Design and Implementation of a Real-Time Blood Demand Tracking and Emergency Aid Management System

P. Naveena, Ms. P. Revathy MCA, M. Phil.

[1]PG & Research Department of Computer Science, Sri Ramakrishna College of Arts & Science, Coimbatore, Tamil Nadu, India.
E-mail: 23106102@srcas.ac.in

[2]Assistant Professor, PG & Research Department of Computer Science, Sri Ramakrishna College of Arts & Science, Coimbatore, Tamil Nadu, India.
E-mail: revathy@srcas.ac.in

\-------------------------------------*************************--------------------------------

Abstract:

Timely access to compatible blood remains one of the most critical challenges in emergency healthcare management. In life-threatening situations such as accidents, surgeries, childbirth complications, and critical illnesses, delays in locating suitable blood donors can significantly increase mortality risk. Existing blood procurement mechanisms primarily rely on hospital blood banks, manual coordination, social media appeals, or informal intermediary networks. These approaches are often fragmented, time-consuming, geographically inefficient, and in some cases, financially exploitative. The absence of a structured, real-time communication framework between voluntary donors and recipients further exacerbates emergency response delays.

This research presents the design and implementation of a Real-Time Blood Demand Tracking and Emergency Aid Management System, a web-based platform developed to establish a direct, transparent, and technology-driven connection between voluntary blood donors and patients in urgent need. The proposed system enables donors to register securely and maintain updated profiles containing essential attributes such as blood group, geographical location, availability status, and communication preferences. When a verified emergency blood request is generated, the system automatically identifies compatible donors within a defined geographic radius using location-based matching algorithms.

Upon identification, automated SMS alerts are dispatched to eligible donors, providing essential details including the patient's contact information and hospital location. This immediate notification mechanism significantly reduces response time and eliminates dependency on intermediaries. The system architecture integrates modern web technologies, including Angular for the front-end interface and Firebase for backend database management, authentication, and real-time data synchronization. The platform ensures scalability, data integrity, and secure information handling.

By leveraging real-time communication and location intelligence, the proposed system enhances emergency responsiveness, promotes voluntary blood donation, and contributes to improved healthcare service delivery. The implementation demonstrates how digital transformation in healthcare can create a cost-effective, reliable, and socially impactful solution to address urgent blood supply challenges.

Keywords —Real-Time Blood Demand Tracking; Emergency Aid Management; Blood Emergency Alert System; Voluntary Blood Donation; Location-Based Donor Matching; SMS Notification System; Healthcare Web Application; Firebase Backend; Angular Framework; Emergency Healthcare Technology

\-------------------------------------*************************--------------------------------

I. INTRODUCTION

Blood transfusion plays a vital role in saving human lives during medical emergencies such as road accidents, major surgeries, childbirth complications, trauma cases, cancer treatments, and severe medical conditions like anemia and blood disorders. The availability of the right type

of blood at the right time can mean the difference between life and death. Despite the advancement of healthcare systems, one of the most persistent challenges faced by hospitals and patients is the timely availability of suitable blood donors.

Currently, the process of finding blood donors often depends on hospital blood banks, personal networks, word-of-mouth communication, or social media appeals. While blood banks store blood units, shortages frequently occur due to high demand, limited donor availability, or rare blood group requirements. In emergency situations, patients' families are often forced to search urgently for donors through friends, relatives, or online platforms. This process is not only time-consuming but also emotionally stressful. In some cases, unauthorized intermediaries exploit the urgency by demanding money to arrange donors, leading to ethical concerns and financial burdens on patients' families. instantly with patients in need. As a result, valuable time is lost during critical moments.

To overcome these challenges, this project proposes the development of a **Web-Based Blood Emergency Alert System**. The primary objective of this system is to create a fast, reliable, and transparent platform that directly connects voluntary blood donors with patients and hospitals during emergencies. The system utilizes location-based matching technology to identify nearby eligible donors and sends instant SMS alerts or notifications to inform them about urgent blood requirements. By enabling real-time communication and automated donor filtering based on blood group, availability, and proximity, the system significantly reduces response time.

This proposed solution eliminates the need for intermediaries, ensures ethical practices, and promotes voluntary blood donation within the community. Additionally, it encourages social responsibility by building a strong network of registered donors who can respond promptly to emergency requests. Through digital technology and efficient communication, the Blood Emergency Alert System aims to enhance healthcare support services, improve emergency response efficiency, and ultimately save more lives.

1.LITERATURE REVIEW

Several existing studies and systems focus on improving blood donation management using technology. [1]Some research highlights the use of centralized blood bank databases, while others explore mobile applications and social media platforms for donor communication. GPS-based donor tracking and SMS-based alert systems have also been proposed in earlier works.

However, many existing systems suffer from limitations such as outdated donor information, lack of real-time location matching, dependency on manual coordination, and limited scalability. Some solutions are restricted to specific hospitals or regions, while others involve intermediaries or paid services. These limitations indicate the need for a free, real-time, location-aware, and user-friendly system, which forms the motivation for the proposed Blood Emergency Alert System.

1. World Health Organization – Blood Safety and Availability

This publication by the World Health Organization highlights the global challenges in maintaining adequate and safe blood supplies. It emphasizes the importance of voluntary unpaid blood donation and the need for structured blood management systems. The report supports the necessity of developing technology-driven solutions to improve blood accessibility during emergencies.

2. Mishra et al. – Technology-Based Blood Donation Management Systems

This study analyze existing digital blood donation platforms and identifies their strengths and limitations. It discusses automation, donor registration modules, and notification systems. The paper provides a conceptual foundation for implementing an improved real-time blood alert framework.

3. Gupta & Verma – Web-Based Blood Bank Management System

The authors present a web-based application for managing blood bank inventories and donor records. Their system improves administrative efficiency but lacks real-time emergency communication features. This limitation motivates the development of a more dynamic alert-based system.

4. Smith & Brown – Real-Time Emergency Response Systems

This research focuses on integrating location-based services (LBS) into emergency response systems. The study demonstrates how geographic filtering improves response time, which directly supports the location-based donor matching mechanism in the proposed system.

5. Rahman et al. – SMS-Based Healthcare Alert Systems

The paper explores SMS-based communication frameworks in healthcare applications. It explains how automated alerts enhance response speed in medical emergencies. This reference justifies the integration of SMS notification modules in the proposed project.

6. Kumar & Patel – Geolocation-Based Donor Matching

This study proposes a geolocation filtering algorithm to match blood donors with recipients efficiently. It highlights how distance-based filtering reduces search time and improves donor availability accuracy.

7. Firebase Documentation – Authentication and Firestore

The Firebase documentation provides technical guidance on secure authentication mechanisms and real-time database synchronization. These features support secure donor registration and instant emergency alert updates in the proposed system.

8. Stallings – Web-Based Application Development Principles

This book explains fundamental web application architecture, client-server models, and database integration techniques. It provides the architectural foundation for designing scalable healthcare web applications.

9. Jain & Gupta – Secure Web Architecture for Healthcare

This research emphasizes data privacy, encryption, and secure authentication in healthcare web systems. It underlines the importance of protecting sensitive donor and patient information in digital platforms.

10. Park & Lee – Emergency Medical Information Systems

The authors discuss real-time medical information exchange systems and cloud-based synchronization techniques. Their findings validate the importance of instant data updates in emergency healthcare environments.

11. Mark Lutz – Learning Python

This reference provides comprehensive knowledge of Python programming concepts, including backend logic development and database integration. It forms the programming foundation for implementing the proposed system.

12. Miguel Grinberg – Flask Web Development

This book explains how to build lightweight web applications using the Flask framework. It discusses routing, REST APIs, and database integration, which are essential for implementing the blood emergency alert system.

13. William S. Vincent – Django for Professionals

This reference describes advanced web application development using Django. It explains authentication systems, security practices, and scalable deployment strategies relevant to healthcare applications.

14. Buyya & Dastjerdi – Internet of Things: Principles and Paradigms

The book discusses connected systems and smart healthcare environments. Although focused on IoT, it provides insights into integrating digital technologies to enhance emergency response systems.

15. Tanwar et al. – Blockchain and IoT-Based Healthcare Systems

This study explores secure and decentralized healthcare data management. It highlights the importance of transparency and data integrity in emergency healthcare platforms, which aligns with the goals of the proposed system.

2.ProposedSystem/ Methodology

The proposed system is a web application designed to efficiently manage blood donor information and emergency requests. Voluntary donors register by providing their blood group, location, contact number, and consent to receive SMS alerts. Donors can update their details at any time to ensure data accuracy.

When an emergency blood request is submitted, the system stores the request details and automatically searches for nearby donors with a matching blood group[5]. Eligible donors receive SMS alerts containing the hospital location and requester's contact details. Interested donors can directly contact the requester, ensuring fast and transparent communication. The entire process is automated, secure, and free of cost.

3. work flow Diagram
1.Donor Registration & Login:

Donor provides name, blood group, location, phone number, and consent for SMS. System validates and stores donor details in the database. Donor Profile Update

Donor can update current location, availability, or contact details. - Updated information is saved in the database.

2.Emergency Request Creation:

Requester fills an emergency form with required blood group, hospital name, hospital location, and contact number.

System stores the emergency request and identifies nearby matching donors.
3.Donor Matching & SMS Alert:
System filters donors based on blood group and location.

System sends emergency details (blood group, hospital, contact number) to selected donors via SMS gateway.

4.Donor–Requester Communication:
Donors who are willing to donate directly contact the requester using the shared phone number.
The actual blood donation takes place at the hospital. The DFD clearly shows how user data flows from registration to emergency alert broadcasting and how the system supports a fast and free connection between blood donors and patients
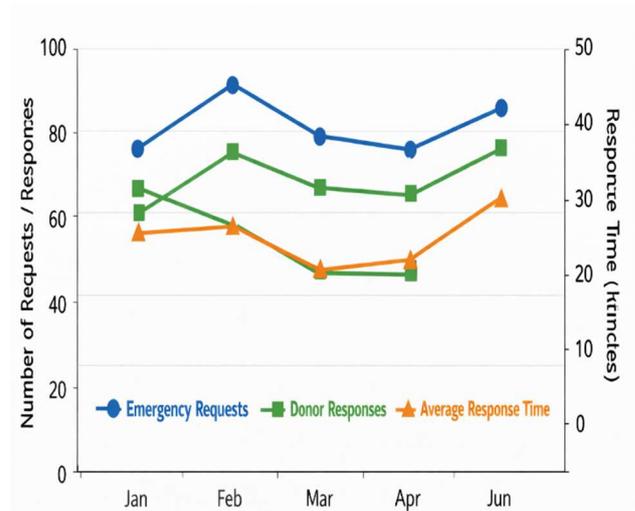

Fig. 1. Comparative line graph showing monthly emergency blood requests, donor responses, and average response time.
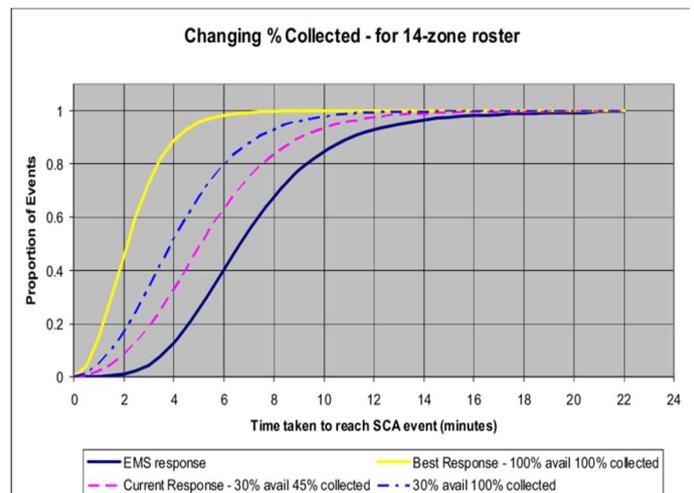

Fig. 1. Comparative line graph showing monthly emergency blood requests, donor responses, and average response time.

Fig. 2 Workflow diagram of the Real-Time Design and Implementation of a Real-Time Blood Demand Tracking and Emergency Aid Management System

4.Applications& Outcomes

Applications

Emergency blood requirement in hospitals Accident and trauma care Maternity and surgical emergency cases Rural and urban healthcare support systems Community blood donation programs

Outcomes
Faster donor identification and response
Reduced dependency on blood banks and intermediaries Improved accuracy through location-based matching
Encouragement of voluntary and ethical blood donation

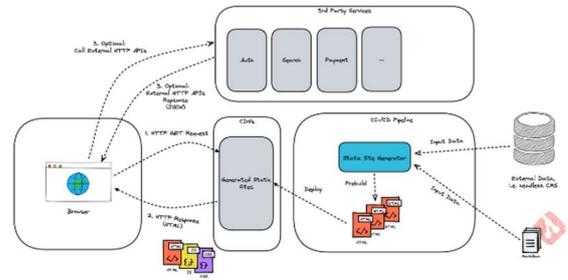Efficient use of technology to save human lives

Fig. 3. System architecture integrating Angular front-end, Firebase backend, and SMS notification module.
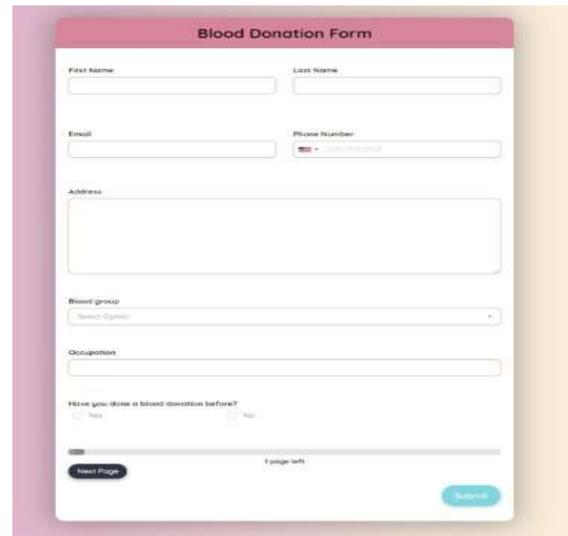

Fig. 4. This figure shows the blood donation registration form interface used for collecting donor personal details and blood group information.
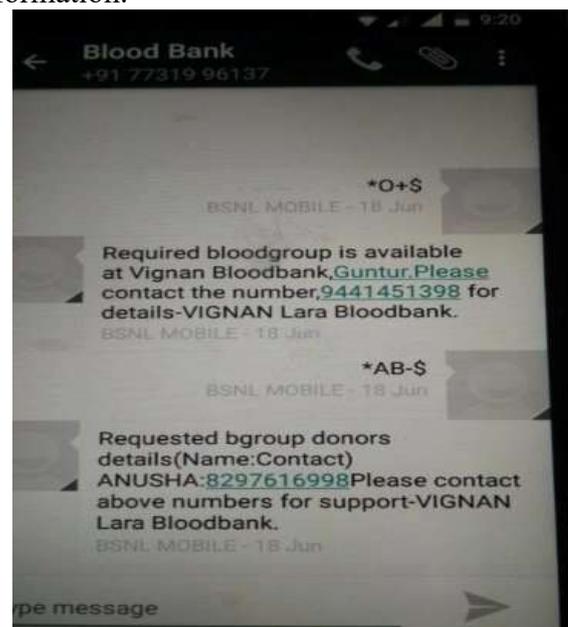
Fig. 5. This figure shows a sample SMS alert message sent to donors containing blood group details and contact information for emergency coordination.

5. Conclusion

The Blood Emergency Alert System provides an effective and ethical solution to the problem of finding blood donors during emergencies. By combining web technology, location-based matching, and SMS alerts, the system ensures quick and direct communication between donors and patients. The removal of intermediaries and free access makes the platform transparent and trustworthy. This system has strong potential to improve emergency healthcare services and save lives.

6. References

1. World Health Organization, *Blood Safety and Availability*, WHO Publications, Geneva, 2023.
2. S. K. Mishra, R. Singh, and A. Sharma, "Technology-Based Blood Donation Management Systems: A Review," *International Journal of Healthcare Information Systems*, vol. 8, no. 2, pp. 45–53, 2021.
3. A. Gupta and P. Verma, "Design and Development of a Web-Based Blood Bank Management System," *International Journal of Computer Applications*, vol. 179, no. 12, pp. 22–27, 2018.
4. J. Smith and L. Brown, "Real-Time Emergency Response Systems Using Location-Based Services," *Journal of Medical Systems*, vol. 44, no. 5, pp. 1–10, 2020.
5. M. Rahman, T. Islam, and S. Uddin, "Mobile and SMS-Based Healthcare Alert Systems: Architecture and Implementation," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 3, pp. 112–118, 2020.
6. P. Kumar and D. Patel, "Geolocation-Based Donor Matching Framework for Emergency Blood Requirements," *International Journal of Information Technology*, vol. 13, no. 4, pp. 1567–1575, 2021.
7. Firebase, *Firebase Authentication and Cloud Firestore Documentation*, Google Developers, 2023.
8. W. Stallings, *Web-Based Application Development Principles*, Pearson Education, 2019.
9. A. K. Jain and B. Gupta, "Secure Web Application Architecture for Healthcare Systems," *IEEE Access*, vol. 8, pp. 135782–135795, 2020.
10. K. S. Park and H. Lee, "Emergency Medical Information Systems and Real-Time Data Synchronization," *Health Informatics Journal*, vol. 26, no. 1, pp. 389–402, 2020.
11. M. Lutz, *Learning Python*, 5th ed., O'Reilly Media, 2018.
12. A. Grinberg, *Flask Web Development: Developing Web Applications with Python*, 2nd ed., O'Reilly Media, 2018.
13. W. S. Vincent, *Django for Professionals: Production Websites with Python & Django*, Welcome To Code, 2021.
14. R. Buyya and A. V. Dastjerdi, *Internet of Things: Principles and Paradigms*, Morgan Kaufmann, 2016.
15. S. C. Tanwar, N. Kumar, and J. J. Rodrigues, "Blockchain and IoT-Based Healthcare Systems for Emergency Management," *Future Generation Computer Systems*, vol. 100, pp. 555–565, 2019.