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Development of a System for the Central Blood Bank

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ABSTRACT

Demand for access to information about the blood bank management system is rising day by day due to the growing demands for blood. The traditional system alone cannot help in facilitating the needs of the community at large and may result in critical delays in responding to emergencies. To handle this problem, an integrated blood bank management system has been developed based on a comprehensive and updated database. This system will allow users to get immediate results or lists compiled according to their specific criteria, such as geographic location and blood type, to manage inventories, donations, and campaigns. These efforts are geared to raise the need for blood donation and allow the community to participate in donation campaigns, creating better social cohesion and humanitarian consciousness. Through such donations, people can become heroes by saving the lives of others; hence, these activities are of essence in enhancing community interaction. It can locate blood bags, and when a patient requiring blood units arrives, the system will be linked to a search page where they can view the available donors. In addition, when a donor enters the site, their information is captured and analyzed instantly to come up with potential donors regarding age and disease-free body conditions The research will help improve the management of blood banks by adopting modern technologies, such as MySQL for data storage and HTML5, CSS, and JavaScript for web development. This enhances the efficiency of the system and ensures that critical information is accessed quickly and accurately. Hopefully, this will improve users' experiences and enhance the sustainability of blood supplies in the community.

Keywords: Blood donation, donor recruitment, donor database, blood type matching, emergency response.

تطوير نظام لمصرف الدم المركزي

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ملخـــــص البحـــــث

أصبح الوصول إلى معلومات دقيقة حول نظام إدارة بنوك الدم أكثر أهمية في ظل الحاجة المتزايدة للدم. في هذا السياق، لا تكفي الأنظمة التقليدية بمفردها لتلبية احتياجات المجتمع. إن نقص المعلومات الدقيقة حول موقع المتبرعين وأنواع الدم المتاحة يمكن أن يؤدي إلى تأخيرات خطيرة في الاستجابة للحالات الطارئة. لمعالجة هذه المشكلة، تم تطوير نظام لإدارة بنوك الدم يعتمد على قاعدة بيانات شاملة ومحدثة بانتظام. يتيح هذا النظام للمستخدمين الحصول على نتائج فورية أو قوائم مخصصة بناءً على معايير محددة، مثل الموقع الجغرافي ونوع الدم، مما يسهل إدارة المخزون والتبرعات وتنظيم الحملات. تسعى هذه الجهود إلى تعزيز الوعي بأهمية التبرع بالدم، وتحفيز المجتمع على المشاركة في حملات التبرع، مما يسهم في

بناء روابط اجتماعية قوية وتعزيز الروح الإنسانية. من خلال التبرع، يمكن للفرد أن يصبح بطلاً في إنقاذ حياة الآخرين، مما يبرز أهمية هذه الفعاليات في تعزيز التفاعل المجتمعي. يتمكن النظام من تتبع أكياس الدم، وعندما يدخل مريض يحتاج إلى وحدات دم، يُوجَّه إلى صفحة البحث لاستعراض المتبرعين المتاحين. بالإضافة يتم تسجيل بيانات المتبرعين عند دخولهم إلى الموقع، وتُحلل هذه البيانات فورًا لاختيار المتبرعين الملائمين من حيث العمر وخلوهم من الأمراض. تهدف دراستنا إلى تحسين نظام إدارة بنوك الدم من خلال دمج تقنيات حديثة مثل MySQL لتخزين البيانات وHTML5 وCSS وJavaScript لتطوير الويب، مما يعزز من فعالية النظام ويضمن الوصول السريع والدقيق للمعلومات الحيوية. نأمل أن تسهم هذه الجهود في تحسين تجربة المستخدم وتعزيز استدامة إمدادات الدم في المجتمع.

الكلمات الدالة: التبرع بالدم، تجنيد المتبرعين، قاعدة بيانات المتبرعين، مطابقة فصائل الدم، الاستجابة للطوارئ .

1. INTRODUCTION

The Central Blood Bank has a major role in the development of blood donation processes and raising the level of services provided for the community. This study focuses on research into the effectiveness of services provided by the central blood bank, and how to adapt such services more effectively to respond to the needs of both donors and beneficiaries. It adopts an integrated system where people are allowed to register themselves as blood donors, provided they are capable of passing through the health check that ensures the safety in any sort of donation process. Blood bags are tested and provided against various blood types and world health standards that guarantee availability for patient needs [1]. There is the development of a system that will monitor the available stock at the bank and issue notifications in the case of any stock replenishment or an emergency through officials and donors [2].

The bank offers an interactive forum where donors share their experiences and opinions to make one understand the need to create awareness in the area of blood donation for others to come forward. Regular blood donation campaigns are organized and hosted in collaboration with civil society organizations and health authorities, further enhancing inventories to meet the most urgent needs [3]. Advanced communication tools are made available by the bank through which donors and beneficiaries alike may access the latest information and updates related to processes involved in donation and usage of blood. It disseminates information and statistics showing the health and social benefits of the process to the community in order to educate them on the importance of blood donation. In order to enhance the effectiveness of these operations, there is a dire need to shift from a traditional system to an electronic one. The electronic system saves time and effort, in addition to improving the accuracy and efficiency of operations. By adopting digital technology, inventory tracking can be enhanced, alerts can be issued much faster, and a much more interactive platform can be provided for donors to share experiences and opinions. The organization and hosting of campaigns, and communication with donors and beneficiaries, can also be made much more efficient.

1.1 Lecture Review

Many researches have been carried out about the concept of blood banks. Some of these studies worked on maintaining the records of the donors in order to make the donation process easier, while other studies focused on linking all the blood banks together in one system and one integrated database [4]. Other studies also used recent technologies like the use of electronic cards and barcode.

a) BSIS System

The Blood Bank Information Management System is an integrated system for the management of donors and patient records at the blood banks. It provides an overall approach towards information storage, its processing, retrieval, and analysis as required for administrative purposes as well as the management of inventory. The BSIS provides authorized persons with a facility to login with the help of a secret password to make easy management of donors and patient records in a more professional way.

The system also plays a major role in attracting donors and other stakeholders because of its simplicity in the reservation process and notification of donors about their appointment to donate. BSIS contributes to the improvement in the quality of services provided by speeding up the procedures and reducing error [4].

b) BloodNet System

The Blood Net system is a blood bank information management system that tries to connect different blood banks in a single network. This system provides an excellent way of sharing information among healthcare institutions. It enables the management of blood donation records and tracking of the donation process. BloodNet also allows for the analysis of data on blood needs, thus enabling the healthcare system to meet the needs of its patients. In improving the responsiveness of blood banks to emergency needs, BloodNet contributes to enhancing the efficiency of blood transfusion services [5].

c) Wateen System

The Wateen system is an overall framework for the management of services related to the blood donation process in the Kingdom of Saudi Arabia. The Wateen system helps in enhancing the management level of records regarding donors and patients at the facility level, improving the donation process for blood, and raising standards of services rendered. To date, this system provides an easy approach to working staff for registration, donor appointment management, and inventories of blood units.

The system also allows sharing of information with other blood banks within the Kingdom, hence making it easier to transfer blood to other hospitals and improving health care services [6].

1.2 Problem Statement

The blood bank in Bani Walid General Hospital uses a paper-based system which presents a number of problems that hamper the effective management of blood donations. The major challenges among these are the unavailability of information about the blood banks and their respective stock positions, which make it difficult for hospitals and donors to reach the required resources effectively.

Besides, communication among blood banks, hospitals, and donors is inefficient, which causes delays and results in missed opportunities for timely donations of blood. The current system also lacks centralized management of blood stocks and tracking, hence making the monitoring of blood availability and putting up adequate supplies difficult. One of the most serious problems facing the hospitals is the shortage of blood during emergencies. The urgent need for blood transfusions calls for effective management on the determination of what blood type is available. Also, the information of the donors, the blood groups, and tracking of data become cumbersome and time-consuming to handle manually. The manual system involves many men, which increases the risks of data insecurity, and it leads to a very lengthy process in retrieving data and generating reports. Addressing these challenges requires developing an integrated system based on modern technology that would help to raise the efficiency of the blood bank management and timely availability of all the supplies**.**

1.3 Objective

According to the aforementioned issues, the goal has been highlighted in this research work

of proposing a system design to central blood bank management concerning the provision of information from collection to testing and the application about the components of the blood, blood type, or the donor of this precious liquid in real-time. Furthermore, it intends to reach an important set of objectives. First, it seeks assurance of the source being available and reliable through a setup that provides a means by which blood donors can seek and, therefore, have better access to blood donation opportunities, enhancing timely and sufficient supplies. The second aim of the research is to facilitate the process of blood donation by developing an easy and smooth registration, screening, and donation process, hence making it convenient and time-saving for blood donors. In addition, in regard to central control and management, the study aims to connect different blood banks by ensuring that resources are shared and worked on for the better provision of blood regionally. It aims to systematize the blood donation process through a structured and systematic way of planning and organizing the donation drives with an emphasis on the blood banks keeping sufficient stocks to meet their local demand.

2. MATERIALS AND METHODS

The methodology used for constructing the research methodology is the incremental model, which contained various stages. The different stages were related to problem study, collection of data, design and finally, conclusion [7]. Based on the defined objectives, a visit was made to the general hospital in Bani Walid, Libya, where interviews were conducted with members of the blood bank staff, and the blood donation procedures were described in detail. The main activities of the blood bank include registering donors, collecting donor information and tests, the blood donation process, blood testing, and managing blood inventory and stock movement. Presently, the bank depends on a manual system to keep records of donor registration and blood testing. This has resulted in several problems and errors. An attempt was also made to get some of the forms used in collecting donor information. The data was then assessed and analyzed to come up with the information needed. The problems mentioned above will be treated through the design of an information management system in PHP, taking MySQL as a database and leaning on a Windows operating system. The proposed system will include an interface representing the main sections of the blood bank; a database was created therein and divided into tables according to the proposed parts of the new system. Each table is devoted to a part of the system and in order to connect the database with the different interfaces, PHP codes were used.

2.1 System Modeling

Methodology The methodology explained that the proposed system has been divided into a number of screens representing the major heads of the departments in the blood bank. This system is utilized in maintaining all information related to the donors and blood on the basis of a central database that stores all the input details ranging from donor information to blood stock and blood types.

This use-case model represents the major functionality of the system and helps conceptualize the interaction between a user and the system [7]. Each screen has a table in the database for all inputs that have something to do with it, and every screen also had its own PHP code that connects them to the database

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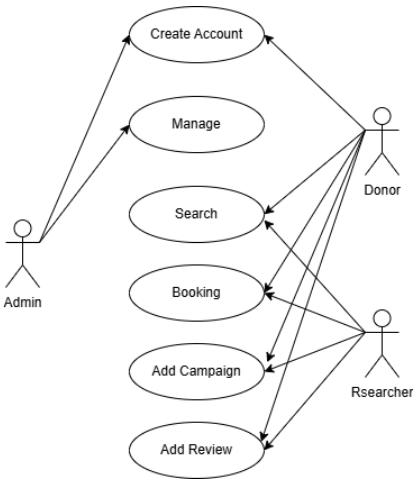

Fig 1. Use Case Modeling.

2.2 *Database Design*

After filling the fields of the blood bank system with all the needed data, the validity of the data is checked with the use of several types, including: Valid positive numbers for age and other quantities and information. Text data for names, notes, and other fields.Images uploaded to display the profile picture in PNG, JPEG, or JPG format. The system also verifies the correctness of the date and email address. This dataset, "Bloodlands", will be a useful resource to enhance the blood donation system by incorporating various interrelated tables: Donors Table: Includes information on blood donors, such as donor ID, name, blood type, contact information, last donation, and any other relevant information.Donations Table: This table will store information about blood donations, such as donor ID and donation date. Blood Inventory Table: Maintains the stock of available units of blood, including blood type, quantity in stock, expiration date, and associated information. Blood Request Table: This table holds the requests of blood units. It has the request ID, the requester's details, the required blood type, amount needed, the delivery date, and the status of the request. Reviews Table: This holds the feedback and reviews from the donors and recipients. The table will store the review ID, review text, rating, and City. Messages Table: This holds the messaging information between the users, recipients, and the blood bank system.
Hospitals Table: Contains information about hospitals associated with the blood bank system, including hospital ID, name, address, contact details, services offered, and any relevant notes. City Table: Provides details about cities where the blood bank system operates, including city ID, city name, region, population size, and any additional city-specific information.

3. RESULTS AND DISCUSSION.

Based on the analysis of the information, module divisions, database table creation, and PHP code, the layout of the resulting screens in the system is as follows.

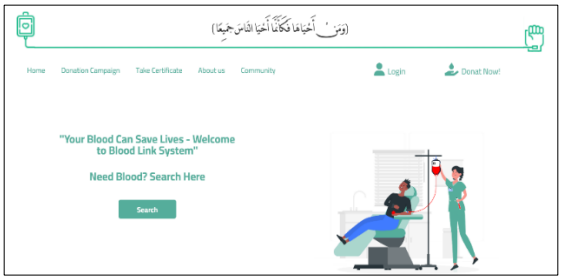

Fig 2: Home page.

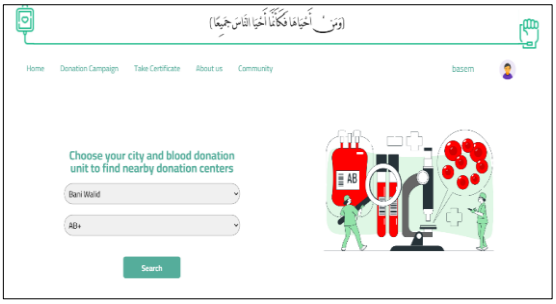

Fig 3. Search Section.

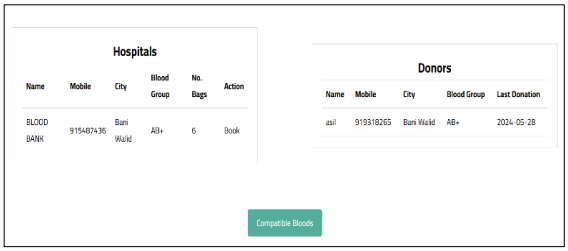

Fig 4. Result Section.

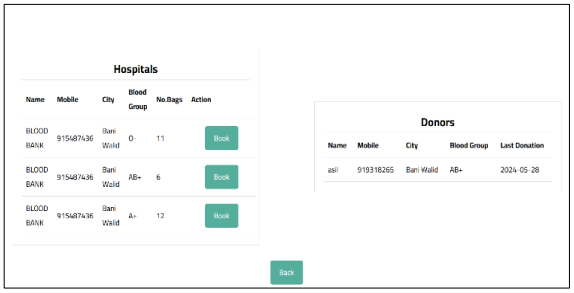

Fig 5. Compatible Section.

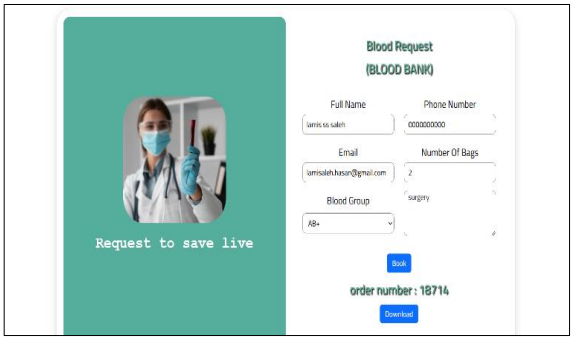

Fig 6. Bookong section.

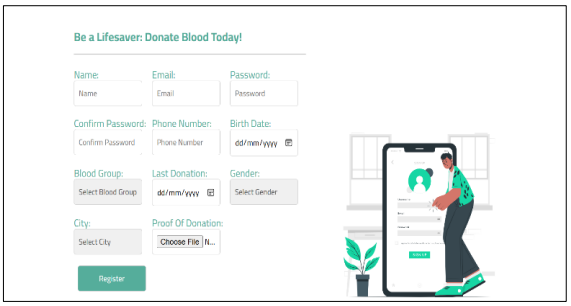

Fig 7. Donor Sigin Form.

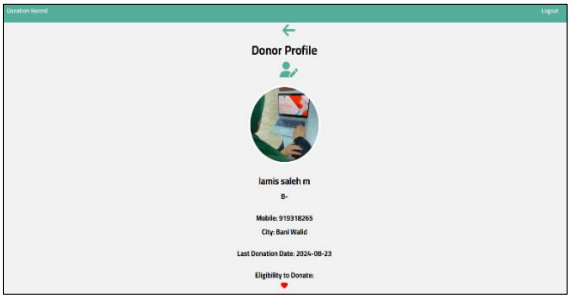

Fig 8. Donor Profile Page.

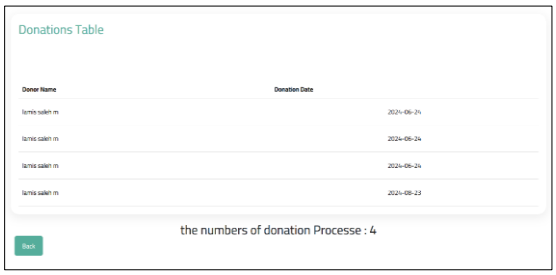

Fig 9. Donation Record Table.

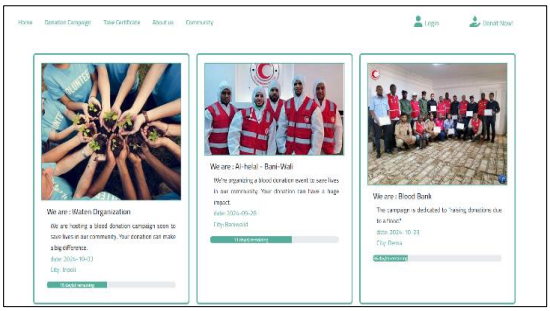

Fig 10. Donation Campaign page.

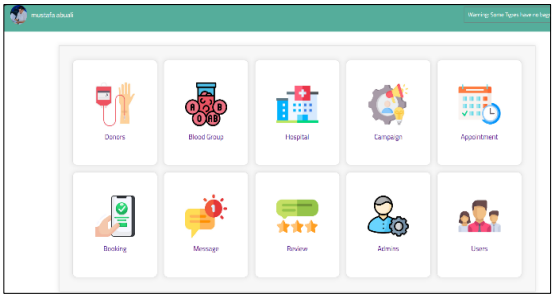

Fig11. Dashboard.

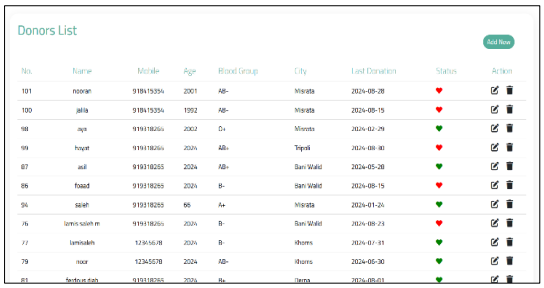

Fig12. Donor List Page.

Fig 12. Manage Blood Group Page

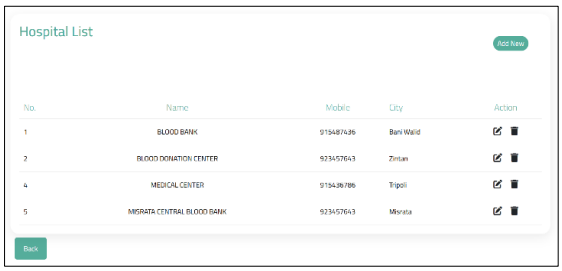

Fig 13. Hospital Page.

Fig 14. Campaign List page.

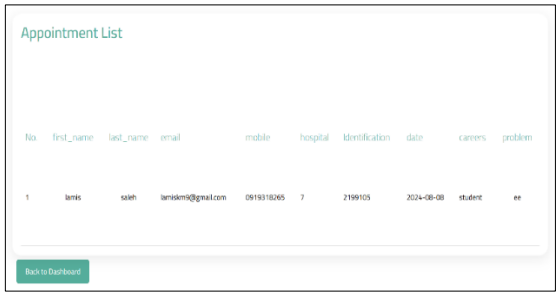

Fig .15 Appointment List Page.

Fig16. Booking List Page.

Fig 18. Message List Page.

Fig 17. Review Request Page.

The results of the previous screens, as illustrated in Figs 2 to 19, showcase the achievements of the proposed Central Blood Bank System (CBBS) through the following points:

a. *Search Blood Donors and Blood Center:* It provides the facility to find blood donors or blood centers where blood bags are available, as show in Fig 2.
b. The search button redirects to a specific area to select the city and the blood group in order to start the searching process, as show in Fig 3.
c. The proposed system provides an interface for the reservation of blood bags. By this interface, it's easy for the user to perform the reservation and select the type of blood he wishes along with the number of bags required, as show in Fig 4.
d. In the Compatible Results section, users can easily find donors of a similar blood group or find the centers where compatible blood bags are available as per their search criteria for efficient blood donation connections, as show in Fig 5.
e. This is the registration for signing up in the system as a donor, where a donor's name, unique email, password, and contact phone will be entered, along with the blood type, city of residence, gender, last donation date, date of birth, and proof of donation. It must be taken into consideration that the donor should be above 18 years of age and the date of the last donation should be at least 42 days back, as show in Fig 6.
f. *Booking Section:* This section pops up when a user is booking a blood bag from a center or a hospital. The name of the user, along with his contact information, will be asked, and he has to specify for how many bags he needs. He has to choose a date and time for pickup. After confirmation of his booking, a unique code symbolizing the reserved blood bag will be provided to him. Finally, this document can be downloaded to your device and presented to the center, as show in Fig 7.
g. *The donor interface:* this system includes an interface for the donors where they can easily access their personal information and manage it. It will be easy and promote interaction with the system, as show in Fig 8.
h. *Donor Record:* It will store the information about the donors and present it when needed in the system, as show in Fig 9.
i. *Campaign Organization:* All donation campaigns are organized by and presented in the system while simultaneously showing the current proceedings about the causes and advancements to be updated about contributions, as show in Fig 10.
j. *Dashboard:* This would include the platform data from an evaluation table, counts of donors and users, hospitals, management of blood stock, messages received from all users through "Contact

Us," reviews, and finally the management of donation campaigns, as show in Fig 11.

k. Donor list page, Here, all the donors registered on the platform are listed, but the admin can delete them at any time if he feels so, as shown in Fig 12.
l. *Inventory display and expiration date management:* The system shows, on the screen in real time, updated cyclically about the quantity of items that are still good and the quantity that needs to be changed. It also details the expiration dates of the different components of the blood, sending warnings of items approaching their expiry dates, enhancing inventory safety, as shown in Fig 13.
m. *Hospital Management:* Here, the admin will manage different parameters of the hospital inside the system: adding new hospitals, editing their information, or even deleting some of them if required, as shown in Fig 14.
n. *Campaign Management:* It can also allow the administrator to create, monitor, and control campaigns, set goals for campaigns, and track them to ensure proper donation drives. They can also approve or discard the campaigns submitted by users, as shown in Fig 15.
o. *Appointment Scheduling:* A client using the system can schedule a visit for either donating or medical check-ups at the center, hence enabling proper planning for a visit at the center in good time, as show in Fig 16.
p. *Booking List:* In this section, administrators can view the list of bookings made within the system**,** as show in Fig 17.
q. *Messages:* In this segment, all the messages are shown from users via contact us to the administrator for finding out the opinion, problems, or any comment they have about the platform, as show in Fig 17.
r. *Feedback and Rating Sharing:* It provides a facility for users to share their opinions, ratings, and reviews concerning the platform and services or any experiences they have had, which is a very valuable tool in service improvement and community trust, as show in Fig 19.
s. *Time Efficiency:* The system contributes to reducing the time spent on administrative processes, hence contributing to operational efficiency.
t. *Minimizing Human Errors:* The system minimizes human errors by automating a number of tasks.
u. Cumulatively, the above-mentioned features enhance the performance of the CBBS in terms of user experience.

4. RESULTS AND DISCUSSION

The Central Blood Bank System is a proposed system to alleviate challenges experienced by the paper-based system implemented in its current state at the blood bank in Bani Walid General Hospital. It will improve the effectiveness of managing the blood banks for timely availability. The system has provided a facility to search for blood donors and blood centers, and on the basis of this, it lets the user select any city or blood group option to start searching. The system has included an interface for booking Blood Bags in which the blood group type and number of bags can easily be booked. A donor interface has been included, allowing donors to access their personal information and interact more with the system. It will store records of the donors, organize donation camps, and view inventory along with the expiration dates. It will facilitate users to create appointments for donation or a medical check-up, give feedback, and ratings. On the other hand, it helps by reducing the time of administrative processes. The CBBS minimizes human errors by automating tasks, hence increasing the user experience .Moreover, the CBBS should, on a routine basis, monitor the errors and technical problems to curtail them. The administrator should adopt proactive policies in refreshing the technological framework, enhancing the security measures, and enhancing the loading speeds .In addition, the CBBS should provide modules for safe blood storage and tracking and blood

management in a transparent way to ensure the stakeholders handle the inventory in an accountable manner .This can be further improved by incorporating the feature for displaying the nearest blood donor with respect to the user's location, which can use the list of probable donors in view of proximity by geolocation information. The advantages of the CBBS are a reduced operation time, minimum staff requirement, and economic efficiency. The added advantage of sharing the sub-units and flexibility to add new users in this system makes it more efficient for blood bank management.

- Future Work

With increasing usage, the CBBS will require monitoring at regular intervals. This will be of great help in order to eliminate any errors or technical issues that may arise. This necessitates consistent oversight by the platform's system administrator to ensure uninterrupted operation. Potential actions include updating the platform's technological infrastructure, strengthening security protocols, and optimizing loading speeds to enhance overall performance. These improvements are essential to maintain the platform's stability and reliability, thereby fostering user trust and engagement [8]. To this end, the system administrator should not be limited to reactive measures; proactive strategies boosting the overall performance of the platform must be implemented. This may include:

As the usage of the CBBS increases, regular monitoring will be required to eliminate any errors or technical issues that may arise. This necessitates consistent oversight by the platform's system administrator to ensure uninterrupted operation [9]. Potential actions include updating the platform's technological infrastructure, strengthening security protocols, and optimizing loading speeds to enhance overall performance [10].These will help in maintaining stability and reliability of the platform, hence gaining the trust of the users and increasing engagement [11]. The system administrator should not be limited to reactive measures but proactive strategies that will enhance the overall performance of the platform [12]. This can be done by incorporating AI tools and algorithms into the system. For example, machine learning algorithms can analyze data to predict natural disasters and risks, hence enabling quick and efficient responses to emergencies [13]. The techniques of computer vision could also be applied in finding the nearest blood donor from a user's location to further enhance the efficiency of the system [14].

Besides, the system can be integrated with natural language processing techniques to communicate with users and inform them about blood donation [15]. The face recognition technology will verify the identity of the donors using facial recognition [16]. These AI tools and algorithms will enhance CBBS's efficiency in offering a better user experience when integrated into the system [17]. The capability for the prediction of natural hazards and risks and the system of alerts and preparations in view of the affected geographical area may also be enhanced [18] .

5. CONCLUSIONS

This is because any such migration from paper-based records to electronic health records has to be well orchestrated in its selection, implementation, training, and maintenance phases. In the development of a prototype for the CBBS, there was a step-by-step process that led to several specifications, as depicted in the form of screens. One of the key attributes of the system is the privacy screen, which will enable users to save the information they input safely. Another significant benefit of the system is its flexibility in adding new users, which easily allows sharing of various sub-units when the CBBS is utilized. The information is integrated in the computerized system where all the donor data and blood compatibility information are kept on one database. In terms of benefits, the computerized system will reduce operation time and minimize the number of staff and manpower required for such activities, therefore raising the economic efficiency.

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