood Management System”,Tushar Jaiswal; Sonam Singhal; Dr. J.N. Singh; Dr. Sudept Singh Yadav

The aim of the Blood Donation System project is to develop an electronic information system that connects blood and plasma donors with recipients. This system allows recipients to search for registered donors based on their blood type or plasma requirements. Upon finding a match, the system displays the donor's contact information and location, enabling direct contact between the recipient and the donor. Essentially, it acts as a bridge facilitating direct communication between the two parties. Additionally, recipients or their close relatives must upload prescriptions and hospital details for verification by the donor. The primary goal of this application is to streamline the process for recipients during emergencies and prevent loss of lives due to blood or plasma shortages.

2. “D’WORLD: Blood Donation App using Android”; Dr. A. Meiappane; K. Logavignesh; R. Prasanna

The primary goal of the D'WORLD project is to save lives by facilitating blood donation. It involves developing an Android

app where users can access information about nearby donors. The project addresses both the patient and donor perspectives, providing user validation through registration and login features for new and existing users. Each individual can donate up to 6 pints of blood, which can potentially save up to 33 lives. However, the number of blood donors is lower compared to other countries, highlighting the need for effective communication channels between donors and medical facilities.One of the key issues with existing e-blood donation systems is the lack of quick contact between recipients and donors. The proposed solution aims to address this by automatically removing donor details for the next three months after a donation, thus ensuring up-to-date information. The app utilizes GPS and the Haversine Mathematical Algorithm to locate the nearest donor based on their current location. It also verifies donor medical history with the Department of Health and Welfare.Overall, the project's main objective is to create a unified network of blood donors, validate and store their information securely, and facilitate quick and efficient communication for urgent blood donation needs.

3. "An Approach to Classify Eligibility Blood Donors using Decision Tree and Naive Bayes Classifier", W.B. Zulfikar, Y.A. Gerhana, A.F. Rehmania

Blood donation involves the voluntary collection of blood from individuals for storage in blood banks, which is later used in transfusions. To become a blood donor, certain criteria such as blood type, gender, age, blood pressure, and hemoglobin levels must be met. Currently, these criteria are manually processed to determine donor eligibility, leading to repetitive and time-consuming tasks. This project proposes a classification model to streamline the eligibility process using both decision tree and naive Bayes classifiers. In the evaluation phase, these algorithms are compared based on accuracy and performance. The results show that the decision tree classifier achieves an accuracy of 66.65%, while the naive Bayes classifier achieves 79.95%. Further testing with 100 data testing samples and 400 data training samples reveals that the decision tree classifier achieves 78.5% accuracy, while the naive Bayes classifier achieves 81.5%.

4. "Analyzing Blood Donation probabilities and number of possible donors", Pinar KIRCI; Seyma AKTAS; Burcu SEVINC

The study utilized crucial donor information, including the frequency of blood donations and the time since the last donation. These data types were vital for developing a solution to predict the likelihood of future blood donations. Various machine learning methods were applied to blood transfusion data to estimate whether a potential donor would donate blood again. The performance of the algorithms was compared based on their classification accuracy.

5. "Blood and Plasma Donation, Management System with Global Positioning System using FIREBASE", Indirala Vasavi, Ch. Nanda Krishna, Kalivarapu

Blood and plasma are crucial components for the human body. According to the National Blood Transfusion Council, individuals aged 18 and above are eligible to donate blood. With a population of nearly 139 crores above 18 years old, there are only 2.5 crore units of blood available at blood centers, highlighting a significant gap in supply. Previous systems often focused on either donor information or blood bank details, but rarely provided both. This study introduces a multi-page application called DONORS QUEST, designed to swiftly provide donor information. Using GPS technology, the application also aids in locating nearby blood banks. Developed as a free and open-source web application using the MERN stack, DONORS QUEST enhances interaction between seekers and donors during emergencies. Firebase, with its reliable databases and fast hosting capabilities, powers the application, allowing rapid access to donor details. Seekers can easily locate nearby donors or blood and plasma banks using GPS, enhancing the efficiency of the platform. Firebase's hosting capabilities enable quick deployment of the web application, freeing developers to focus on innovation rather than infrastructure concerns. Overall, DONORS QUEST provides a seamless platform for blood donation interaction, benefiting both seekers and donors in critical situations.

6. "Blood Donation Prediction System Using Machine Learning Techniques", Pooja Selvaraj, Aiman Sarin, B. Ida Seraphim

While blood donation is a safe medical procedure, public beliefs, attitudes, and awareness levels can impact participation. To gauge public awareness and knowledge, a real-time cross-sectional study was conducted at King Abdulaziz Medical City (KAMC). The study aimed to identify challenges within the blood donation process. The study revealed key reasons why people refrain from donating blood. For 32.4% of respondents, the idea of donating blood simply did not occur to them. Another 45% cited a lack of time in their schedules as the primary barrier. Moreover, 61.3% reported difficulty in accessing blood donation centers, highlighting societal unawareness about donation processes. Leveraging sound data-driven machine learning techniques can help predict donation patterns and supply requirements, thereby enhancing the efficiency of the entire supply chain.

7. "Recent intelligent approaches for managing and optimizing smart Blood Donation process", Shadi AlZu'bi, Darah Aqel, Ala Mughaid

Immediate access to blood is crucial for saving lives during emergencies. Given the ongoing demand for blood transfusions in various medical procedures, managing the entire blood supply process, from donors to hospitals and transfusion centers, is essential. This includes ensuring compatibility between donor and patient blood types. This comparative study evaluates existing approaches in blood donation and assignment management systems. The goal is to ensure a consistent supply of blood products to transfusion centers and hospitals by optimizing donation processes and predicting future donation trends. Optimization involves minimizing blood wastage due to expiration and reducing reliance on external blood sources by managing critical shortage levels and monitoring blood unit expiration. The study also discusses key findings, limitations, and

unexplored issues in existing blood donation management systems. It proposes suggestions to address these limitations, offering alternative perspectives and potential areas for future work in blood donation management.

8. "Blood Donor Classifier Using Hybrid Naïve Bayes Decision Tree (HNBDT)", Parth Shah, Yashika Sonchatra, Shyamal Virondkar, Aarya Sutar, Bhargav Pardikar

Blood donation is crucial for healthcare, ensuring a consistent blood supply for medical treatments and emergencies. Identifying eligible blood donors efficiently is vital for maintaining this supply. This research paper explores automating blood donor classification using the Hybrid Naïve Bayes Decision Tree (HNBDT) approach. The study addresses the growing need for an accurate and efficient donor eligibility assessment system. The Hybrid Naïve Bayes Decision Tree Algorithm (HNBDT) proposed in the study achieves an accuracy of 75%, surpassing traditional algorithms like Naïve Bayes and Decision Tree (DT). This improved accuracy is attributed to the hybridization step in HNBDT, enhancing the classification process.

9. "The Blood Boon", Bharath Kumar Nangunuri; Gandhe Sripriya; Konda Avinash; Rama Chandra Rao M

"Blood" stands as a critical need in our lives, yet the number of blood donors in our country remains notably low compared to global standards. Our project aims to revolutionize this situation with a new and highly effective approach. Currently, the average blood donation per person is only 470 ml, accounting for a mere 8% of adults. This paper outlines the functionality of our website, designed to streamline the blood donation process. Users interested in donating blood can register easily, much like signing up for any other online platform. Upon registration, donors input essential personal information such as name, phone number, age, weight, date of birth, blood type, and address with just a few clicks. In case of a blood emergency, the website utilizes GPS technology to locate nearby blood donors. Once the required blood type is specified, the system automatically displays nearby donors and sends an alert notification to them. If the first donor is unavailable, the system proceeds to contact the next donor in line. When a donor accepts the request, the recipient can directly communicate with the donor for blood donation arrangements. To ensure donor safety and manage availability, donor details are automatically removed from the system for the next three months after donation. This process ensures a continuous cycle of blood donation and availability, contributing significantly to addressing blood shortage challenges.

10. "RaktFlow - Blood Bank Management and Donation System", Jaspreet Kaur; Ashish Gupta; Abhishek Tripathi; Ashish Kumar Gupta; Anmol Srivastava

The Blood Bank mobile application aims to simplify the blood donation and receiving process. This app enables users to easily donate and receive required blood, and also provides information about the availability of oxygen and ambulance services at nearby hospitals. It offers details regarding the availability of different blood types across various hospitals and blood banks. Given the challenges posed by the COVID-19 pandemic, where the demand for blood and oxygen surged to unprecedented levels, this app becomes even more crucial. Blood and oxygen are indispensable elements of healthcare, and their demand continues to rise. However, shortages and unavailability persist. The primary goal of this project is to provide a unified platform for addressing these challenges, offering users a seamless solution to access blood, oxygen, and emergency services from their smartphones.

MODEL ARCHITECTURE

The project aims to develop an easy-to-use application for both important parties involved in blood donation, the donor and the recipient(hospitals). The donor and recipient can each register easily on the app, the information will be stored in the real-time database using Firebase. The recipient can send a request for blood donation, and the app will search for potential blood donors depending on their geographical location at the time, as well as the probability of them donating blood, which will be determined by the help of our deep learning model. The recipient can select who to send a request to, depending on requirement and urgency. The donor(s) would then receive a request from the recipient, and if they accept, then they can track the recipient's location using the in-app navigation and geo-tracking, powered by Maps API.

The user interface is designed in a way that would make it easy for even a novice mobile user to use the app. The app itself is written in Java, the Deep learning algorithm has been developed using Python and Support Vector Machines, and the model has been trained on a robust dataset.

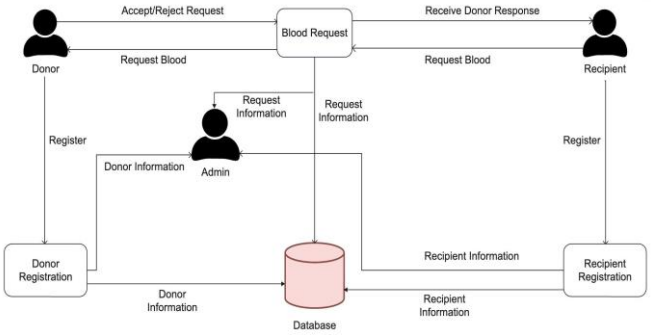

Fig: Model Architecture

SYSTEM COMPONENTS:

1) Registration and Login

As soon as the app is opened, a new user is first brought to the registration page, where the credentials important for the app to function are taken, like Name, Email, Country Identification(Aadhar Card Number), Blood Group and Password

is taken. These credentials and his profile are then stored in the real-time database storage provided by Firebase. The next time he/she opens the application, they will be asked to login with their registered email ID and password.

In the login stage, the app will verify the accuracy of the credentials provided by donor/recipient from its database,and will give appropriate response if wrong credentials are entered. If the user seems to have forgotten his/her password, then recovery operation for that will be available using email.

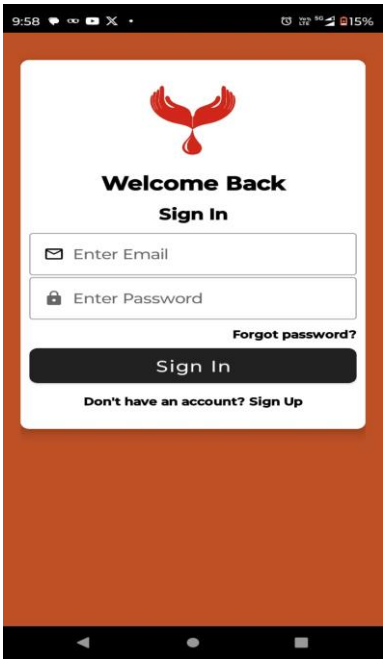

Fig: Snapshot of Login Page

2) Blood Request

In this module, the recipient who needs blood from a compatible blood group will be able to submit a request, which will be sent to all users with a donor account on the app, and whose blood group matches the recipient's requirement. Users with a donor account can also see a list of requests that they've received with all required details.

The user's blood group collected during the registration and login stage would be very important
for this function.

You can also check the blood groups that are compatible with you on a tab that is present in the app regardless of which screen you are on.

The recipient would also see the list of donors in the order of likelihood of the donor donating blood at this time, which would be determined with the help of the Machine Learning model specially built for this purpose.

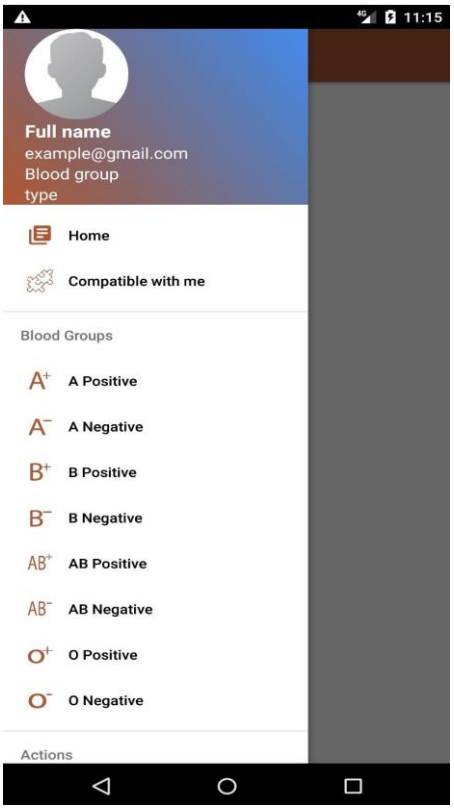

Fig: User tab

3) Machine Learning Model

Various algorithms were considered to train our dataset on like Support Vector Machines, Random Forests, and Decision Trees. But, Support Vector Machine gave us the most accuracy out of the three.

So, the machine learning model was built using Support Vector Machine to try to determine the likelihood of a donor donating blood by taking into account his past record of donations, and most importantly the time interval between them. Fortunately, we were able to find just the right dataset to train the Machine Learning model on.

a) Dataset

The dataset was actually a two-part dataset, divided into the training set and testing set.

The dataset has two important fields: Months since Last Donation and Months since First Donation, which helped the model to determine how long a donor has

been involved in blood donation.

Another column, 'Made Donation in March 2007' helped determine if a donor had donated blood relatively recently.

The column 'Total Volumes Donated' was dropped consideration while building and training the model as it was inconsequential, and to make the overall training process a bit more efficient.

	Months since La	Number of Dona	Total Volume Do	Months since Fi	Made Donation in March 2007
2	619	2	50	12500	98	1
3	664	0	13	3250	28	1
4	441	1	16	4000	35	1
5	160	2	20	5000	45	1
6	358	1	24	6000	77	0
7	335	4	4	1000	4	0
8	47	2	7	1750	14	1
9	164	1	12	3000	35	0
10	736	5	46	11500	98	1
11	436	0	3	750	4	0
12	460	2	10	2500	28	1
13	285	1	13	3250	47	0
14	499	2	6	1500	15	1
15	356	2	5	1250	11	1
16	40	2	14	3500	48	1
17	191	2	15	3750	49	1
18	638	2	6	1500	15	1
19	345	2	3	750	4	1
20	463	2	3	750	4	1
21	372	4	11	2750	28	0
22	8	2	6	1500	16	1
23	539	2	6	1500	16	1
24	734	4	14	3500	40	0
25	573	4	6	1500	14	0
26	482	4	8	2000	21	0
27	330	1	14	3500	58	0
28	222	4	10	2500	28	1

Fig: Snapshot of Dataset

b) Building and Training the Model

The model was built on the Google Colab platform using Python because of code readability and the ease-to-use nature of the platform itself.

Keras and Tensorflow libraries were used to train the model on neural networks for good results during testing. Seaborn and Matplotlib libraries were used as a means to visualize the results of training and testing the model.

The final model was then passed through the sigmoid function since the data dealt with binary values for prediction purposes, and was optimized using Adam optimizer as our model deals with large amounts of data and parameters.

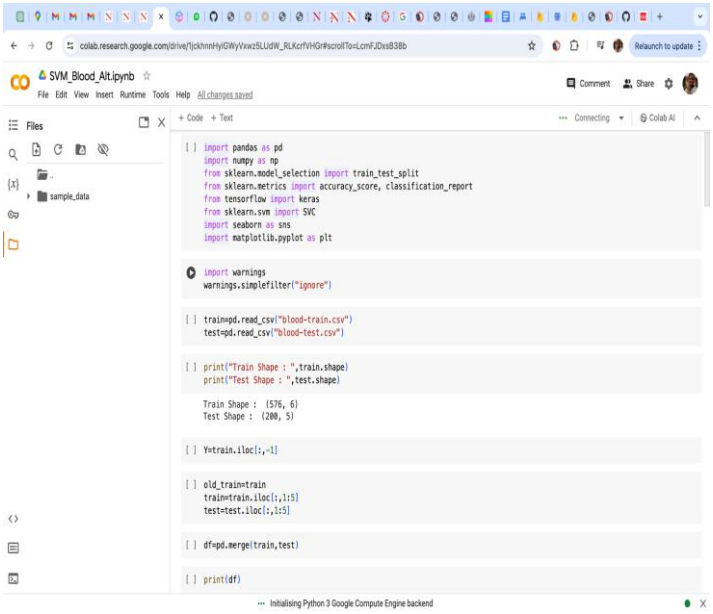

Fig: Sample of code

RESULTS

The SVM model was trained by considering various combinations of train-test-split, most notably 70-30, 60-40, 55-45, etc. and their various accuracies were recorded for comparison.

But, the most accurate combination was one that we never seen being tried before, i.e. 73-27 (73% was training data and 27% was testing data).

The results obtained were as follows:

	precision	recall	f1-score	support
0	0.84	0.99	0.91	121
1	0.92	0.34	0.50	35
accuracy			0.85	156
macro avg	0.88	0.67	0.70	156
weighted avg	0.86	0.85	0.82	156

Accuracy: 0.85

Fig: Confusion Matrix

The above confusion matrix shows that the average precision of the model considering the two classifying values (0 and 1) is 88% and the overall accuracy of the model is 85%. While these results are promising, there is still room for improvement and much work to be done to use the model in a production environment on a large scale.

The graph given below shows the overall accuracy of model during training and testing, based on the 73-27 splitting formula that we used.

We can see that the model improves its predictions as it progresses through the iterations, both during training and testing.

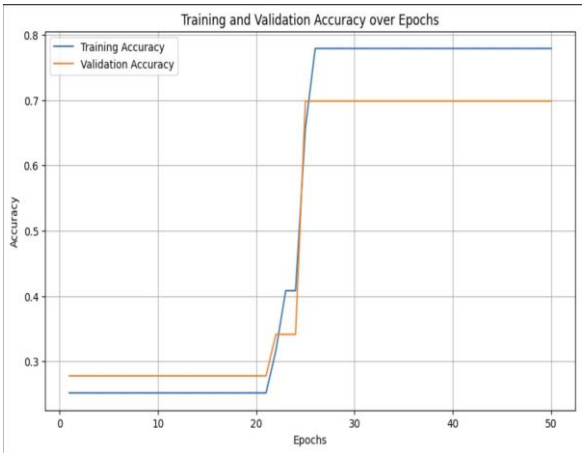

Fig: Training and Testing Graph

CONCLUSION

This project presents an efficient approach by leveraging technological advancements made in recent years to make the blood donation process easier and faster for both parties involved, the donor and the hospital.

By using the power of blood donor prediction and in-app requesting, we have attempted to create an easy-to-use app that can work on all Android versions available in the market today, aiming for widespread use of the app in the country.

Through the review and justification of select studies, we have demonstrated the effectiveness of our approach in addressing the problem.

Additionally, by utilizing APIs such as Maps API, we have provided practical solutions to facilitate the implementation and enhancing the functionality.

By contributing to ongoing efforts in this field, we hope to make meaningful strides toward making it easier for hospital staff and medical professionals in the industry to save more lives than they already do.

FUTURE SCOPE

Even by using this to ease their work, the hospitals still have to rely completely on information provided by donor in good faith, and have to manually conduct blood tests to make sure that the donor is physically suitable and capable of donating blood, i.e. they do not have any blood-related disorders or high BP and blood sugar.

Such tedious work can be avoided by implementing a blood donor eligibility classifier in the system using Machine Learning techniques to determine if a donor is eligible or not, by training the model with a suitable dataset using Naive Bayes classifier or Decision Tree, or a hybrid of both.

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