Design and Implementation of an Online Blood Donation System

ABSTRACT

Blood donation is a critical component of healthcare, saving countless lives each year. However, many regions, including Ghana, face chronic shortages of blood supply, often resulting in life-threatening delays for patients in need. Traditional blood donation methods are plagued with inefficiencies, causing delays in matching donors with recipients, and hindered by cumbersome paperwork that discourages potential donors. To address these challenges, this paper introduces an Online Blood Donation System, which offers an accessible, efficient, and secure platform for connecting blood donors with those in need. The project encompasses a comprehensive study, employing the Agile methodology, HTML, CSS, JavaScript, PHP, and MySQL, to design and develop the system. The system's objectives encompass facilitating blood donation, enhancing efficiency, increasing donor participation, ensuring data security, promoting awareness, and overall healthcare system improvement. This project aims to contribute to the healthcare sector by providing an innovative solution to blood donation challenges, ultimately saving lives and improving healthcare efficiency.

Key words: Online Blood Donation, healthcare, healthcare efficiency

1.0 INTRODUCTION
1.1. Background of the Research

Blood donation is a crucial aspect of healthcare as it saves millions of lives every year. In many countries, blood transfusions are the only treatment option for patients suffering from severe blood loss due to accidents, surgeries, or medical conditions such as anemia and cancer. However, there is often a shortage of blood supply in many parts of the world especially in Ghana, which poses a significant challenge for healthcare providers and patients in the country (Ansah, 2019). In addition, the traditional methods of blood donation have several limitations, including the need for donors to physically visit blood banks or donation centers, which can be time-consuming and inconvenient.

To address these challenges, there is a growing need for an online blood donation system that connects blood donors with patients or hospitals in need of blood. An online blood donation system provides a platform for donors to register, and for users to search and request for blood donations online. This system can simplify the process of blood donation, make it more accessible to those in need, and potentially increase the number of blood donors.

1.2 Statement of the Problem

There are a number of challenges associated with the traditional methods of blood donation, which an online system can help to address. An online blood donation system is concerned with the need for an efficient and effective way to connect blood donors with people who require blood transfusions.

Traditional blood donation procedures have a number of drawbacks, which makes an effective online system that links donors and receivers necessary. The lengthy procedure involved in traditional donation is one major obstacle. Medical personnel frequently encounter delays in finding suitable donors when a patient needs a blood transfusion, which can potentially be fatal in an emergency (WHO, 2018). By allowing donors to register their availability online and enabling quicker matching between donors and receivers, an online blood donation system can help reduce this problem (WHO, 2019).

Furthermore, lengthy paperwork and manual registration procedures might make traditional donation methods ineffective, which lowers participation rates (Daxini, 2020). On the other hand, an online blood donation system simplifies the registration procedure, increasing donors' accessibility and convenience (Gupta, A Review Paper on Blood Donation System: Issues, Challenges and Solutions, 2021). This improved effectiveness stimulates more people to give blood, increasing the amount of blood available overall.

Another important factor to take into account while creating an online blood donation system is scalability. The platform needs to support a big user base and be flexible enough to develop and change in the future (Sundararaman, Sundararaman, R., Pandey, S. K., & Kumari, A., 2019). Leveraging flexible design concepts and scalable architecture guarantees that the system can adapt to the changing requirements of blood donation initiatives.

In summary, the problems with existing donation methods such as delays, inefficiencies, and scalability issues—are the focus of the problem statement for the online blood donation system. The online system can improve the efficiency of

blood donation procedures and perhaps save lives by offering a safe and easy-to-use platform for matching donors and recipients.

1.3 Objectives of the Study
The online blood donation system aims to enhance both the blood donation procedure and the healthcare system through a holistic approach. The technology intends to expedite blood transfusions for patients in need by streamlining the donation procedure and decreasing delays by offering an accessible platform for donors to register and participate. The system also aims to improve donor management through centralised record-keeping and efficient communication channels, and to boost donor participation by providing a practical and user-friendly interface. Ensuring donor information security is a top priority by implementing strong data protection protocols. Additionally, the system contributes to larger public health campaigns by acting as a means of increasing awareness of the significance of blood donation and the requirements for eligibility. The online blood donation system's ultimate goal is to create.

2.0 LITERATURE REVIEW
An online blood donation system is a platform that connects blood donors with blood recipients through the internet.

According to (Teena, Sankar, & Kannan, 2014) in their study entitled "A Study on Blood Bank Management", they defined Blood Bank Information System as an information management system that contributes to the management of donor records and blood bank. Their system allowed an authorized blood bank administrator to sign in with a password to manage easily the records of donors and patients who need blood. The system provided many features including the central database, quick access to the system content through the login, includes the search code to find donors on a given basis, and the ease of adding and updating donor data. The main aim of the system was to complete the process of the blood bank. This system was designed to suit all types of blood banks. Once successful in the implementation of the application, it can be applied and rolled out in several blood banks. This application contains User Login Screen, Blood Management, Menu Form, Blood Stock, Donor Management, Donor Registration, Blood Reservation, Donor Blood Test, Recipient Management and Blood Reservation. The researchers planned in their application to have hospital administrator, doctors, and blood bank receptionists as users. The authors did not mention the research method they used, and failed to provide screenshots of the system prototypes, making it difficult for the researchers to visualize their application. No discussion of their respondents, samples and sampling techniques was included. Subsequently, the researcher planned to provide figures to explain the system, screenshots of system prototypes, and other diagrams that can help other researchers to visualize the development of online blood donation system. Also, the researcher will explicitly discuss its research methods, sampling procedures, and statistical treatment to be used for analyzing the gathered data.

(Gupta, 2021) underscored the pivotal role of online blood donation systems in enhancing the efficiency of blood transfusion services. By leveraging online platforms, these systems significantly decrease the time required to match donors with recipients, consequently expediting crucial transfusions. This expeditious matching process is vital, particularly in emergency situations where timely access to blood can be a matter of life and death. The study highlights how the utilization of online systems streamlines the process of donor-recipients matching, ensuring that blood reaches patients in need promptly. As a result, these systems not only improve the efficiency of blood transfusion services but also contribute to better patient outcomes by reducing the time between the request for blood and its administration.

Another research by (Oyewola, 2018) proposes a mobile-based online blood donation system that uses a mobile application to connect blood donors with recipients. The study found that the system was effective in improving access to blood for patients in need and reducing the time and cost associated with blood donation. This study suggest that online blood donation systems can be effective in improving access to blood for patients in need, reducing the time and cost associated with blood donation, and reducing the incidence of blood shortages. These systems can use various technologies such as decision support systems, mobile applications, and online platforms to connect blood donors with recipients. However, further research is needed to explore the effectiveness of these systems in different contexts and to identify the factors that may influence their adoption and success.

(Sundararaman, 2019) conducted a study focusing on the development of a scalable blood donation management system utilizing big data analytics. The research emphasized the potential of online platforms to enhance donor participation rates by eliminating geographical constraints and time limitations. By leveraging technology, such as online registration portals and mobile applications, the system aimed to attract a broader pool of potential donors. These platforms provide convenient access for individuals to register as donors, schedule appointments, and receive updates about blood donation drives or urgent needs. Additionally, the study highlighted the importance of leveraging big data analytics to analyze donor data and identify patterns or trends that could inform targeted outreach efforts, further increasing donor

participation. By removing barriers to donation and utilizing data-driven strategies, online blood donation platforms can effectively engage a larger audience and address critical blood supply shortages.

On the other hand, study entitled "An Online Blood Donation System using a Decision Support System" by (Kumar, 2019). In this study, Kumar et al. proposed an online blood donation system that uses a decision support system to match blood donors with recipients based on their blood type, location, and availability. The system was developed using PHP programming language and MySQL database. The study aimed to improve the efficiency of the blood donation process by reducing the time and cost associated with blood donation. The study used a survey method to collect data from blood donors and recipients to evaluate the effectiveness of the system. The results showed that the majority of the participants found the system easy to use and efficient. The study also found that the system reduced the time and cost associated with blood donation by eliminating the need for donors to travel to blood banks and wait in long queues. The study concluded that the online blood donation system using a decision support system could help improve the efficiency of the blood donation process and make it more accessible to donors and recipients. The study also highlighted the importance of educating donors and recipients about the benefits of using online blood donation systems to improve their adoption and success.

Another study entitled Design and Implementation of an Online Blood Donation System" (Ahmad, 2019) presented the design and implementation of an online blood donation system to facilitate blood donation in health care facilities. The study aimed to improve the efficiency of the blood donation process by providing a platform for blood donors and recipients to connect online. The online blood donation system was developed using the PHP programming language and MySQL database. The system allowed blood donors to register online, provide their blood group and availability for donation, and view their donation history. The system also allowed hospital staff to search for blood donors based on their blood group, location, and availability. The study evaluated the effectiveness of the system by conducting a survey of blood donors and recipients. The study found that the online blood donation system was effective in improving the efficiency of the blood donation process and making it more accessible to donors and recipients. The study also found that the system was user-friendly and easy to use for both donors and recipients. The study identified some challenges associated with the system, such as the need to promote the system to potential donors and address privacy and security concerns. The study concluded that the online blood donation system could help improve the efficiency of the blood donation process and reduce the incidence of blood shortages. The study suggested that future research should focus on developing effective strategies for promoting the system to potential donors and addressing privacy and security concerns to increase donor trust and participation.

A research work titled "Development and Implementation of an Online Blood Donation System in a Tertiary Care Hospital" by (Sankaralingam, 2018) described the development and implementation of an online blood donation system in a tertiary care hospital in India. The study aimed to improve the efficiency of the blood donation process and reduce the incidence of blood shortages. The online blood donation system was developed using PHP programming language and MySQL database. The system allowed blood donors to register online, provide their blood group, and availability for donation. The system also allowed hospital staff to search for blood donors based on their blood group and location. The study evaluated the effectiveness of the system by analyzing the data collected from the system and conducting a survey of blood donors and hospital staff. The study found that the online blood donation system was effective in improving the efficiency of the blood donation process and reducing the incidence of blood shortages. The study also found that the system was user-friendly and easy to use for both blood donors and hospital staff. The study identified some challenges associated with the system, such as the need to ensure the safety and quality of donated blood and the need to promote the system to potential donors. The study suggested that future research should focus on developing effective strategies for promoting the system to potential donors and ensuring the safety and quality of donated blood.

In the study entitled "Blood Bank Management System Using Rule-Based Method" undertaken by (Liyana, 2017), it found out that it is important for every hospital to use an information system to manage data in blood bank. Also, it observed that the manual system has disadvantages for the user and the hospital. One of the disadvantages identified was the blood bank staff should enter the donor details in each time he/she donate blood in which led to duplicate data of the donor and also the data may be lost or missing after period of time. Thus, the author developed a web-based system to help the blood bank to record the donor details fast and easy. The system used rule-based decisions to ensure to have a right decision on right time. Also, system can send messages to donors if any particular blood type is needed. She developed blood bank system based on incremental model. She had chosen this model because the system can be developed through cycle of phase and also because of the advantages of this model such as easy to understand to flow of the phases, changes possible in the middle of any phases and the system can be developed even if there is an error in the middle and it can be corrected in testing phase. In this study, the researcher observed that the developer failed to include

in the system the function to check the availability of blood bags, and to check the shelf life or expiration of blood bags or products. As such, the researcher will include these in his developed system to enhance safety for blood transfusion.

In the study titled "Development of an Integrated Online blood donation system" by (Sharma, 2020), the authors developed an online blood donation system that aimed to streamline the processes involved in blood donation, inventory management, and transfusion. The system integrated donor registration, blood testing, inventory management, and recipient matching functionalities. The study evaluated the system's effectiveness through user feedback and found that it significantly improved the efficiency of blood bank operations, reduced errors, and enhanced the overall quality of blood transfusion services.

3.0 METHODOLOGY
This section presents the methodology employed in the research study on online blood donation systems. It outlines the research design, data collection methods, data analysis techniques, database management system used and data structure. It also focuses on the software packages employed in order to complete the study.

3.1 Data Collection

The research adopted a descriptive research design, aiming to explore and describe the current state and functionalities of online blood donation systems. This design allowed for an in-depth examination of the features, benefits, and limitations of these systems. Additionally, the research design facilitated the collection of qualitative and quantitative data to gain a comprehensive understanding of the topic.

To gather relevant data, both primary and secondary data collection methods were employed. Primary data was collected through online surveys and interviews. Online surveys were distributed to blood bank administrators, staff members, and system users to gather their perceptions, experiences, and feedback regarding the implementation and effectiveness of online blood donation systems. The survey questionnaire consisted of closed-ended and open-ended questions to obtain both quantitative and qualitative data. The study population for the project includes a wide range of stakeholders that are essential to the system's use and successful implementation. Potential blood donors, patients, blood banks, healthcare facilities, blood donation drive organizations and event organizers make up the population, which helps the platform expand and have an impact. Semi-structured interviews were conducted with the study population. The interviews aimed to explore their perspectives on the usability, functionality, and benefits of online blood donation systems.

Secondary data was collected from various sources, including academic journals, conference papers, books, and reputable online databases. The literature review conducted in Chapter Two served as a significant source of secondary data, providing a foundation of existing knowledge and research findings on online blood donation systems. The secondary data was critically analyzed to identify gaps, trends, and best practices in the field.

3.3 Development Methodology
In software engineering, development methodology is known as Software Development Life Cycle (SDLC). Software Development Life Cycle have few stages to improve better planning and management in developing the software. It is also considered as a subdivision of systems development life cycle. There are common development methodology approaches such as waterfall, prototyping, iterative and incremental development, spiral development, rapid application development, extreme programming and agile methodology. For this project, author decides to use agile software development as it is more suitable for this project which uses both iterative and incremental development at the same time.

3.3.1 Agile System Development Lifecycle Model
Agile model is a system development lifecycle is a model that uses an iterative and incremental approach to software development that emphasizes flexibility, collaboration, and customer involvement (Gaurav Kumar, August 2012). Agile allows iterative development, quick feedback, and adaptability to changing requirements, making well-suited for the development of systems like Point-of-Sale systems that may require frequent updates and improvement based on user needs and market demands. Unlike the traditional System Design Life Cycle (SDLC) models such as waterfall, which follows a linear sequence of phases, Agile breaks down the development processes into smaller manageable iteration known as sprint. Each sprint involves a set period of time during which a specific portion of the system is developed, tested, and delivered. The traditional phases used in linear methodologies are replaced by a series of iterative and incremental cycles when using Agile system development lifecycle. Here are some of the phases used in agile model:

i. **Planning**: In this phase, a subset of the items is selected from the backlog to work on during the upcoming iteration or sprint. Also, the effort required for each item is estimated to determine what can be accomplished in the iteration.

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ii. **Design and Development:** Designing, coding, and testing activities take place in this phase, with an emphasis on delivering a potentially shippable product increment.

iii. **Testing**: Continuous testing is a fundamental aspect of Agile SDLC. In this phase, as features are developed, they are tested to ensure they meet the specified requirements and quality standards. This might include automated tests, unit tests, integration tests, and user acceptance testing.

iv. **Review and Demo:** At the end of each iteration, the complete work is demonstrated to the stakeholders. This helps gather feedback and ensures alignment with expectation.

v. **Retrospective**: In this phase, a meeting is held and the end of iteration to reflect on team or individual performance. It focuses on what went well, what could be improved, and actions to take in the next iteration.

vi. **Release**: After a series of iteration, a release candidate is prepared by integrating the completed increments. This release is then tested thoroughly before being deployed to users.

vii. **Deployment and Feedback:** In this phase, the release is deployed to the production environment or users. Feedback is collected from users, and any issues that arise are addressed in subsequent iterations.

viii. **Ongoing Iteration:** The development process continues with subsequent iterations, each building upon the previous work. The backlog is reprioritized as new information emerges, ensuring that the most valuable features are tackled next.

ix. It is important to note that Agile SDLC does not strictly follow linear sequence of phases. Instead, these activities often overlap and are repeated in cycle, creating a continuous and adaptive development process that responds to changes and feedback quickly

Figure 1: Schematic Agile Model provide source

This schematic diagram shows the various stages or process undertaken in Agile model while developing and designing the system

Advantages of Agile Model (source)

i.   Efficient utilization of resources
ii. Faster Time to market
iii. Enhanced Customer Satisfaction
iv. Flexibility and Adaptability
v.   Early Feedback and User involvement
vi. Increased Customer satisfaction

Reasons for choosing the agile methodology

i.   **Adaptability to Changing Requirements:** Agile's inherent adaptability is one of the main arguments for using it in the design of the system. Changing rules, rising technologies, and breakthroughs in medical knowledge can all hasten the evolution of healthcare systems and the needs that go with them. Agile enables development teams to adapt to these changes fast, incorporating new features or alterations in real-time. This flexibility is essential for an Online Blood Donation System because it keeps the system current with emerging medical techniques and legal regulations.

ii. **Reduced Risk during Testing and creation:** Agile approach encourages the creation of a system in small, incremental steps. Each phase, or sprint, yields a potential product increment that can be distributed. Due to the ability to continuously test and validate the system, this method reduces the risks connected with large-scale development. This iterative testing approach makes sure that any problems are found and fixed early, which lowers

the possibility of errors in crucial procedures like donor information management, where accuracy and data integrity are crucial.

iii. **Improved Project Predictability:** Compared to traditional development approaches, Agile's iterative approach delivers improved project predictability. The stakeholders in the system may clearly identify what has been accomplished and what has to be done at the conclusion of each sprint by observing observable progress. This increased openness improves project management by making it simpler to monitor development, alter schedules, and effectively allocate resources.

iv. **Early Design Problem Discovery:** Agile promotes frequent evaluations and presentations of the work done during each sprint. The early detection of design issues or discrepancies during the development process is made possible by this frequent and early feedback loop. This means that in the event of an online blood donation system, usability problems, security flaws, or workflow inefficiencies may be corrected right away, ensuring a safer and more efficient process.

3.3.2   Dataflow Diagram (DFD)

A data flow diagram is a graphical representation of the flow of data through an information system, modeling its process aspects. A data flow diagram is often used as a preliminary step to create an overview of the system, which can later be elaborated. It can also be used for the visualization of processing (DeMarco, 1979). A data flow diagram shows what kind of information will be input to and output from the system, where the data will come from and go to, and where the data will be stored. It does not show information about the timing of process or information about whether processes will operate in sequence or in parallel. The development of data flow diagram is done in several levels. Each process in lower-level diagrams can be broken down into a more detailed data flow diagram in the next level. The lop-level diagram is often called context diagram. It consists of a single process bit, which plays vital role in studying the current system. The process in the context level diagram is exploded into other process at the first level data flow diagram.

a) Symbols used in the design of a dataflow diagram
There are four symbols used in the design of data flow diagrams. These include:

i.   A square defines a source (originator) or destination of system data
ii.   An arrow identifies data flow. It is the pipeline through which the information flows
iii. A circle or a bubble represents a process that transforms incoming data flow into outgoing data flows.
iv.   An open rectangle is a data store, data at rest or a temporary repository of data

Chart 1: Symbols used in the design of a dataflow diagram

Process that transforms data flow.

Source or Destination of data

Data flow
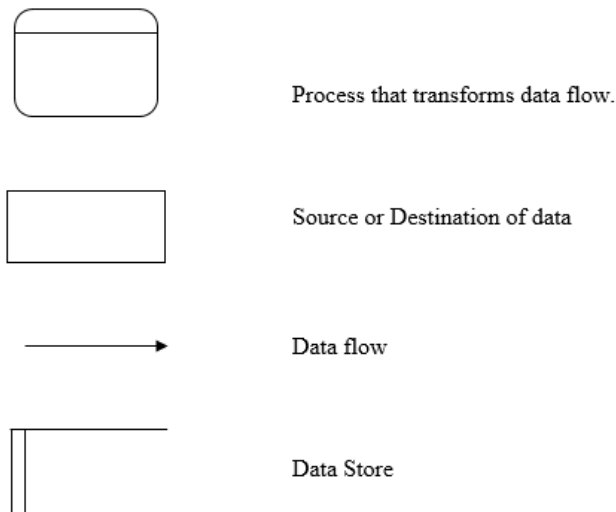
Data Store

b) Data Flow Guidelines

i.   A Data Flow has only one direction of flow between symbols. It may flow in both directions between a process and a data store to show a read before an update. The latter is usually indicated by two separate arrows since these happen at different type.
ii. A join in DFD means that exactly the same data comes from any of two or more different processes data store or sink to a common location.
iii. A data flow cannot go directly back to the same process it leads. There must be at least one other process that handles the data flow produce some other data flow returns the original data into the beginning process.
iv. A Data flow to a data store means update (delete or change).
v.   A data Flow from a data store means retrieve or use.
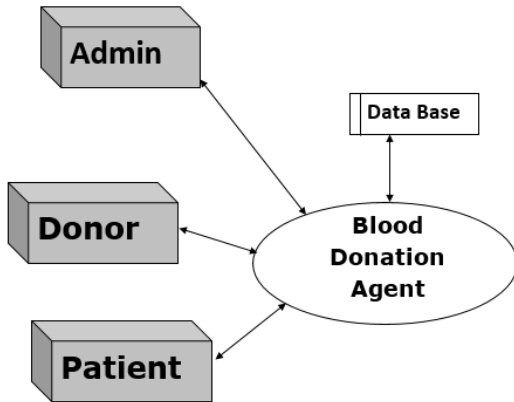
Figure 2: Context Diagram
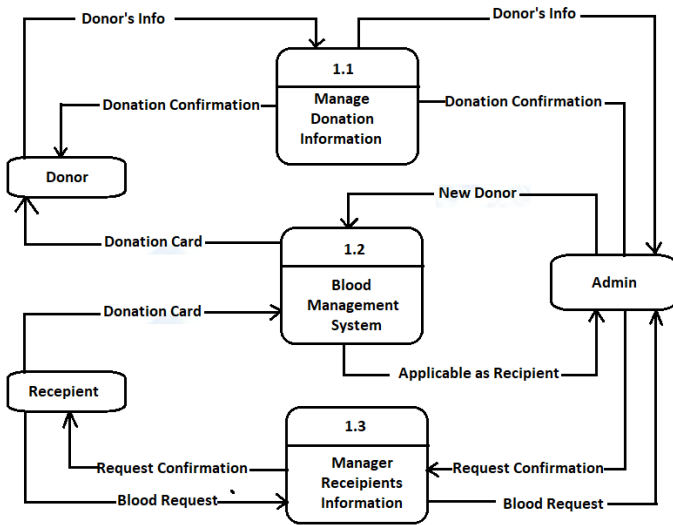
Figure 3: Data flow diagram

The figure above shows the flow of information in the system which entail three users of the system, and these are the blood coordinator who is the administrator, the donors and the receiver. The acceptor can interact with the system by requesting for blood, and also finding donors.

3.3.3 Semantic Model
A conceptual depiction of data called a semantic data model stresses the semantics or meaning of the data rather than its physical structure. It is defined by (Elmasri, 2016) as a representation of the meaning of data within a particular context. It explains how various data pieces relate to the actual things they represent in the world and to one another. To ensure that data is arranged and structured in a way that accurately reflects the underlying concepts and their relationships, this type of model is frequently employed in database design and knowledge representation systems. Characteristics of a semantic data model include:

i. **Entity-Relationships:** It describes entities (i.e., objects, ideas, or things), their properties, and the connections between them. These connections and interactions between entities are described by these relationships.
ii. **Semantic Integrity:** To guarantee that data is reliable and consistent, semantic data models frequently impose semantic integrity restrictions. Based on the semantics of the data, these constraints specify the requirements that data must meet.
iii. **Hierarchical Organization:** Higher-level concepts often contain lower-level ones in a semantic data model's hierarchical organization. The complicated relationships between data pieces are better represented by this structure.
iv. **Abstract:** Semantic data models abstract away from the specifics of the data's physical storage and concentrate on the way the data is logically represented. The data is now simpler to comprehend and work with as a result.
v. **Rich Semantics:** To explain the meaning and context of data pieces, semantic data models use rich semantics. This includes defining the concepts and relationships using controlled vocabularies, ontologies, and taxonomies.
vi. **Data Independence:** In a semantic data model, users and applications can interact with data without having to be aware of the specifics of the physical implementation. Because of the degree of data independence provided by this, it is simpler to adjust to modifications in data storage and retrieval techniques.

a) Types of semantic data model
There are many different types of semantic data models, but some of the most common ones include:
i. **Ontology:** A formal representation of a common understanding of a domain is an ontology. It is made up of a number of concepts, their connections, and the axioms that explain what each notion means.
ii. **Frame:** Data structure known as a "frame" that depicts a concept's properties and relationships.
iii. **Semantic Network:** A semantic network is a graph-based data model that uses nodes and edges to represent concepts and the connections between them.
iv. **Taxonomies:** A taxonomy is a system for classifying ideas in a hierarchy.

Text, pictures, and sensor data are just a few examples of the types of data that can be represented using semantic data models. They are especially helpful for portraying data that is already rich in significance, such financial or medical data.
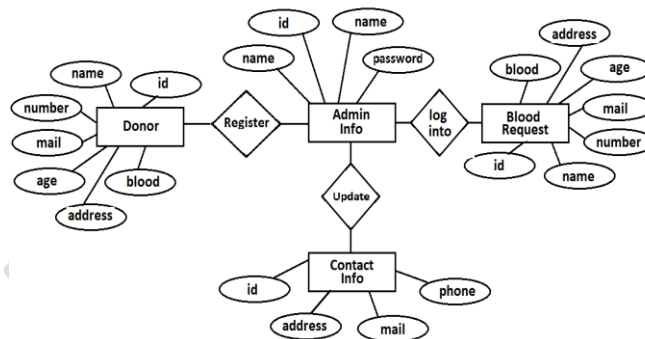

Figure 4: Semantic Data Model

3.3.4 Entity Relationship Model
Entity relationship diagram is a graphical representation of entities and their relationship to each other.

Primary Parts to the Entity Relationship Model:

Entities: These stand in for the objects or ideas that are kept in the database. A customer, for instance, may be an entity in a customer relationship management system.

Attributes: These are an entity's characteristics, or attributes. An example of an attribute might be the name, address, and phone number of a customer entity.

Relationships: These demonstrate the connections between objects. A "placed" relationship, for instance, could link a customer entity to an order entity.
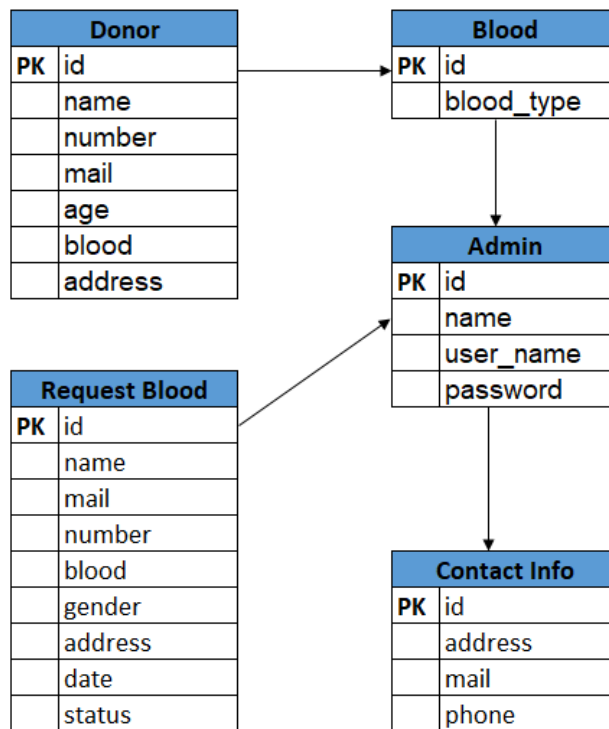
Figure 5: Entity Relationship Diagram

3.3.5 Object models

Object modeling uses object-oriented techniques. This means expressing the system requirements using an object model, using an object-oriented approach, and developing the system in object-oriented programming languages. Object models developed during requirement analysis used to represent both system data and its processing. They combine some of the uses of dataflow and semantic data models. They are useful for showing how entities in the system may be classified and composed of other entities.

The object models has the following notations that represent an object class

i) **Class name:** The Class Name section lists the object class name.
ii) **Attribute:** The attribute section lists the attributes of that object class.
iii) **Method/Service:** The service section shows the operations associated with the object.
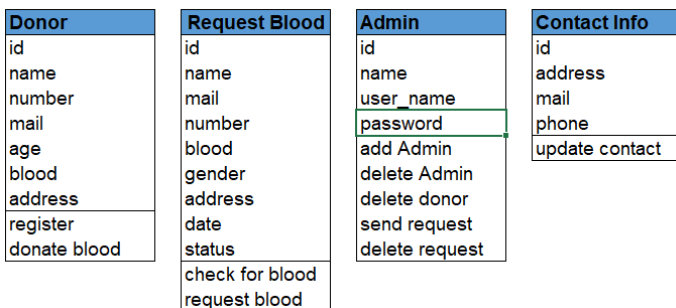
Figure 6: Object Models of Entities

3.3.6 Data Dictionaries

A Data Dictionary is a centralized repository of metadata, which provides a detailed description of the data within a database or information system (Date, 2003). Data dictionary is a list of names used by the systems, arranged alphabetically. As well as the name, the dictionary should include a description of the named entity and, if the name represents a composite object, there may be a description of the composition. Other information such as a date of the

creation, the creator, and representation of the entity may also be included depending on the type of model which is being developed.

Donor

Name	Type	Description
id	int	Donor Identification
name	varchar	Donor full name
number	varchar	Mobile Number
mail	varchar	Email address
age	int	Age of donor
blood	varchar	Donor blood groud
address	varchar	Region of Donor

Request Donor

Request Blood	Type	Description
id	int	Request Identification
name	varchar	Full name
mail	varchar	Email address
number	varchar	Contact number
blood	varchar	Blood group
gender	varchar	Gender of receiver
address	varchar	Region of receiver
date	timestamp	Date of requesting
status	int	Track status of request

Admin

Admin	Type	Description
id	int	Admin Identification
name	varchar	Full name
user_name	varchar	Login name
password	varchar	Login password

Contact

Contact Info	Type	Description
id	int	Admin Identification
address	varchar	Admin address
mail	varchar	Email address
phone	varchar	Contact number

Figure 7: Data Dictionaries

4.0 Results and Discussion

This section presents the results obtained from the development and implementation of the Online Blood Donation System and discusses these results in the context of the project objectives and user requirements. The development of the system was executed following the chosen methodology, adhering to the design principles outlined in section three.

4.1 Results of the Study

A number of beneficial results are anticipated from the project "The design and implementation of an online blood donation system" if it is implemented successfully. These include higher blood donation rates, more effective blood bank operations, better access to blood for patients in need, planned and successful blood donation drives, data-driven insights for better decision-making, improved stakeholder communication, high user satisfaction, raised awareness of blood donation, and the capacity to scale the system to handle increasing demand. Together, these findings might lead to a blood donation process that is more responsive and effective, ultimately benefiting both donors and receivers while possibly saving lives and enhancing healthcare services in the country.

4.1.1 Intended Users

The intended users of this online blood donation system are patients seeking blood donation, people seeking to donate blood, healthcare professionals, including doctors and medical staff, seeking blood for their patients and blood banks.

4.2 System Requirements

When the system is finished, there are a number of things that will be required of it by both the prospective users and the system administrator. These then serve as the prerequisites for the system and are roughly divided into functional and non-functional criteria.

4.2.1 Functional requirements

i. **Donor Registration:** Allow individuals to register as donors, providing personal information.
ii. **Search:** This feature is used by the users to search for donors and also search for available blood groups.
iii. **Blood Bank Management:** Create features for managing donations, and donor records.
iv. **Matching and Blood Request System:** Implement algorithms for matching donors with patients based on blood type and location.
v. **Communication and Notifications:** Develop features for sending alerts and notifications to donors and health facilities.

vi. **Security and Privacy:** Ensure data security, user privacy, and compliance with data protection regulations.
vii. **Scalability:** Design the system to handle a growing user base and data volume efficiently.

4.2.2 Non-functional requirements

i. **Reliability requirements:** The Performance and response rate of the system should remain constant even as the number of concurrent users or data levels increase. Architecture used to build the system should be flexible enough to allow integration with other systems if need be in the future.
ii. **Usability requirements:** The system should have an attractive, user friendly and interactive graphical user interface and it should be easy to use even with the person with least knowledge of computers.
iii. **Security requirements:** This system must be highly secured in the login part. This is because some of the privileges are only allowed for the admin level.
iv. **Implementation requirements:** In implementing the system, it uses PHP, HTML, Cascading Style Sheet (CSS) as the main programming language and tools for the front end. At the back end, MYSQL is used to maintain the information in the database.
v. Portability requirement: The system needs to be portable on all major platforms. This system should not be restricted by any specific technology such as database, web server and operating system

4.3 Hardware & Software Requirements for the System

4.3.1 Hardware requirements

Computer desktop or a laptop with the following specifications:
   i.   At least 2GB RAM (Giga Byte Random Access Memory)
   ii. 2.0 GHZ (Giga Hertz) processor speed
   iii. At least 20GB hard disk capacity
   iv. External Memory (External Hard disk) approximately 20GB for data backups

4.3.2 Software requirements

The software requirements are as follows:
   i.   MYSQL is used to maintain the information in the database
   ii. PHP, HTML, Cascading Style Sheet (CSS) as the main programming language and tools for the front end.
   iii. Operating system at least Windows XP
   iv. A computer antivirus: This is the software that will help protect the developed files against corruption due to malware and viruses.

4.4 Implementation
Give more explanations to the various functionalities outlined below and show their advantages over existing related blood donation systems and provide ciations to the related/similar works/show how different your system is from existing ones.

Project implementation is the phase in which theory is put into action. The researcher creates the interfaces that will interact with the system's many users at this stage, as well as the programs that will assist the system live up to its expectations.

Home Page: This is the main page for all the users of the system i.e. the admin, donor and the recipient. The users will login first to access the other parts of the system.
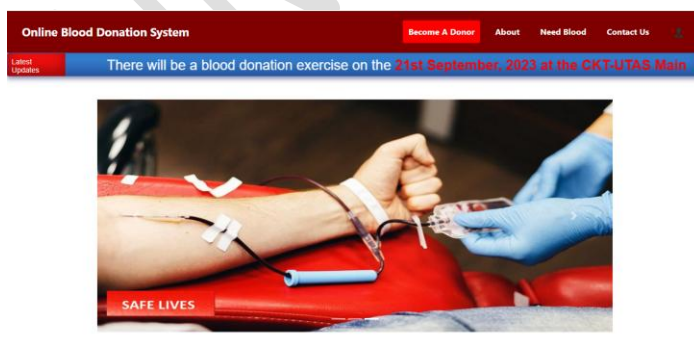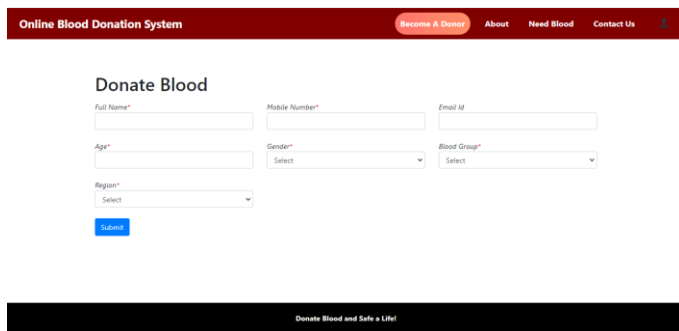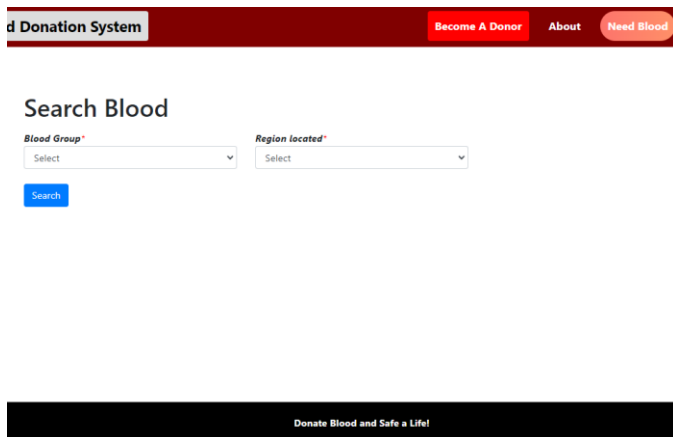
Donor Registration Page

The above diagram is the donor registration page. This page allows the donor to provide his details and hence committing himself for possible blood donation.

Figure 9: Donor Registration Page

Search Blood Page: This page allows the search for donors and available blood groups. This is done by clicking on the need blood menu or button. One do not need to be registered in the systems before you can search for donors.

Figure 10: Search Blood Page

Request for Blood Page: Users can request for blood by providing their details after clicking on the need blood menu. This page also provides the contact details for users to reach the administrators of the system.

Figure 11: Request Blood/Contact Page

The Admin Login Page: The below diagram is the homepage of the system; this page is designed for online administrative with assigned login credentials can login.

Figure 12: Administrator Login Page

Admin Panel: It grants access to the admin. This is where the admin manages blood donation activities between the donors and receivers. The administrator can also add donors, delete, update, and manage pages displaying vital information of blood donation to the public.

Figure 13: Dashboard (Admin Panel)

Donor list page: This display the list of donors

Figure 14: Donor List Page

4.5 System Testing

When development is complete and the system is prepared for deployment, the final phase is system testing. Next, the testing process is conducted to see if the initial planned goals have been achieved. Functional testing, which examined whether the software is performing as expected correctly and in the expected manner, or testing based on whether completeness will have been realized, were both used. Following that, user testing was done to determine whether users would be happy with the results.

The system will be considered acceptable once it has undergone testing and passed all validations and verifications. At that point, it will be given to the owners for operation and maintenance.

The first test plan is for a person to open the system and login into the system as an administrator.

4.5.1 Unit Testing

In this phase of testing, the researcher concentrated on certain software units or components to make sure they are all fully functional. Each and every source code component of the program is tested as a unit to ensure that it functions as intended.

Figure 15: An overview of the system codes

4.5.2 Integration Testing

In this step, all of the system's components were assembled and tested collectively to see if they performed in accordance with the requirements. This is crucial because it establishes how effectively the components work together. The researcher investigated if the admin panel could be accessed by using a compromised username or password.

From the Admin login interface, a user will login with unregistered username and password, and another user will login by modifying the password or a username.
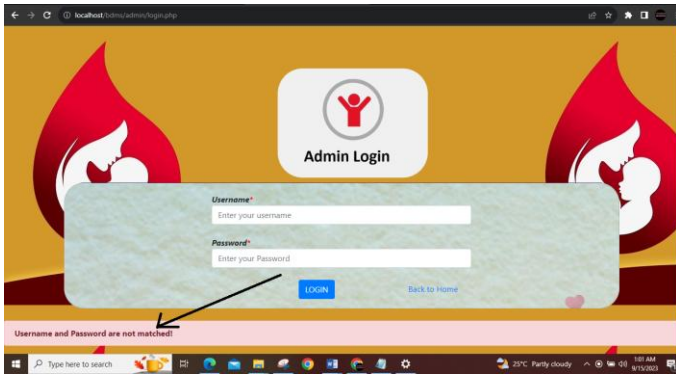
14

Figure 16: Wrong Credential Screen

4.6 Expected impacts

This project is anticipated to produce a functional online system for blood donations. Patients and health care facilities in need of blood will receive better and quicker services using an online blood donation system. The system should make it simpler to locate blood donors and specific blood groups. The system should also meet the following:

i. People will no longer need to go looking for information about blood donations because it is all available in this system.
ii. The system should have access to the donor's information and details so that users may easily find them.
iii. The system should be efficient in times of emergency and also save time and effort.

Blood is widely acknowledged as the most vital component that preserves life. It saves numerous lives worldwide in a variety of situations. In the modern world, where we can accomplish many tasks from home, we can take use of that idea by creating an online solution for the lack of blood donors. The online blood donation system helps to limit the use of paper, therefore there should be less chance of mistakes. This system on the web makes a modest contribution to society. It can save lives by enticing people to donate blood, keeping track of donors and those in need of blood, and assisting those in need of blood in quickly, perfectly, and safely locating potential donors.

5.0 Conclusion and Recommendations

5.1 Conclusion

In conclusion, Chapter One has laid the foundation for the proposed online blood donation system. It highlighted the importance of blood donation in healthcare, the challenges associated with traditional donation methods, and the need for an efficient and effective online system. The objectives, scope, and justification for the system were clearly defined, emphasizing its potential to improve accessibility, efficiency, and overall healthcare. The chosen methodology, the Agile model, and the software tools for implementation were also outlined.

The proposed online blood donation system aims to simplify the donation process, enhance efficiency, ensure donor security, and contribute to the healthcare system's improvement. With these objectives in mind, the study moves forward to the review of literature, where existing research and findings in this field were explored.

5.2 Recommendations

Due to time constrains as a result of academic activities and the lack of resources that hindered the researcher in the design of the online blood donation system, the following recommendations are therefore made for future researchers to consider in order to enhance the system for a better delivery.

i. **Awareness and Promotion:** Develop a strategy for raising awareness about the online blood donation system to encourage donor participation and user engagement.
ii. **Feedback Mechanism:** Incorporate a feedback mechanism within the system to collect input from users and continuously improve its functionality.
iii. **Scalability:** Consider future scalability in the system design to accommodate a growing number of users and potential expansions as the platform gains popularity.
iv. **Privacy and Security:** Implement robust security measures to protect donor information and ensure data privacy and compliance with relevant data protection regulations.

v. **Further Research:** Conduct further research to explore the effectiveness of online blood donation systems in various healthcare contexts, considering factors that influence their adoption and success.

vi. **User Involvement:** Involve users and stakeholders in the design and development process, ensuring that the system meets their needs and expectations.

By addressing these recommendations, the online blood donation system can become a valuable tool in the healthcare sector, helping to save lives and improve the efficiency of blood donation processes.

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