Course Project - Phase I

Team 12

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1 Introduction to Mini-World

Our Mini-World is a virtual representation of a hospital. This mini world offers a captivating glimpse into the multifaceted domain of healthcare, specialties, and services. The hospital consists of several specialist doctors, healthcare workers, administration services, ad-hoc services like Pharmaceuticals and Ambulances. Although the project assumes a hypothetical hospital, it simulates the structure of a real-life (independent) hospital.

2 Purpose of the database

The primary goal of the Hospital's database is to efficiently manage and store comprehensive information pertaining to the medical facility. This database contains detailed records of patients, medical staff, doctors, and healthcare workers. Through this database, we can easily access and manage the information for all cases, allowing us to maintain a systematic and organized record of each case and its associated entities. Moreover, the database facilitates the monitoring of case progress, ensuring that patients receive the best care and treatment. It is purposefully designed to support various essential functions within the hospital, including case management, patient interactions, employee management, financial transactions, and valuable data for medical research and analysis.

3 Users of the Database

A user of the database is anyone (with authorized access) who wants to learn about any particular records of the hospital. Some of the examples are given below:-

1. **Medical professionals**
    - i Doctor
    - ii Nurses

2. **Patients**
   Patients and their family members can be provided with information like - meeting briefings, prescribed medicines, precautions, reports, etc.

3. **Pharmaceutical Stores**
   Hospital-recognized pharmaceutical stores can have access to limited data of the patient. This can help them know the medical history of the patient.

4. **Administrative Department**
   Administrative personnel, including hospital administrators, office managers, and receptionists, use the database to manage appointments, patient records, and general hospital operations.

5. **Quality Assurance and Research Teams**
   Quality Assurance and Research Teams can access the database to get information of the current state of the patients to manage, use statistical analysis to formulate plans, and keep up the crucial medical supplies as well as in-hospital requirements.

6. **Medical Students and Teachers**
   Medical Students and teachers can be given selective access to do case studies. This is for learning purposes and explicitly for hospital-recognized medical schools.

4 Database Requirements

4.1 Assumptions

- We assume that access to the data is restricted to authorized personnel.
- To a case, only one doctor is assigned to a case. A further requirement of another doctor can be considered a fresh entry.
- Cases that require authorizations from police, and government legal authorities are not considered.
- For each department there is at least one doctor.
- Each doctor works in exactly one department.

4.2 Strong Entity types

1. Doctor

Name of Attribute	Data Type	Constraints
Doctor ID	Integer	PRIMARY KEY
Doctor Name	varchar(255)	NOT NULL
Speciality	varchar(255)	NOT NULL
DOB	Date	NOT NULL
Date OF Joining	varchar(255)	NOT NULL
Age	varchar(255)	NOT NULL
Designation	varchar(255)	NOT NULL
Alma Mater	varchar(255)	NOT NULL
Salary	Integer	NOT NULL
Department Id	varchar(255)	Foreign Key

Table 1: Description of Doctor

Doctor Name is a COMPOSITE attribute with firstname and lastname.
Alma Mater is a Multivalued Attribute (doctor can qualify from multiple colleges)
Age is a DERIVED attribute from DOB.

2. Department

Name of Attribute	Data Type	Constraints
Department ID	Integer	Primary Key
Department Name	varchar(255)	NOT NULL
HOD ID (Doctor ID)	Integer	Foreign Key
Department Location	varchar(255)	NOT NULL

Table 2: Description of Department

3. Patient

Name of Attribute	Data Type	Constraints
Patient ID	varchar(255)	Primary Key
Patient Name	varchar(255)	NOT NULL
Gender	Character	NOT NULL
Mobile number	Integer	NOT NULL, 10 Digits
Blood Group	varchar(255)	NOT NULL
Previous Cases	Integer	-

Table 3: Description of Patient

Patient Name is a COMPOSITE attribute with firstname and lastname.
Previous Cases is a MULTIVALUED attribute.

4. Case

Name of Attribute	Data Type	Constraints
Case ID	Integer	PRIMARY KEY
Patient ID	Integer	FOREIGN KEY
Doctor ID	Integer	FOREIGN KEY
Department Id	varchar(255)	FOREIGN KEY
Case Since	varchar(255)	NOT NULL
Number Of Visits	Integer	NOT NULL
Last Visit	varchar(255)	NOT NULL
Next Appointment	varchar(255)	NOT NULL
Status	varchar(255)	NOT NULL

Table 4: Description of Case

5. Nurse

Name of Attribute	Data Type	Constraints
Nurse ID	Integer	PRIMARY KEY
Nurse Name	varchar(255)	NOT NULL
Gender	Char	NOT NULL
DOB	Date	NOT NULL
Salary	Integer	NOT NULL
Alma Mater	varchar(255)	NOT NULL

Table 5: Description of Nurse

Nurse Name is a COMPOSITE attribute with firstname and lastname.

6. Accountant

Name of Attribute	Data Type	Constraints
Accountant ID	Integer	PRIMARY KEY
Accountant Name	varchar(255)	NOT NULL
Gender	Char	NOT NULL
DOB	DATE	NOT NULL
Salary	Integer	NOT NULL

Table 6: Description of Accountant

7. Workers

Name of Attribute	Data Type	Constraints
Worker ID	Integer	PRIMARY KEY
Worker Name	varchar(255)	NOT NULL
Gender	Char	NOT NULL
DOB	DATE	NOT NULL
Salary per hour	Integer	NOT NULL
Shift	Integer	NOT NULL
Number Of Hours worked in current week	Integer	NOT NULL

Table 7: Description of Workers

Salary/week is DERIVED Attribute from Salary/hour and number of hours worked in a week

8. Receptionist

Name of Attribute	Data Type	Constraints
Receptionist ID	Integer	PRIMARY KEY
Receptionist Name	varchar(255)	NOT NULL
Gender	Char	NOT NULL
DOB	DATE	NOT NULL
Salary	Integer	NOT NULL

Table 8: Description of Receptionist

The names of persons in the above examples are Composite Attributes.

4.3 Weak Entity types

1. Prescription (Dependent on Case)

Name of Attribute	Data Type	Constraints
Case ID	Integer	FOREIGN KEY
Prescription No.	Integer	PARTIAL KEY
Medicine/s(multivalued)	varchar(255)	NOT NULL

Table 9: Description of Prescription

For a particular case ID, the Doctor prescribes many prescriptions whose Prescription No. starts from 1. So a prescription is uniquely identified by tuple of $\langle PrescriptionNumber, CaseID \rangle$. Hence, both together form a Partial Key.

2. Bill (Dependent on Case)

Name of Attribute	Data Type	Constraints
Case ID	Integer	PARTIAL KEY
Consultation Charges	Integer	NOT NULL
Operation Charges	Integer	-
Other Charges	Integer	-
Transaction ID	Integer	NOT NULL

Table 10: Description of Bill

Note: Assuming there is ONLY ONE BILL per Case

3. Medical History (Dependent on Patient)

Name of Attribute	Data Type	Constraints
Patient ID	Integer	PARTIAL KEY
Diabetic	Boolean	NOT NULL
Blood Pressure	Boolean	NOT NULL
Description of any past conditions	varchar(255)	-

Table 11: Description of Medical History

4.4 Relationship types

4.4.1 Unary relationships

a Doctor(Senior) SUPERVISES Doctor(Junior)

- The entity type used here is a strong entity type.
- Unary relationship between two employees where a Senior employee supervises the Junior Employee.
- Cardinality ratio (1:N)
- For Junior Employee, (0,1)
- For Senior Employee, (0, N)

4.4.2 Binary relationships

a Cases OF Patients

- Both participating entity types are strong entity types.
- Binary relationship between Patients and cases
- Cardinality ratio (N:1)
- Min-Max:-
  - For Case, (1,1)
  - For Patient, (1, N)

b Doctor HANDLES Case

- Both participating entity types are strong entity types.
- Binary relationship between a Doctor and a Case
- Cardinality ratio (1:N)
- Min-Max
  - For Doctor, (0, N)
  - For Case, (1,1)

c Doctor WORKS_IN Department

- Both participating entity types are strong entity types.
- Binary relationship between a Doctor and a Department.
- Cardinality ratio (N:1)
- Min-Max
  - For Doctor, (1,1)
  - For Department, (1, N)

d Doctor IS_HEAD_OF Department

- Both participating entity types are strong entity types.
- Binary relationship between a Doctor and a Department.
- Cardinality ratio (1:1)
- Min-Max
  - For Doctor, (0,1)
  - For Department, (1,1)

e Receptionist GIVES_APPOINTMENT Patient

- Both participating entity types are strong entity types.
- Binary relationship between a Receptionist and a Patient.
- Cardinality ratio (1:N)
- Min-Max
  - For Receptionist, (0, N)
  - For Patient, (1,1)

f Doctor IS_HEAD_OF Department

- Both participating entity types are strong entity types.
- Binary relationship between a Doctor and a Department.
- Cardinality ratio (1:1)
- Min-Max

- For Doctor, (0,1)
- For Department, (1,1)

g Nurse gives NURSING_AID to Patient

- Both participating entity types are strong entity types.
- Binary relationship between a Nurse and a Patient.
- Cardinality ratio (M:N)
- Min-Max
  - For Nurse, (1, N)
  - For Patient, (1, M)

4.4.3 Ternary Relationships

a Bill PAID BY Patient TO Accountant

- All the participating entity types are strong entity types.
- Ternary relationship between a Bill, Patient, and Accountant.
- Cardinality Ratio is (N:M:1)
- Min-Max
  - For Bill, (1,1)
  - For Patient, (1, N)
  - For Accountant, (1, M)

b Receptionist GIVES APPOINTMENT OF Doctor TO Patient

- All the participating entity types are strong entity types.
- Ternary relationship between a Receptionist, Patient, and Doctor.
- Cardinality Ratio is (1:N:N)
- Min-Max
  - For Receptionist, (1, N)
  - For Doctor, (0, N)
  - For Patient, (1, N)

5 Functional Requirements

5.1 Modification

1. INSERT OPERATION

   - Whenever an employee(Doctor, Accountant, Receptionist, Nurse, etc) joins the hospital the corresponding data is added to the database along with his/her/their attributes.

- Whenever a patient comes, the corresponding patient details are added to the database if the patient has arrived for the first time. Also, the corresponding case details are added to the database.
- Whenever there is a new bill or prescription, it is added to the database.

2. UPDATE OPERATION
   - For a particular case, whenever there is an update in the case status, the corresponding update is made in the database.
   - Whenever there is an update in the employee or patient details a corresponding update is made in the database
   - If the patient suffers from a new disease then the medical history of that patient is updated in the database.
3. DELETE OPERATION
   - Whenever an employee(Doctor, Accountant, Receptionist, Nurse, etc) is fired or resigns, the corresponding entry is deleted from the database.
   - When the death certificate of a patient is issued by the government the details of the patient are removed from the database.

5.2 Retrieval

1. SELECTION QUERY
   - List all the details including the Doctor involved, the Patient, the bill amount of the case, the medicines prescribed, etc.
     (a) SELECT * FROM CASES WHERE CASE_ID IS 432543
     (b) SELECT * FROM CASES WHERE PATIENT_ID IS 242342
2. AGGREGATION QUERY
   - Perform Operation like the average salary of the employee(Doctor, Accountant, Receptionist, etc.), or an average number of cases of a Doctor, the average age of the employees, or average bill amount, etc.
     (a) SELECT AVG(SALARY) FROM DOCTOR
3. SEARCH QUERY
   - To print the details of a particular Doctor including their Name, Number of Patients treated, Department, Speciality, etc.
     (a) SELECT * FROM DOCTOR WHERE DOCTOR ID IS 12345
4. PROJECTION QUERY
   - Print all the details of the doctors in a particular department

(a) SELECT * FROM DOCTOR WHERE DEPARTMENT ID IS 1234

5. ANALYSIS

- List all the cases that were successful for a particular doctor
  (a) SELECT CASES.case id, DOCTOR.Doctor Name FROM CASES INNER JOIN DOCTOR ON CASES.Doctor Id = DOCTOR.Doctor Id where CASES.Case Status='SUCCESS' AND DOCTOR.Doctor Id=1234
- List the PATIENTS for given BLOOD GROUP who have visited since last 6 months.
  (a) SELECT CASE.Patient ID FROM CASES INNER JOIN PATIENT on CASES.Patient ID = Patient.Patient ID where Patient.Blood Group is "O+" AND CASE.Last Visit LESS THAN 6 MONTHS

6 Summary

A Mini-World Hospital is a scaled-down hospital simulation used primarily for training, research, and educational purposes in the healthcare industry. This miniature model replicates the environment of a real hospital, offering a controlled setting for healthcare professionals and students to practice various medical procedures, improve their skills, conduct research, and enhance their knowledge in a risk-free environment.

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