BLOOD GROUP MANAGEMENT SYSTEM DATABASE SEMESTER PROJECT

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What is a Database?

A database is a structured collection of data that is stored and managed electronically. Databases are designed to support the storage, retrieval, and management of data in an organized manner. They are used in various applications to ensure data integrity, consistency, and efficient access of data.

Uses of Database:

Store large amounts of data:

Databases are used to store large amounts of data. Databases can handle vast amounts of data efficiently.

Ensure data integrity:

They help maintain the accuracy and consistency of data over its lifecycle.

Enable data sharing:

Multiple users can access and modify data concurrently.

Provide data security:

Databases offer mechanisms to protect data from unauthorized access.

Help in data retrieval:

They support powerful query languages (like SQL, NoSQL, MongoDB) to retrieve data quickly.

Advantages of Databases:

Data Redundancy Reduction:

Databases minimize duplication of data which was one of the biggest problem in file based system.

Data Integrity:

They ensure the accuracy and consistency of data.

Data Security:

Databases provide excellent security features to protect sensitive data.

Data Accessibility:

Only the Authorized users can access data easily and efficiently. It is a great bless blessing of database management system.

Data Management:

They offer tools for managing large amounts of data systematically.

Blood Group Management System:

The Blood Group Management System (BGMS) is a database system designed to manage information related to blood donations, donors, recipients, blood inventory, and transfusions. BGMS ensures that the right type of blood is available when needed and tracks the entire lifecycle of blood units from donation to transfusion.

Advantages of BGMS:

Efficient Management:

BGMS provides an organized way to manage blood donations and inventory.

Enhanced Tracking:

It tracks the donation and transfusion process, ensuring traceability and accountability.

Improved Availability:

Helps maintain an adequate supply of different blood types.

Reduced Waste:

Manages expiry dates to minimize blood wastage.

Better Service:

Ensures timely availability of blood for recipients.

Use cases of BGMS:

Hospitals and Clinics:

To manage blood inventory and transfusions.

Blood Banks:

To handle blood donations, storage, and distribution.

Emergency Services:

To quickly find and access required blood types in emergencies.

Benefits of BGMS:

Automated Processes:

Reduces manual work by automating data entry and retrieval.

Real-time Data:

Provides up-to-date information on blood availability and donor status.

Decision Support:

Helps in making informed decisions regarding blood collection and distribution.

Regulatory Compliance:

Ensures adherence to health and safety regulations by maintaining accurate records.

System Analysis

Requirements Gathering

Requirements gathering involves identifying the needs and expectations of stakeholders for the Blood Group Management System (BGMS). This includes understanding the functionalities required to manage blood donations and transfusions effectively.

Key Requirements

User Management:

Register donors and recipients.

Maintain profiles with personal information, blood group, and contact details.

Blood Inventory Management:

Track blood donations (donor details, donation date, quantity).

Manage blood inventory (blood group, quantity, expiry dates).

Transfusion Management:

Log blood transfusions (recipient details, transfusion date, quantity).

Hospital Integration:

Maintain hospital information and contact details.

Log transfusion requests from hospitals.

Operational Logging and Reporting:

Log all operations within the system.

Generate reports on donations, transfusions, and inventory levels.

Financial Transactions:

Record transactions related to blood donations and services.

Automated Notifications and Alerts:

Send notifications for upcoming blood donation expiry dates.

Alert when blood inventory levels are low.

Use Case Diagrams

Use case diagrams visually represent interactions between users (actors) and the system, illustrating functional requirements.

Actors

Admin: Manages the system, user registrations, and data.

Donor: Provides blood donations.

Recipient: Receives blood transfusions.

Hospital: Requests blood transfusions.

Key Use Cases

Register User:

Actors: Admin

Description: Register new donors and recipients.

Manage Blood Inventory:

Actors: Admin, Hospital

Description: Track donations and inventory levels.

Record Blood Transfusion:

Actors: Admin, Hospital

Description: Log blood transfusions.

Generate Reports:

Actors: Admin

Description: Generate reports on donations, transfusions, and inventory.

Manage Financial Transactions:

Actors: Admin

Description: Record financial transactions.

Send Notifications:

Actors: System

Description: Send automated notifications and alerts.

Functional and Non-Functional Requirements

Functional Requirements

User Registration:

Register donors and recipients.

Maintain user profiles.

Blood Inventory Management:

Track donations with donor details and dates.

Manage inventory (blood group, quantity, expiry dates).

Transfusion Management:

Log transfusions with recipient details and dates.

Operational Logging:

Log all operations within the system.

Financial Transactions:

Record all financial transactions.

Reporting:

Generate reports on donations, transfusions, and inventory levels.

System Design

Architectural Design

The Blood Group Management System (BGMS) follows a multi-tier architecture to ensure scalability, maintainability, and efficient data management. The architecture typically consists of the following layers:

Presentation Layer:

This layer is responsible for interacting with the users. It includes the user interface, which could be a web-based application, mobile application, or desktop application.

Users can perform various operations such as registering donors, logging donations, managing inventory, and viewing reports.

Application Layer:

This layer contains the business logic of the BGMS. It processes user requests, performs validations, and interacts with the database to fetch or update data. The application layer can be built using various technologies such as Java, .NET, Python, or PHP.

Database Layer:

The database layer is responsible for data storage and management. It includes the MySQL database that stores all the data related to blood groups, donors, recipients, donations, transfusions, inventory, hospitals, operations logs, transactions, and blood tests. The database layer ensures data integrity, consistency, and security.

API Layer:

This optional layer provides an interface for other systems or applications to interact with the BGMS. It exposes various endpoints that allow external systems to perform operations such as adding new donors, fetching blood inventory details, or logging transfusions. APIs can be designed using RESTful services or GraphQL.

Entity-Relationship Diagram (ERD)

The Entity-Relationship Diagram (ERD) visually represents the data model of the BGMS. It shows the entities involved, their attributes, and the relationships between them. Below is the description of the ERD for the BGMS:

Entities and Attributes:

BLOOD_GROUPS: GROUP_ID, GROUP_NAME

DONORS: DONOR_ID, NAME, BLOOD_GROUP_ID, BIRTHDATE, GENDER, PHONE_NUMBER, ADDRESS, REGISTRATION_DATE

RECIPIENTS: RECIPIENT_ID, NAME, BLOOD_GROUP_ID, BIRTHDATE, GENDER, PHONE_NUMBER, ADDRESS, REGISTRATION_DATE

BLOOD_DONATIONS: DONATION_ID, DONOR_ID, DONATION_DATE, EXPIRY_DATE, QUANTITY_ML

BLOOD_TRANSFUSIONS: TRANSFUSION_ID, RECIPIENT_ID, DONOR_ID, TRANSFUSION_DATE, QUANTITY_ML

BLOOD_INVENTORY: INVENTORY_ID, BLOOD_GROUP_ID, QUANTITY_ML, EXPIRY_DATE

HOSPITALS: HOSPITAL_ID, NAME, LOCATION, CONTACT_NUMBER

OPERATIONS_LOG: LOG_ID, LOG_DATE, OPERATION_TYPE, DESCRIPTION

TRANSACTIONS: TRANSACTION_ID, TRANSACTION_DATE, TRANSACTION_TYPE, AMOUNT

BLOOD_TESTS: TEST_ID, TEST_NAME, DESCRIPTION, STANDARD_VALUE

Relationships:

BLOOD_GROUPS to DONORS: One-to-Many (One blood group can be associated with many donors)

BLOOD_GROUPS to RECIPIENTS: One-to-Many (One blood group can be associated with many recipients)

DONORS to BLOOD_DONATIONS: One-to-Many (One donor can make many donations)

DONORS to BLOOD_TRANSFUSIONS: One-to-Many (One donor can be involved in many transfusions)

RECIPIENTS to BLOOD_TRANSFUSIONS: One-to-Many (One recipient can receive many transfusions)

BLOOD_GROUPS to BLOOD_INVENTORY: One-to-Many (One blood group can have multiple inventory records)

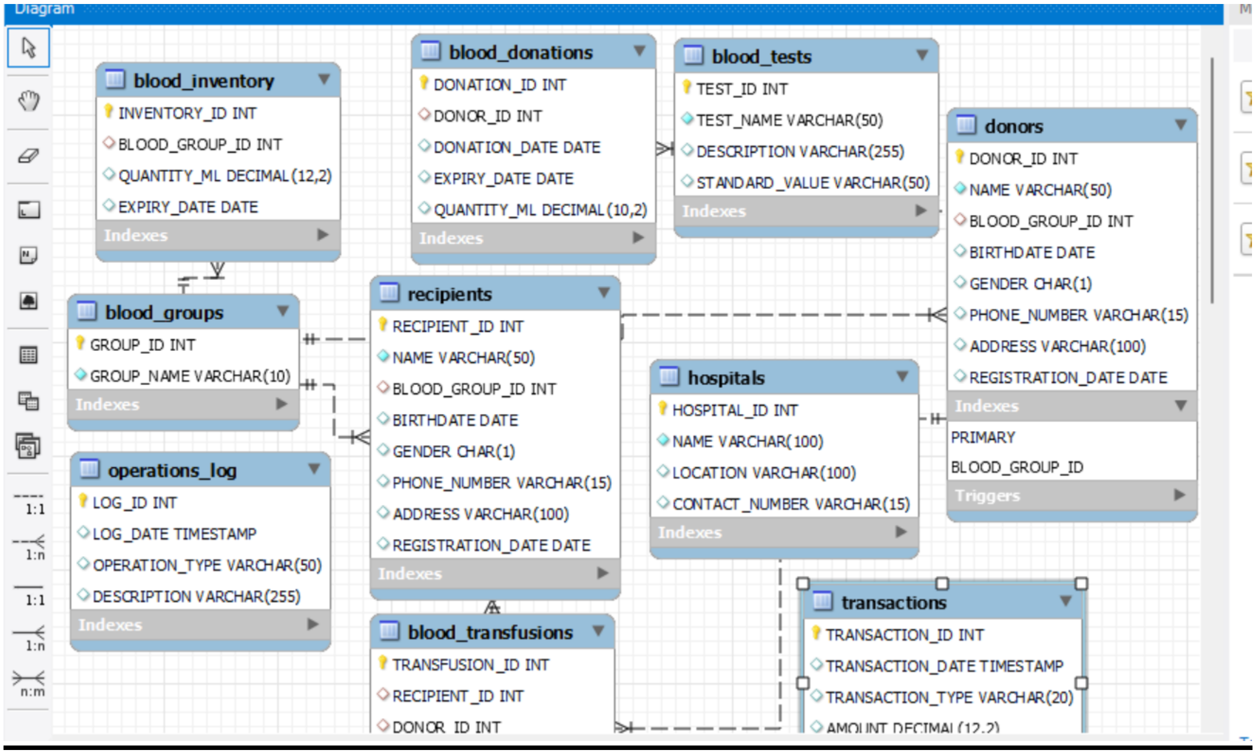
HOSPITALS to BLOOD_TRANSFUSIONS: One-to-Many (One hospital can handle multiple transfusions)

OPERATIONS_LOG: Logs various operations without direct relationships to other entities

TRANSACTIONS: Logs financial transactions without direct relationships to other entities

BLOOD_TESTS: Stores blood test information without direct relationships to other entities

ERD DIAGRAM:



Database Design

Schema Design

The BGMS database schema is designed to efficiently manage blood donations, transfusions, and related entities. It includes tables for blood groups, donors, recipients, donations, transfusions, inventory, hospitals, operations logs, transactions, and blood tests. The schema ensures data integrity and supports various operations within the blood management system.

Table Definitions and Relationships

BLOOD_GROUPS:

Purpose: Stores blood group information.

Columns: GROUP_ID (Primary Key), GROUP_NAME.

DONORS:

Purpose: Contains details about blood donors, including their blood group, contact information, and registration date.

Columns: DONOR_ID (Primary Key), NAME, BLOOD_GROUP_ID (Foreign Key referencing BLOOD_GROUPS(GROUP_ID)), BIRTHDATE, GENDER, PHONE_NUMBER, ADDRESS, REGISTRATION_DATE.

RECIPIENTS:

Purpose: Stores information about blood recipients.

Columns: RECIPIENT_ID (Primary Key), NAME, BLOOD_GROUP_ID (Foreign Key referencing BLOOD_GROUPS(GROUP_ID)), BIRTHDATE, GENDER, PHONE_NUMBER, ADDRESS, REGISTRATION_DATE.

BLOOD_DONATIONS:

Purpose: Records details of blood donations, including donor information and donation dates.

Columns: DONATION_ID (Primary Key), DONOR_ID (Foreign Key referencing DONORS(DONOR_ID)), DONATION_DATE, EXPIRY_DATE, QUANTITY_ML.

BLOOD_TRANSFUSIONS:

Purpose: Logs information about blood transfusions to recipients.

Columns: TRANSFUSION_ID (Primary Key), RECIPIENT_ID (Foreign Key referencing RECIPIENTS(RECIPIENT_ID)), DONOR_ID (Foreign Key referencing DONORS(DONOR_ID)), TRANSFUSION_DATE, QUANTITY_ML.

BLOOD_INVENTORY:

Purpose: Manages blood inventory, including blood group and expiry date.

Columns: INVENTORY_ID (Primary Key), BLOOD_GROUP_ID (Foreign Key referencing BLOOD_GROUPS(GROUP_ID)), QUANTITY_ML, EXPIRY_DATE.

HOSPITALS:

Purpose: Contains information about hospitals using the BGMS.

Columns: HOSPITAL_ID (Primary Key), NAME, LOCATION, CONTACT_NUMBER.

OPERATIONS_LOG:

Purpose: Keeps a log of operations performed within the system.

Columns: LOG_ID (Primary Key, Auto Increment), LOG_DATE, OPERATION_TYPE, DESCRIPTION.

TRANSACTIONS:

Purpose: Records financial transactions related to blood donations and services.

Columns: TRANSACTION_ID (Primary Key, Auto Increment), TRANSACTION_DATE, TRANSACTION_TYPE, AMOUNT.

BLOOD_TESTS:

Purpose: Stores details about blood tests performed.

Columns: TEST_ID (Primary Key), TEST_NAME, DESCRIPTION, STANDARD_VALUE.

Normalization Process

Normalization is applied to the BGMS schema to ensure efficient data storage and retrieval:

First Normal Form (1NF): All tables have unique columns, and each column contains atomic values.

Second Normal Form (2NF): All non-key columns are fully dependent on the primary key, eliminating partial dependencies.

Third Normal Form (3NF): All columns are dependent on the primary key and nothing else, ensuring no transitive dependencies.

Sample Queries:

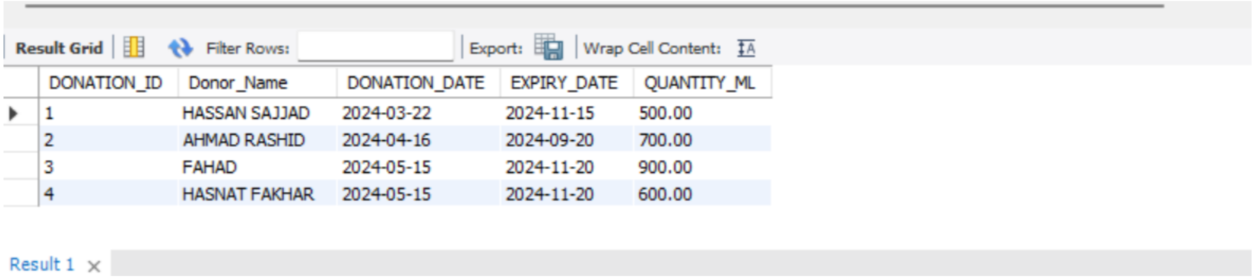
The provided queries in MySQL demonstrate how to retrieve specific information from the BGMS, few of them are:

Fetch donation details including donor names, donation dates, expiry dates, and quantity

```
SELECT bd.DONATION_ID, d.NAME AS Donor_Name, bd.DONATION_DATE, bd.EXPIRY_DATE, bd.QUANTITY_ML

FROM BLOOD_DONATIONS bd

JOIN DONORS d ON bd.DONOR_ID = d.DONOR_ID;
```

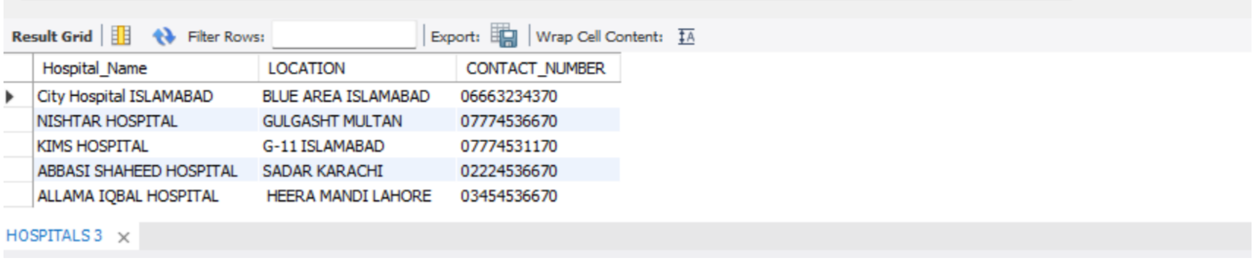


DONATION_ID	Donor_Name	DONATION_DATE	EXPIRY_DATE	QUANTITY_ML
1	HASSAN SAJJAD	2024-03-22	2024-11-15	500.00
2	AHMAD RASHID	2024-04-16	2024-09-20	700.00
3	FAHAD	2024-05-15	2024-11-20	900.00
4	HASNAT FAKHAR	2024-05-15	2024-11-20	600.00

Fetch hospital details including name, location, and contact number

```
SELECT NAME AS Hospital_Name, LOCATION AS Location, CONTACT_NUMBER

FROM HOSPITALS;
```



Hospital_Name	LOCATION	CONTACT_NUMBER
City Hospital ISLAMABAD	BLUE AREA ISLAMABAD	06663234370
NISHTAR HOSPITAL	GULGASHT MULTAN	07774536670
KIMS HOSPITAL	G-11 ISLAMABAD	07774531170
ABBASI SHAHEED HOSPITAL	SADAR KARACHI	02224536670
ALLAMA IQBAL HOSPITAL	HEERA MANDI LAHORE	03454536670

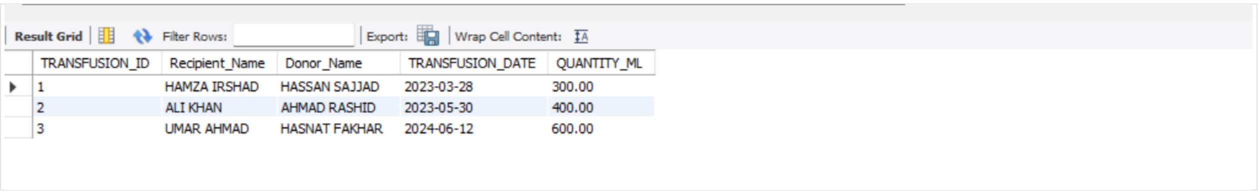
Fetch transfusion details including recipient names, donor names, transfusion dates, and quantity

```
SELECT bt.TRANSFUSION_ID, r.NAME AS Recipient_Name, d.NAME AS Donor_Name, bt.TRANSFUSION_DATE, bt.QUANTITY_ML

FROM BLOOD_TRANSFUSIONS bt
```

JOIN RECIPIENTS r ON bt.RECIPIENT_ID = r.RECIPIENT_ID

JOIN DONORS d ON bt.DONOR_ID = d.DONOR_ID;



TRANSFUSION_ID	Recipient_Name	Donor_Name	TRANSFUSION_DATE	QUANTITY_ML
1	HAMZA IRSHAD	HASSAN SAJJAD	2023-03-28	300.00
2	ALI KHAN	AHMAD RASHID	2023-05-30	400.00
3	UMAR AHMAD	HASNAT FAKHAR	2024-06-12	600.00

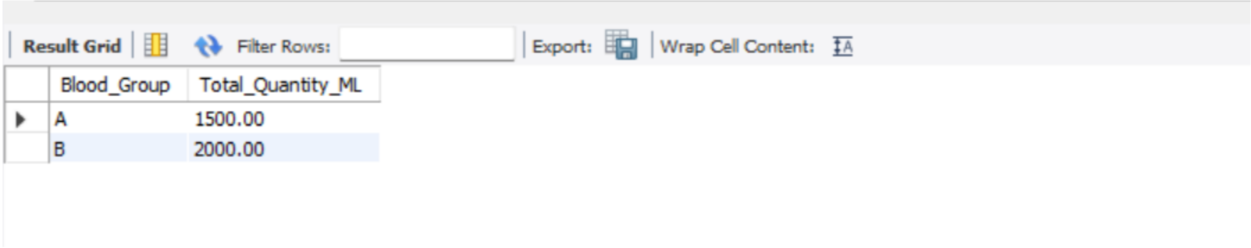
Fetch total quantity of blood available grouped by blood group

SELECT bg.GROUP_NAME AS Blood_Group, SUM(bi.QUANTITY_ML) AS Total_Quantity_ML

FROM BLOOD_INVENTORY bi

JOIN BLOOD_GROUPS bg ON bi.BLOOD_GROUP_ID = bg.GROUP_ID

GROUP BY bg.GROUP_NAME;



Blood_Group	Total_Quantity_ML
A	1500.00
B	2000.00

IMPLEMENTATION:

Database Setup and Table Creation:

The MySQL script begins by creating the BGMS database and setting it as the active database. It defines tables for blood groups, donors, recipients, blood donations, blood transfusions, blood inventory, hospitals, operations logs, transactions, and blood tests.

BLOOD_GROUPS:

Stores blood group information.

DONORS:

Contains details about blood donors, including their blood group, contact information, and registration date.

RECIPIENTS:

Stores information about blood recipients.

BLOOD_DONATIONS:

Records details of blood donations, including donor information and donation dates.

BLOOD_TRANSFUSIONS:

Logs information about blood transfusions to recipients.

BLOOD_INVENTORY:

Manages blood inventory, including blood group and expiry date.

HOSPITALS:

Contains information about hospitals using the BGMS.

OPERATIONS_LOG:

Keeps a log of operations performed within the system.

TRANSACTIONS:

Records financial transactions related to blood donations and services.

BLOOD_TESTS:

Stores details about blood tests performed.

Functions and Triggers:

Function CALCULATE_AGE:

Calculates the age of donors or recipients based on their birthdate.

Trigger SET_REGISTRATION_DATE:

Automatically sets the registration date for new donors to the current date.

Procedures:

Procedure LOG_BLOOD_TRANSFUSION:

Logs blood transfusion details, updates the operations log, and records the transaction.

Sample Data Insertion:

The script includes sample data insertion for blood groups, donors, recipients, donations, transfusions, inventory, hospitals, operations logs, and transactions to demonstrate the functionality of the BGMS.

Summary of Key Operations:

Software used:

MySQL Workbench

Creating and Managing Tables:

Defines the structure and relationships between different entities in the BGMS.

Inserting and Retrieving Data:

Demonstrates how to insert sample data and retrieve meaningful information using SQL queries.

Maintaining Data Integrity:

Ensures data consistency and accuracy through foreign keys, functions, and triggers.

Conclusion:

The Blood Group Management System (BGMS) is a powerful tool that helps hospitals and blood banks manage blood donations and transfusions efficiently. Using MySQL, it keeps data organized, accurate, and easy to access. This system ensures that the right blood is available when needed and helps keep track of everything from donations to transfusions, making the whole process smoother and more reliable. BGMS not only saves time but also helps provide better care for patients by ensuring they get the blood they need quickly and safely.