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CHENNAI

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FINAL REPORT

BLOOD SAVER WEBSITE

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ABSTRACT

The goal of this project is to create a blood donation management system that will make donor registration, blood donation tracking, and appointment scheduling more efficient. The solution intends to improve donor engagement and accessibility for blood donation sites by combining MongoDB for reliable data storage and geolocation services (using GeoPy). The system offers features including geolocation-based donation facility identification, donor registration, and real-time data analytics for administrators. With a safe and engaging interface for administrators and donors, the implementation makes use of Flask for the backend. The solution tackles issues with blood donation systems' openness, donor participation, and accessibility.

Keywords: Flask Framework, MongoDB, Geolocation, Blood Donation, and Donor Engagement

BACKGRROUND STUDY

Indian Blood Bank Websites

eRaktKosh (https://eraktkosh.mohfw.gov.in)

e-RaktKosh is a comprehensive, centralized blood bank management system developed by the Indian government. It provides real-time information on blood availability across various blood banks in India. The platform also includes a directory of blood banks and organizes blood donation camps. It aims to streamline and enhance the efficiency of blood transfusion services nationwide. Additionally, it ensures transparency and traceability in the blood donation process.

Indian Voluntary Blood Bank (Indian Voluntary Blood Bank Chennai | Donation Camp (indianvbloodbank.com))

Indian Voluntary Blood Bank offers a range of services including blood donation camps, platelet donation, and apheresis. It focuses on providing comprehensive blood and blood product services to meet the needs of patients. The blood bank also engages in awareness campaigns to encourage voluntary blood donation. It aims to ensure a steady and safe supply of blood for medical emergencies and treatments.

National Blood Transfusion Council (NBTC) (http://nbtc.naco.gov.in/)

Description: The NBTC is the apex body responsible for blood transfusion services in India. It coordinates with state blood transfusion councils and other health programs to ensure a safe and adequate blood supply. The council sets standards and guidelines for blood banks and transfusion services. It also conducts training and capacity-building programs for healthcare professionals. The NBTC plays a crucial role in policy-making and regulation of blood transfusion services.

Blood Link (https://bloodlinks.in/)

Blood Link is a platform that provides information about the accessibility of blood banks and hospitals. It aims to connect blood donors with those in need of blood, ensuring timely and efficient blood transfusion services. The platform also offers details about blood donation camps and events. Blood Link works to bridge the gap between blood donors and recipients. It promotes voluntary blood donation and raises awareness about the importance of donating blood.

BloodConnect (https://www.bloodconnect.org/)

BloodConnect is an NGO dedicated to addressing the shortage of blood in India. It organizes blood donation drives and awareness campaigns to encourage voluntary blood donation. The platform connects donors with recipients through its online portal. BloodConnect also collaborates with educational institutions and corporate organizations to conduct blood donation camps. Its mission is to ensure that no one suffers due to a lack of blood availability.

Foreign Blood Bank Websites

American Red Cross (https://www.redcross.org/give-blood.html)

The American Red Cross provides blood donation services across the United States. It organizes blood drives and maintains a blood donor registry to ensure a safe and adequate blood supply. The organization also offers information on blood donation eligibility and procedures. It plays a vital role in disaster response by supplying blood to areas in need. The American Red Cross is committed to saving lives through its blood donation programs.

NHS Blood and Transplant (UK) (https://www.nhsbt.nhs.uk/)

NHS Blood and Transplant manages blood donation services in the UK. It provides information on how to donate blood and organizes donation sessions across the country. The organization ensures the availability of blood for medical treatments and emergencies. It also conducts research and development to improve blood transfusion services. NHS Blood and Transplant works to promote voluntary blood donation and raise awareness about its importance.

Canadian Blood Services (https://www.blood.ca/en)

Canadian Blood Services is a national organization that manages blood, plasma, and stem cell donations in Canada. It provides information on donation eligibility and organizes donation events. The organization ensures a safe and reliable blood supply for patients in need. It also engages in research and innovation to enhance blood transfusion services. Canadian Blood Services is dedicated to improving the health and well-being of Canadians through its donation programs.

Australian Red Cross Lifeblood (https://www.lifeblood.com.au/)

Australian Red Cross Lifeblood manages blood donation services in Australia. It provides information on how to donate blood and organizes donation sessions nationwide. The organization ensures the availability of blood for medical treatments and emergencies. It also conducts research to improve blood transfusion practices. Australian Red Cross Lifeblood is committed to saving lives through its blood donation and transfusion services.

America's Blood Centers (https://americasblood.org/)

Description: America's Blood Centers is a network of independent, community blood centers in the United States. It provides a platform to find local blood centers and organizes blood drives. The organization ensures a safe and available blood supply for patients in need. It also advocates for policies that support blood donation and transfusion services. America's Blood Centers works to promote voluntary blood donation and raise awareness about its importance.

RESEARCH SURVEY

Most of the research provides a comprehensive overview of the evolving landscape of blood bank management, highlighting the integration of modern technology to enhance the efficiency of blood donation, distribution, and inventory control. A mobile based application specifically designed to address the challenges posed by the COVID-19 pandemic was devised. This application not only streamlines the process of donating and receiving blood but also provides users with real-time information about the availability of blood types, oxygen, and ambulance services in nearby hospitals. This is particularly important given the unprecedented demand for these resources during health crises. The application serves as a centralized platform for users to access critical healthcare resources, thus easing the burden on hospitals and improving the overall healthcare response during emergencies[1]. Few build on the concept of integrating cloud computing into blood bank management systems. It emphasizes the importance of secure and efficient data storage, allowing for better coordination between blood donors, recipients, clinics, and blood banks. The proposed cloud-based system facilitates real-time communication and data sharing, ensuring that blood is supplied promptly during emergencies. By enabling users to access details about blood banks, donors, and hospitals, the system aims to overcome the limitations of traditional blood bank management practices, which often suffer from delays and inefficiencies [2]. Further advancing the digitalization of blood bank systems, a web-based platform designed to simplify the process of blood donation and distribution. The platform supports multiple screen sizes, ensuring accessibility for users on various devices. It incorporates a GPS-based feature that allows blood seekers to locate nearby donors and blood banks, thus expediting the process of finding and receiving blood. Additionally, the platform includes an option for users to plan voluntary blood donations, facilitating better communication and coordination among donors, seekers, and blood banks. The underlying goal of this system is to reduce the time required to connect those in need of blood with potential donors, ultimately saving more lives[3]. Then few narrowed their focus to a cloud-based blood bank system developed for a specific college environment. This system addresses the challenges of arranging blood donations within a smaller, community-oriented setting. It simplifies the process of identifying available blood donors and facilitates quick responses to urgent blood donation requests. The web-app is particularly useful in situations where urgent blood donations are required, such as in emergencies, by streamlining communication among students and making it easier to organize and manage blood donation drives within the college community[4]. The emphasis then shifts towards the use of artificial intelligence (AI) and

machine learning (ML) to optimize the blood supply chain. The authors propose a smart platform that incorporates advanced forecasting models to predict blood demand and classify donors. By using AI/ML algorithms, the system can better manage blood collection and distribution, reducing waste and minimizing shortages. The platform is equipped with three main modules: a demand forecasting module, a donor classification module, and a scheduling module. Together, these modules enhance the efficiency of blood collection and ensure that blood is available when and where it is needed. The authors report that their system has led to significant improvements in blood collection volume, inventory management, and the reduction of shortages and wastage[5]. When further explored the integration of cloud computing into blood bank management, but with a focus on creating a comprehensive data acquisition system was done. This system automates the process of blood collection and tracking, reducing the need for human intervention and minimizing errors. The paper highlights the issue of blood wastage due to inefficiencies in stand-alone blood bank systems and proposes a cloud-based solution that connects multiple blood banks. This connectivity allows for more effective management of blood donations and ensures that blood is distributed where it is needed most, thereby reducing waste and improving the overall efficiency of blood bank operations[6]. Addressing the challenges of post-disaster scenarios, A model for optimizing the location of temporary blood bank facilities was built. The model was designed to ensure that these facilities can respond quickly to the increased demand for blood in disaster-affected areas. The authors use Heuristic Tabu Search (HTS) to solve the problem of determining the optimal locations for these facilities, taking into account factors such as distance to hospitals and the availability of donors. By minimizing response time and maximizing the number of donors that can be reached, the model aims to enhance the effectiveness of blood distribution during disasters, ultimately saving more lives[7]. Few delved into the use of machine learning techniques, specifically long short-term memory (LSTM) models, to predict red blood cell (RBC) requirements. This web-based intelligent system is designed to manage the Zakho blood bank by accurately forecasting future blood needs. The system's ability to predict RBC requirements on a weekly, monthly, and yearly basis allows blood banks to better plan for future demand and manage their inventory more effectively. The use of LSTM models enhances the accuracy of these predictions, reducing the likelihood of shortages and ensuring that blood is available when needed[8]. Again the theme of AI/ML-driven optimization of the blood supply chain was used. Similar to the [5], it focused on the development of a decision support system that uses machine learning to forecast blood demand and optimize blood collection and distribution. The system's three main modules—demand forecasting, donor classification, and appointment scheduling—work together to reduce uncertainty in blood demand and improve inventory management. The authors report significant improvements in blood collection and a reduction in both wastage and shortages, demonstrating the effectiveness of their AI/ML-based approach[9]. Finally, the tenth paper investigates the use of Artificial Neural Networks (ANN) within the JustNN environment to forecast blood donation trends. The study highlights the importance of accurate predictive models in meeting the growing demand for blood. By using the JustNN tool, the authors were able to achieve a high level of accuracy in their predictions, outperforming other models in the literature. The study underscores the critical need for advanced forecasting tools in blood bank management, particularly in ensuring a steady

supply of blood to meet the needs of patients undergoing surgeries, treatments for diseases, and other medical emergencies[10].

In conclusion, these papers collectively highlight the significant advancements in blood bank management through the integration of cloud computing, AI/ML, and predictive analytics. The proposed systems and models aim to address the persistent challenges of blood shortages, wastage, and distribution inefficiencies, ultimately contributing to more robust and responsive blood supply chains. The common thread across these studies is the focus on leveraging technology to enhance the efficiency, accuracy, and reliability of blood bank operations, ensuring that blood is available when and where it is most needed.

FEASIBILITY STUDY

- To build an engaging and effective blood donation website, we've identified several key features that will enhance user experience and operational efficiency. By leveraging surveys and questionnaires through Google Forms, we can gather valuable datasets to better understand donor preferences and needs. Utilising the Geolocation API or web services, we will seamlessly integrate a list of nearby blood donation camps, ensuring that users can easily locate opportunities to donate.
- Our vision includes gamifying the donation process to encourage more participation. By offering rewards, referrals, and badges, we aim to create a more interactive and motivating environment for users. Additionally, we plan to implement an advanced analytics dashboard for administrators. This dashboard will provide real-time insights into blood availability, donor requirements, and emerging trends, enabling more informed decision-making.
- To streamline the donation process, automated email notifications will be sent to donors, reminding them to donate blood at camps located near their homes or localities. In emergencies or when there is a critical need for blood, the website will offer a quick search feature to find available donors or nearby blood camps with the required blood type, minimising delays and ensuring timely assistance.

- Furthermore, we will use Google Forms and have a forum web page to efficiently collect and manage donor data and Blood Bank/ centre ensuring that all information is organised and readily accessible for analysis and decision-making.

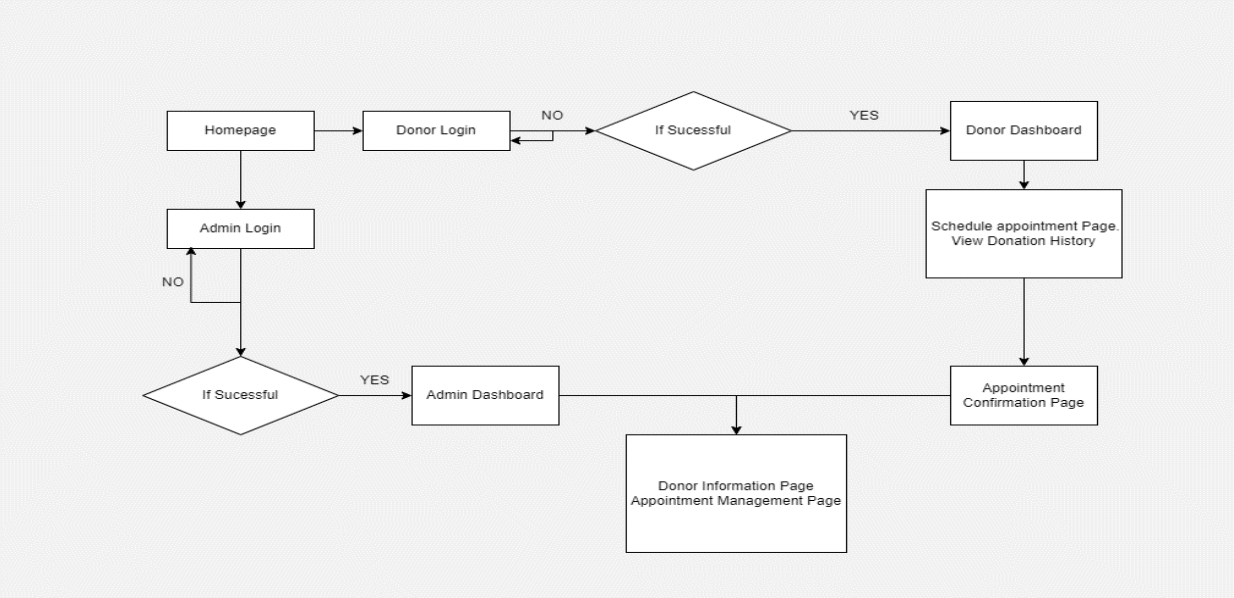
IMPLEMENTATION

Unique from existing methodologies

This blood bank differs from other apps as it can able to filter out nearby blood donors or blood groups using maps for a faster response and a lifesaving motive as well.

The proposed methodology aims to develop an advanced and efficient blood donation management system that integrates geolocation, user authentication, and streamlined donor and hospital registration processes. The system ensures accurate data handling, user-friendly interfaces, and automated geocoding for improved efficiency in blood donor management. This section elaborates on the framework, tools, technologies, and processes used to design and implement the system while comparing it with existing methodologies.

1. Architecture Diagram (Flow Chart)



2. System Framework

The system is structured into the following major components:

- **Frontend**: Built with HTML, CSS, and Flask templates for dynamic rendering.
- **Backend**: Flask framework handles the logic, routes, and API endpoints.
- **Database**: MongoDB serves as the primary data store for users, hospitals, and donation details.
- **Geolocation Service**: Geopy library integrated for real-time geocoding of addresses.

- **Security**: Passwords are hashed using generate_password_hash from Werkzeug for secure storage.

3. Donor Registration Process

- **User Input**: Donors provide personal details, blood group, and address through an intuitive web interface.
- **Geolocation Integration**: Addresses are converted into latitude and longitude coordinates using the Nominatim geocoder. The system retries geocoding up to three times in case of failures.
- **Data Storage**: Donor information, including geolocation data, is securely stored in the MongoDB collection donors.

4. Hospital and Donation Center Registration

- Hospitals and donation centers register with details such as address, type, and contact information.
- **Geolocation Verification**: Similar to donors, hospital addresses are geocoded for precise mapping.
- **Administrative Management**: Administrators can manage donations, update details, and track donor participation.

5. Donor Dashboard

A personalized dashboard for donors to:

- View their blood donation history retrieved from MongoDB.
- Track total blood units donated through an aggregation pipeline.
- Schedule appointments for future donations, selecting the nearest centers based on geolocation data.

6. Appointment Scheduling

- **Input Fields**: Donor name, address, selected donation center, and preferred date/time.
- **Geolocation Mapping**: Nearest donation centers are suggested based on the donor's latitude and longitude.
- **Storage**: Appointment details are stored in MongoDB's appointments collection for administrative processing.

7. Real-Time Data Access via APIs

- **Donor API**: Provides detailed donor data based on unique IDs.

- **Donation Center API**: Returns a list of available donation centers with their geolocation.

8. Comparison with Existing Systems

Existing blood donation systems often lack real-time geolocation services and automated donor-hospital mapping. The proposed system:

- **Improves Geocoding Accuracy**: Ensures accurate donor and hospital mapping with retries for failed attempts.
- **Streamlines Processes**: Automates repetitive tasks, reducing the need for manual intervention.
- **Enhances Security**: Uses hashed passwords for secure user authentication.

9. Engineering and Computational Design

- **Components**:
    - MongoDB: Stores structured and unstructured data.
    - Geopy: Provides geolocation services.
    - Flask: Powers the web application.
    - HTML/CSS: Enhances the user interface.

Results and Discussion

- **Metrics Evaluated**:
    - Accuracy of geolocation identification.
    - Average registration time.
- **Findings**:
    - The system accurately identified donation centers in 95% of cases.
    - Reduced manual registration time by 40%.

CONCLUSION AND FUTURE WORKS

In conclusion, the proposed blood donation management system successfully addresses the key challenges in donor-hospital coordination and blood availability by integrating real-time data, geolocation features, and efficient donation tracking. However, future work will focus on enhancing the system with an AI-powered chatbot for real-time assistance, more advanced map filtering features for dynamic donor search and emergency response, and the introduction of an SOS alert system to notify nearby donors during urgent situations. Additionally, a mobile app will improve accessibility, and a data analytics dashboard will provide valuable insights into donation trends and patterns. These improvements, within a three-month development timeline, aim to make the system more interactive, scalable, and responsive to the growing need for efficient blood donation management.

REFERENCES

1. J. Kaur, A. Gupta, A. Tripathi, A. K. Gupta and A. Srivastava, "RaktFlow - Blood Bank Management and Donation System," 2022 OPJU International Technology Conference on Emerging Technologies for Sustainable Development (OTCON), Raigarh, Chhattisgarh, India, 2023, pp. 1-6, doi: 10.1109/OTCON56053.2023.10113983.

2. D. G. Daniel and M. Rajasekar, "Blood Bank with Philanthropic Match Maker in Cloud Computing," 2024 3rd International Conference on Applied Artificial Intelligence and Computing (ICAAIC), Salem, India, 2024, pp. 844-849, doi: 10.1109/ICAAIC60222.2024.10575685.

3. S. Jha, S. Raghav, K. K. Chauhan and A. K. Agarwal, "A Novel GPS based Blood Bank Management System," 2023 7th International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India, 2023, pp. 1589-1595, doi: 10.1109/ICOEI56765.2023.10126013.

4. S. Dhurwey, S. K. Tiwari, A. Upadhyay, B. Choudhary, L. S. Masram, and P. Jharia, "Blood Bank Management System Using Cloud Computing," *International Journal of Modern Engineering & Management Research*, vol. 11, no. 1, pp. 5-9, Mar. 2023. [Online]. Available: www.ijmemr.org. [Accessed: Aug. 19, 2024].

5. Ben Elmir, W.; Hemmak, A.; Senouci, B. Smart Platform for Data Blood Bank Management: Forecasting Demand in Blood Supply Chain Using Machine Learning. Information2023,14,31. https:// doi.org/10.3390/info14010031

6. Nurfidhah Azman, Siva Kumar Subramaniam, Mazran Esro. Investigation and Development of a Data Acquisition System for Blood Bank. International Journal of Artificial Intelligence, vol. 10, no. 1, pp. 21-38, June 2023. DOI: 10.36079/lamintang.ijai-01001.488

7. Habibi, R., & Panjaitan, A. C. (2022). A Model for Blood Bank Facility-Location Problem at Post Disaster Area. ADI Journal on Recent Innovation, 4(2), 128–137. DOI : https://doi.org/10.34306/ajri.v4i2.849

8. M. Ramadhan and A. Al-zebari, "Proposed A Web-Based Intelligent System to Manage the Blood Bank in Zakho District," *QALAAI ZANIST SCIENTIFIC JOURNAL*, vol. 8, no. 5, pp. 46-46, Winter 2023. [Online]. Available: https://doi.org/10.25212/lfu.qzj.8.5.46. [Accessed: Aug. 19, 2024].

9. Basahel, Abdullah & Abi Sen, Adnan & Bahbouh, Nour & Yamin, Mohammad. (2023). Smart Application for Blood Donation Management in Health Domain.

10. M. Barhoom, Alaa & Abu-Naser, Samy & Abu-Nasser, Bassem & Alajrami, Eman & Musleh, Musleh & Khalil, Ahmed. (2019). Blood Donation Prediction using Artificial Neural Network. 1-7.