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Web-Based Blood Bank Application

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***Abstract:** The need for efficient blood management systems has increased significantly due to rising medical emergencies and demand for real-time blood availability. This paper presents the design, implementation, and performance evaluation of a scalable web-based blood bank management system developed using React.js, Spring Boot, and MySQL. The system provides real-time donor-recipient matching, secure authentication using JWT, and optimized data handling through REST APIs. Advanced features such as location-based search, responsive user interface, and efficient inventory tracking are implemented. Performance evaluation shows reduced response time, high throughput, and system reliability. The proposed system significantly enhances traditional blood bank operations and contributes to improved healthcare delivery.*

I. INTRODUCTION

Blood is a critical resource in healthcare systems, especially during emergencies such as accidents, surgeries, and natural disasters. Traditional blood bank systems rely heavily on manual processes, which result in delays, inefficiencies, and lack of real-time communication. To overcome these challenges, this research focuses on implementing a web-based blood bank system that provides a centralized digital platform connecting donors, recipients, and blood banks. The timely availability of blood without any hustle can be the difference between life and death in medical emergencies. However, traditional blood bank management systems are often plagued by inefficiencies such as delays in donor recipient matching, outdated inventories, and lack of coordination among hospitals and blood banks. In rural area this is the biggest problem ever. With the advent of internet technologies, web-based applications have emerged as powerful tools to improve healthcare systems by enhancing accessibility, real-time communication, and data management. A web-based blood bank application is designed to connect donors, recipients, and blood banks in a centralized manner, easily accessible platform. This research explores the development, benefits, and implementation challenges of such a system. With the rise of the internet in the 1990s and the growth of web development technologies in the 2000s, web-based systems started replacing traditional models. In recent years, many countries have begun adopting digital blood bank management systems, and public awareness. After the development of web-based application the percentage of death due to blood is decreased .Web-based applications have the potential to stable the condition of blood and donor unavailability. From this blood bank application finding of donor and blood banks and the interaction between donor, blood bank and the blood recipient is much more efficient.

II. RELATED WORK

The related work includes all the necessary information, working pattern, blood storage management, new lab technologies in blood testing, blood donor data, updating databases, updating servers, user interface updates, admin interface update, blood bank data and location upcoming events , blood request, recipient data are some crucial related work of web based blood bank Application. The emergence of this web based application plays a crucial role in medical and healthcare field. It's made a bridging between the donor, blood bank, recipients and hospitals. One can easily access the application and found the blood on time which in needed. This application brings a boost in blood donation activity and awareness among people to donate blood periodically. Despite these efforts, many existing systems suffer from limitations such as lack of interoperability, poor user interfaces, limited real-time integration with blood banks, or insufficient emphasis on data security and user privacy. Many systems and application has facing the insecurity between the donors and recipient and also having the issues of their personal data. Furthermore, few systems offer features such as automated matching of blood types between donors and recipients, geolocation-based donor discovery, or mobile-responsive interfaces for wider accessibility. In contrast, the proposed system aims to overcome these challenges by implementing a responsive web application with a user-friendly interface, real-time blood inventory updates, secure login mechanisms, and a donor-receiver matching algorithm based on location and blood type. This solution not only facilitates efficient communication between donors, hospitals, and blood banks but also enhances the visibility and accessibility of blood donation services. Because of this web-based blood bank application it is very easy to find the specific blood on time without any hustle.

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Several studies have proposed digital solutions for blood bank management. However, existing systems suffer from limitations such as lack of real-time updates, poor user interfaces, and weak data security.

The proposed system addresses these gaps by providing a secure, scalable, and real-time web-based solution.

The main contributions of this research are Real-time donor-recipient matching using location and blood group, Secure authentication using JWT, REST API-based architecture, Improved response time and system efficiency and User-friendly interface for donors and recipients.

III.SYSTEM ARCHITECTURE AND METHODOLOGY

The proposed system follows a client–server architecture implemented as a web-based application, emphasizing modularity, usability, and secure data management. The design ensures that user interaction, data processing through APIs are handled through distinct layers, thereby maintaining scalability and data integrity. The Various APIs are used to sign-up, log-in, to put data, to get donors data, to find all the registered donors, to delete the donors and so on from the database. The various tasks are performed by the APIs created in the backend programming which is the backbone of the entire application which is connected to the frontend and to the database. Client can easily and flexibly handle the user interface from which they put and get the desire data all these tasks are performed by the backend which is routed to the frontend application. The user-interface is also being flexible to use and handle. The same interface is visible to all the clients or donors. This is the one page application which work is components for better and fast access.

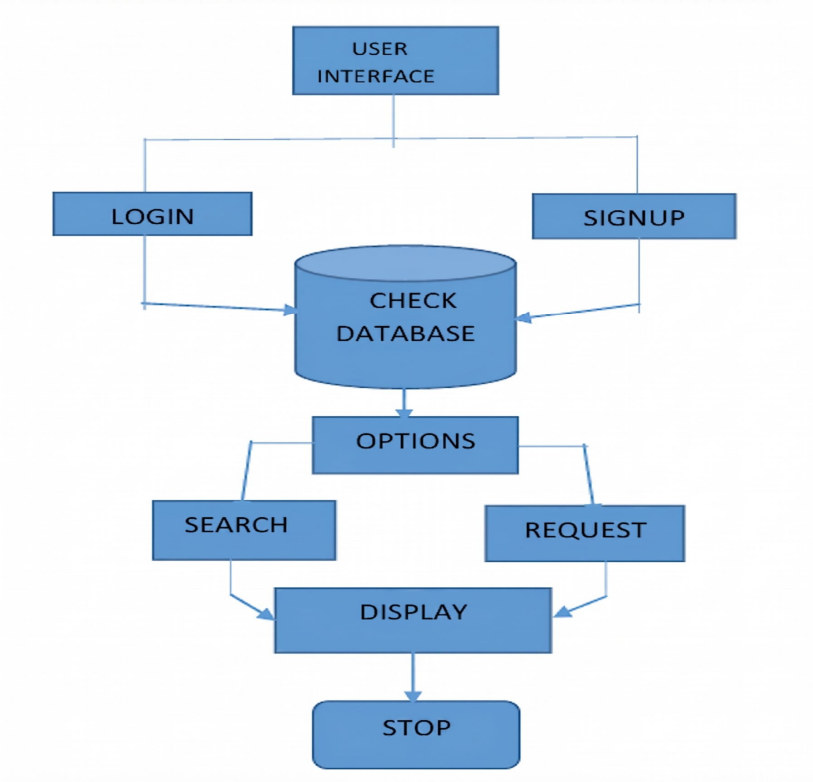


Figure 1: Architecture of the web based blood bank application.

1) Data Input: Users interact with a web interface to provide relevant blood information. This can be achieved either by completing a online sign-up form by giving all the necessary data and report of blood group and major test including Gmail, contact no. and residential address.

2) Backend Processing: Upon submission, the input data is securely transmitted to the backend via encrypted communication channels. The backend server includes a dedicated API endpoint capable of handling multipart form data, effectively managing both textual and image-based inputs.

3) Inference: The request of the specific blood group is sent to the database and user got all the detail of donor and blood bank too. One can do direct interaction with the donor to because the data base holds the contact information of the donor.

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4) Specification: All this accessed through a secure API. The application natively supports the entire API With JWT (JSON WEB TOKEN) which provide authentication and authorization which makes the data secure.

5) Output Delivery: After searching for the specific blood group the donor list will appear on screen with all the necessary details from which recipient can contact directly or by make contact through blood bank.

6) Backend Development The backend infrastructure was implemented using JAVA in conjunction with the Spring boot framework, providing a lightweight yet robust environment optimized for scalability and efficient request handling. A single Restful API endpoint, /analyses, manages all incoming client requests, ensuring a streamlined communication flow between the frontend and backend. Sign-up Form uploads are processed using the Restful API which facilitates handling of multipart/form data requests and supports.

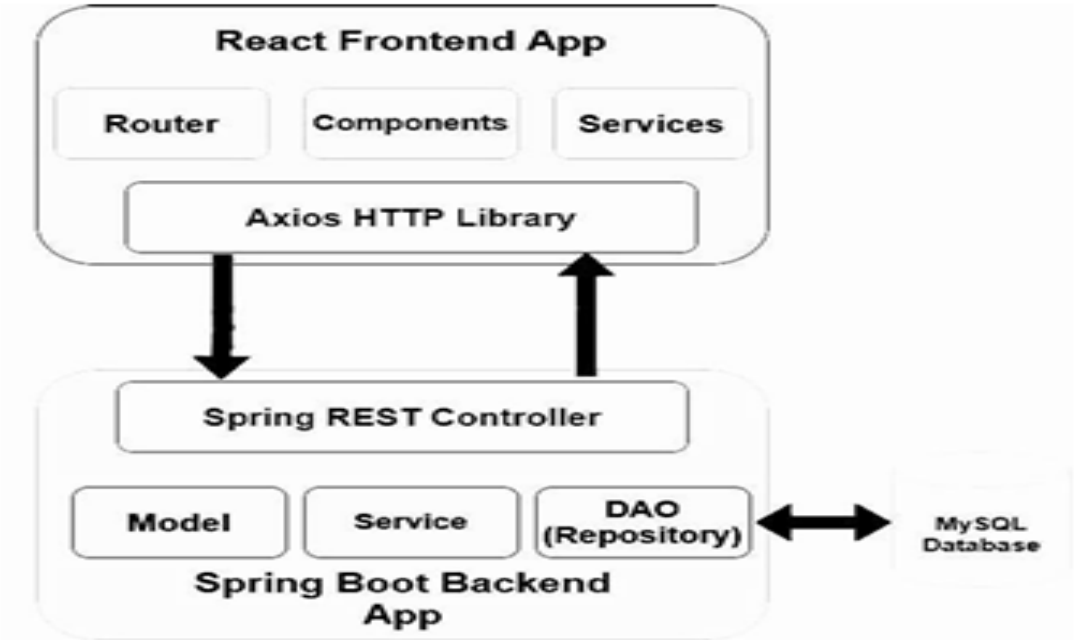


Figure 2: Data flow and showing connection of React Frontend App with Spring Boot Backend App and My SQL Database.

7) Frontend Development The frontend is designed as a minimalist single-page application (SPA) built with standard React application, CSS, JavaScript prioritizing performance and accessibility. A dark themed visual design was adopted to reduce eye strain and align with contemporary web aesthetics. The interface organizes user interactions into distinct sections for manual data entry and file uploads, promoting clarity and ease of use. Backend communication is handled asynchronously via the fetch API, enabling non-blocking requests and real-time feedback. During model inference, a dynamic loading indicator provides progress visibility, and upon completion, the interface displays secure download links for the generated reports—all without requiring a page reload, thereby enhancing user experience and responsiveness.

8) Data Flow and Security Once data submission occurs, the data is submitted in the JSON format but in MySQL database all the register user data are stored in table format. Before submitting the data server hold the data for a specific period and send it to database with the help of API which are created in backend. It extracted data from the server, effectively safeguarding patient privacy and ensuring compliance with secure data management practices.

IV. RESULT

The development and the implementation of the web-based blood bank application were successfully completed the system was tested for functionality, usability and performance. The results demonstrate the system's ability to meet the objectives outlined in the research. The various test are done before it as functional testing as user registration/login, donor management, search and request blood group, admin panel. A usability test was also conducted with some donor recipients and admin. A performance evaluation is also done which is based on system response time and load testing, response time and uptime. As per we discuss in the abstract and introduction the same result we got after research and developing the web based blood bank application.

1) Response Time: The duration between a user's request (e.g., searching for O-negative blood) and the system displaying the results. In optimized systems, this is typically under 2–3 seconds.
2) Throughput: The number of concurrent users the application can handle. High-performance systems are designed to support hundreds of simultaneous requests without a drop in speed, especially during local disasters or emergencies.
3) Data Integrity: Ensuring that the blood stock count is updated instantly ($real-time$) without errors. If 1 unit is issued, the database must reflect this immediately to prevent double-booking.
4) Resource Utilization: How efficiently the system uses CPU and Memory. A well-designed application should maintain low server overhead to ensure 24/7 availability.
5) The implemented system shows: Faster donor search, Improved user experience, Real-time updates and reduced manual workload

V. CONCLUSIONS

This study presented a proof-of-concept that web-based blood bank application designed to support and play vital role in medical and healthcare. This research presented the design, development, and evaluation of a web- based blood bank application aimed at enhancing the efficiency, transparency, and accessibility of blood donation and distribution services. The system successfully addressed key challenges in traditional blood bank management, such as delayed request processing, lack of real-time inventory tracking, and limited donor engagement. By developing this web-based application the founding of donor, blood bank is very convenient. The development of this web-based blood bank application successfully demonstrates the integration of a modern React.js frontend with a robust Java (Spring Boot) backend to solve the critical challenges of traditional blood management. By transitioning from manual record keeping to an automated digital ecosystem, this system significantly reduces the "search-to-delivery" time, which is paramount during medical emergencies. In conclusion, the 6. REFERENCES p-ISSN: 2395-0072 [1] S. Maturkar, "Blood Bank Management System," International Research Journal of Engineering and Technology (IRJET), vol. 7, no. 9, pp. 361-365, Sep. 2020. [Online]. Available: www.irjet.net. [2] R. R. Mahalle and S. S. Thorat, "Smart Blood Bank Based on IoT: A Review," International Research Journal of Engineering and Technology (IRJET), vol. 5, no. 1, pp. 101 105, Jan. 2018. [3] A. Khan et al., "Scalable Blood Requirement Analysis System," International Research Journal of Engineering and Technology (IRJET), vol. 7, no. 5, pp. 2966-2970, May 2020. proposed system is not merely a database management tool but a life-saving digital intervention. It optimizes the blood supply chain, enhances donor engagement through a user friendly interface, and provides a scalable framework that can be integrated with national healthcare registries. Future enhancements could include the integration of AI-based demand forecasting and GPS-enabled real-time donor tracking to further refine the efficiency of emergency responses.

VI. ACKNOWLEDGMENT

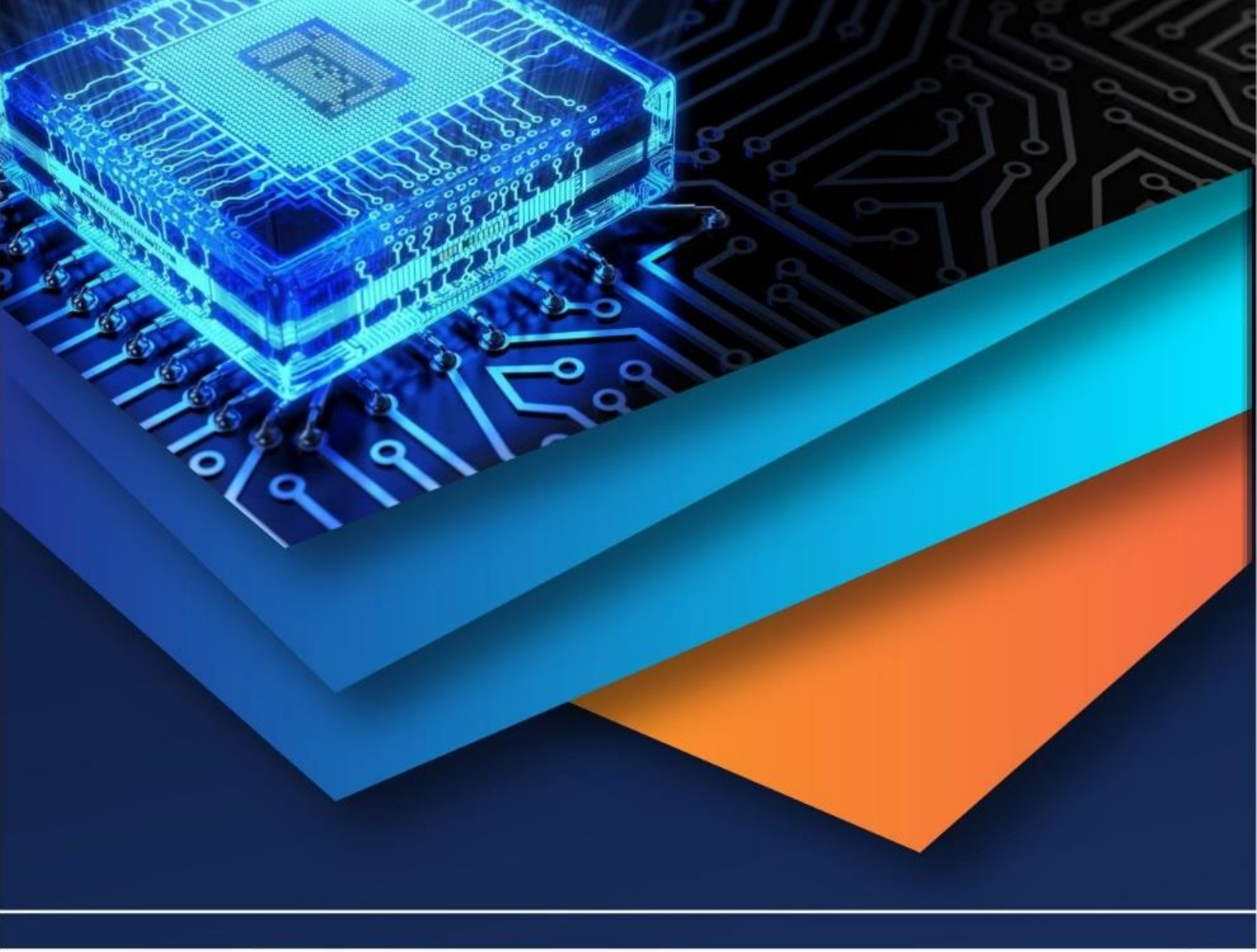
We would like to express our sincere gratitude to our respected guide Dr. Sushma Telrandhe for her continuous support, valuable guidance, and encouragement throughout the development and implementation of this research work. Her insightful suggestions and expertise greatly contributed to the successful completion of this project.We are also thankful to the Department of Computer Science and Engineering, Guru Nanak College of Engineering and Technology, Nagpur, for providing the necessary resources and academic environment to carry out this research.We extend our appreciation to all faculty members and our colleagues for their support and constructive feedback during the course of this work.Finally, we would like to thank our family and friends for their constant motivation and support, which helped us complete this research successfully.

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