Indian Institute of Technology Kharagpur

Department of Computer Science and Engineering

Assignment 1

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Database Management System Laboratory (CS39202)

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Contents

1 Problem Statement

1.1 DBMS Lab 1: Database Design: COVID-19 Tracking Information System

1.1.1 Introduction:

Design the E-R diagram to capture the logical data organization for the COVID-19 tracking system described below. Convert the E-R diagram to relational tables. Upload a pdf file with the E-R diagram and the table definitions to moodle. Credits will be given based on the richness of the design and the number of functionalities that may be supported.

1.1.2 System Description:

A large-scale pandemic creates confusions and leads to spread of rumours. We would like to build an information system where a user can access verified information about the pandemic. We obtain data from the following sources:

1. Hospitalizations: including patient information including location, symptoms, treatments involved, and healthcare resources used.
2. Self-reporting from affected citizens
3. Testing labs
4. Vaccination centres
5. Social media

The system is supposed to cater to the information need of following users.

(A) Citizens: for information gathering about various facets of the pandemic

(B) Healthcare professionals: for patient profile, disease and symptom tracking

(C) Government agencies: for resource mobilization and infrastructure readiness

Various features of the system include –

(i) reporting the prevalence and progress of pandemic with time, among various patient profiles, geographical units like districts and states

(ii) tracking symptoms and variants that are currently common

(iii) use of healthcare resources and inventory management for future readiness

(iv) contact tracing

(v) any other functionality that you want to support.

2 Abstract

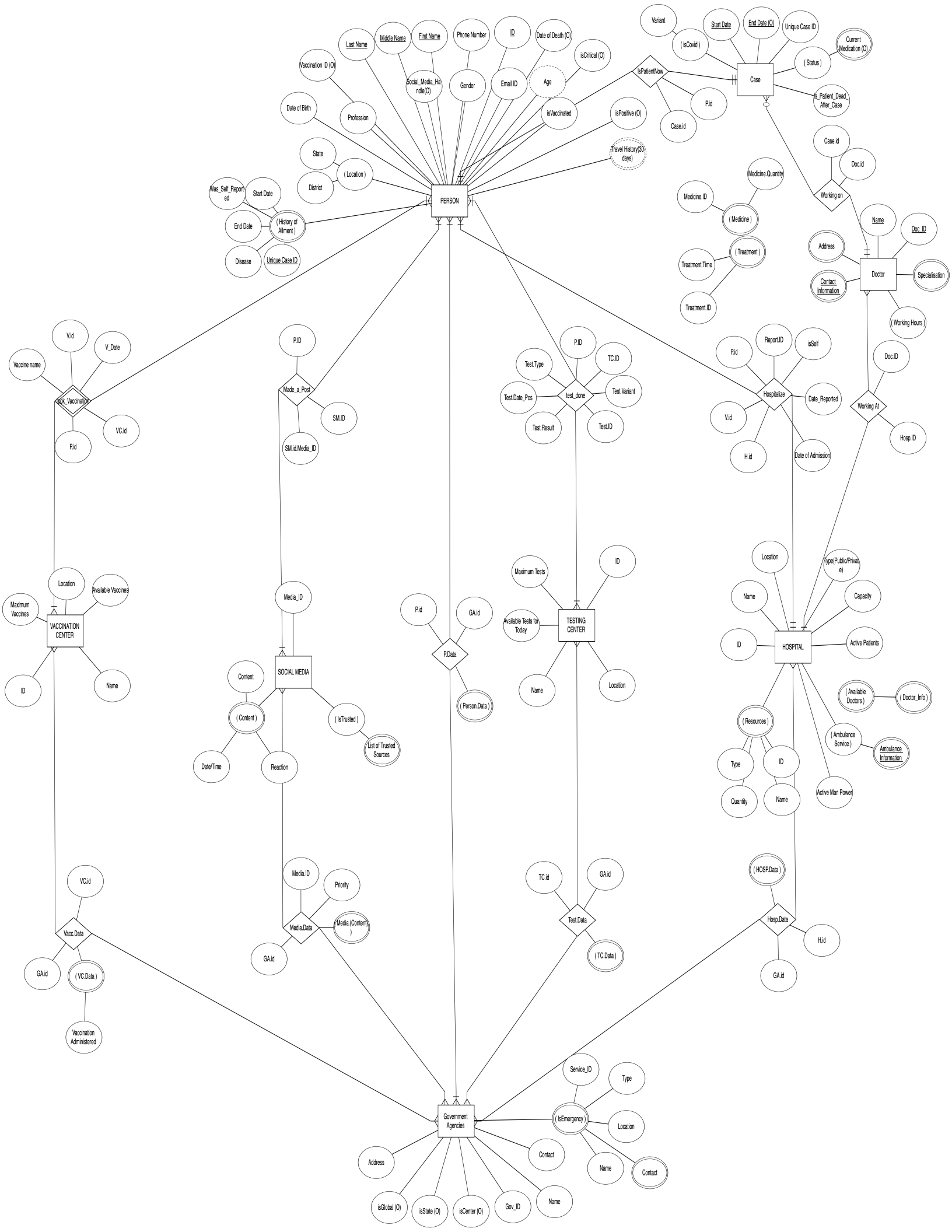
2.1 Introduction

This document outlines a comprehensive system for monitoring the progression of COVID-19, including data collection, analysis, and reporting. The system includes real-time tracking of confirmed cases, contact tracing, and identification of potential hot-spots. Additionally, it facilitates easy sharing of data with public health officials and researchers to aid in understanding and controlling the virus. The system is user-friendly and accessible to all, with a focus on accuracy and privacy. To create an E-R diagram and convert it to relational tables for this system, one would need to have a solid understanding of database design and normalization, as well as gather more specific information about the data and relationships. An E-R diagram for a Live COVID-19 System is provided below:-

3 Entities

The Below are the Entites in the Diagram

1. PERSON
2. VACCINATION CENTER
3. SOCIAL MEDIA
4. TESTING CENTER
5. Case
6. Doctor
7. Hospital
8. Government Agencies


PERSON
Last Name
Middle Name
First Name
Phone Number
ID
Date of Death (O)
Vaccination ID (O)
Social_Media_Handle(O)
Gender
Email ID
Age
isCritical (O)
Date of Birth
Profession
isVaccinated
isPositive (O)
Travel History(30 days)
State
District
(Location)
Was_Self_Reported
Start Date
End Date
Disease
Unique Case ID
(History of Ailment)
isPatientNow
Case
Variant
(isCovid)
Start Date
End Date (O)
Unique Case ID
Current Medication (O)
(Status)
Is_Patient_Dead_After_Case
P.id
Case.id
Case.id
Doc.id
Working on
Medicine.Quantity
Medicine.ID
(Medicine)
(Treatment)
Treatment.Time
Treatment.ID
Name
Doc_ID
Address
Contact Information
Doctor
Specialisation
(Working Hours)
Doc.ID
Working At
Hosp.ID
book_Vaccination
V.id
V_Date
Vaccine name
P.id
VC.id
Made_a_Post
P.ID
SM.ID
SM.id.Media_ID
test_done
P.ID
TC.ID
Test.Type
Test.Date_Pos
Test.Variant
Test.Result
Test.ID
Hospitalize
P.id
Report.ID
isSelf
Date_Reported
V.id
H.id
Date of Admission
VACCINATION CENTER
Location
Available Vaccines
Maximum Vaccines
ID
Name
SOCIAL MEDIA
Media_ID
Content
(Content)
(IsTrusted)
Date/Time
Reaction
List of Trusted Sources
P.Data
P.id
GA.id
(Person.Data)
TESTING CENTER
Maximum Tests
ID
Available Tests for Today
Name
Location
HOSPITAL
Location
Type(Public/Private)
Name
Capacity
ID
Active Patients
(Resources)
(Available Doctors)
(Doctor_Info)
(Ambulance Service)
Ambulance Information
Type
ID
Quantity
Name
Active Man Power
Vacc.Data
VC.id
GA.id
(VC.Data)
Vaccination Administered
Media.Data
Media.ID
Priority
Media.(Content)
GA.id
Test.Data
TC.id
GA.id
(TC.Data)
Hosp.Data
(HOSP.Data)
H.id
GA.id
Government Agencies
Service_ID
Type
(IsEmergency)
Location
Name
Contact
Address
Contact
isGlobal (O)
isState (O)
isCenter (O)
Gov_ID
Name

4 Relationships

The Information on the the Relationships shared between Entities is Enlisted Below:-

4.1 Relationships and Their Attributes

1. **took_Vaccination**
    - Vaccine name
    - V.id
    - V_date
    - VC.id(FK)
    - P.id(FK)
2. **Made_a_Post**
    - P.id(FK)
    - SM.id(FK)
    - Sm.id.Media_ID(FK)
3. **test_Done**
    - P.id(FK)
    - TC.id(FK)
    - Test.Variant
    - Test.id
    - Test.Result
    - Test.Date_Pos
    - Test.type (Rapid Antigen or RT-PCR)
4. **Hospitalize**
    - P.id(FK)
    - isSelf
    - Report.ID
    - Date_reported
    - Date of Admission
    - H.id(FK)
    - V.id
5. **isPatientNow**
    - Case.id(FK)

- P.id(FK)

6. **Working on**
   - Case.id(FK)
   - Doc.id(FK)
7. **Working at**
   - Doc.id(FK)
   - Hosp.id(FK)
8. **Vacc.Data**
   - VC.id(FK)
   - GA.id(FK)
   - (VC.Data)[Vaccines Administered]
9. **Media.Data**
   - Media.ID(FK)
   - GA.id(FK)
   - Priority
   - Media.(Content)
10. **Test.Data**
    - TC.id(FK)
    - GA.id(FK)
    - (TC.Data)
11. **P.Data**
    - P.id(FK)
    - GA.id(FK)
    - (Person.Data)
12. **Hosp.Data**
    - H.id(FK)
    - GA.id(FK)
    - (HOSP.Data)

4.2 Cardinality of Relationships

1. Person shares a One to Many Relationship with Hospital.(1:N)
2. Person shares a One to One Relationship with Case.(1:1)
3. Case shares a One to One Relationship with Doctor.(1:N)
4. Doctor shares a One to Many Relationship with Hospital.(1:N)
5. Person shares a Many to Many Relationship with Government Agencies.(N:M)
6. Social Media shares a Many to Many Relationship with Government Agencies.(N:M)
7. Testing Centers shares a Many to Many Relationship with Government Agencies.(N:M)
8. Vaccination Centers shares a Many to Many Relationship with Government Agencies.(N:M)
9. Hospital shares a Many to Many Relationship with Government Agencies.(N:M)
10. Person shares a Many to Many Relationship with Vaccination Centers.(1:N)
11. Person shares a Many to Many Relationship with Testing Centers.(1:N)
12. Person shares a Many to Many Relationship with Social Media.(1:N)

5 Functionalities that may be Supported

The Following Functionalities may be implemented using the Schema depicted in the Entity Representation Diagram:-

5.1 Features According to the Type of the User

The following kinds of users are expected to use our COVID-19 Information System:-

1. **Citizens**:
   Aim:- For information gathering about various facets of the pandemic.
   The Database has all the information like the Amount of Affected Citizens in a District, State and if Required in the whole of the Country. So, the Citizens who can publicly access the above information know about the various facets of the pandemic like the Mortality Rate, Infection Rate and where is the nearest hospital with available Man-Power and facilities(Mainly the Required Medicines and appropriate Equipment), in their District, State just using a few queries(searches in the front-end of the website). Also an additional feature I implemented was to keep a track of the person's travel in the last 30 days which can also help a citizen get insights into the Travel Advisory about how travelling to certain regions via a given medium can cause him to be more vulnerable to the Virus.

2. **Healthcare professionals**:
   Aim:- for patient profile, disease and symptom tracking We have declared an entity named Doctor he can access the information regarding patient profiles, the disease and symptom tracking with the help of it's relationship with case; wherein he can study the profiles of his patients, also as being a part of the hospital he can access the hospital data. And begin a citizen using our database system he can accsess data for patients in his region/state.

3. **Government agencies**:
   Aim:- for resource mobilization and infrastructure readiness The Relationships namely the Vacc.Data, Person.Data, Media.Data, Test.Data, Hosp.Data provide the Government Agencies with Relevant Data like the Current Resources used by a Hospital in a Region, the Positive cases per no. of persons coming up for testing. The Vacc.Data helps in getting data about the Vaccination Rate in the Nation or a particular Region(State/District). The Media Data also comes in handy like the media also reach out to the most treacherous region for the Govt. to reach and may help in a way. The Personal Data about every citizen and Hospitals give accurate data about the current situation of the pandemic in a region and better helps in resource mobilization and infrastructure readiness from their end(see Resources attribute in the Hosp.data).

5.2 A Detailed Enlistment of the Features Implemented in the System

Below listed are a brief about the features implemented in the system:-

5.2.1 Prevalence and Progress of Pandemic with Time

- We can find the total coronavirus cases, deaths and the recovered patients in a particular State, District or the Nation per se.
- We can find the Amount of Daily COVID Cases detected using the fact the from the Case Entity the ones of having start date today will add to the amount of Daily Reported Cases.
- We can also find the Death Rate daily and also keep track over a period of time, as we know from the Cases Entity that if the patient is dead or not after the case and also the End Date of the Case lies in the desired period.
- We can also find the total recovered patients using the Information from patient and Case entities and measure them in different scales like total recovered per 1 Million Population, total recovered this month/today/week etc.
- We can also find the Total Tests conducted in a certain time range and also measure what may be the positivity rate in a certain interval of time.

With the above points we can conclude that we can conveniently report the prevalence and progress of the pandemic (like positivity rate, mortality rate, recovered cases, COVID-19 infection density in any region.)

5.2.2 Tracking Symptoms and Variants that are Currently Common

- From the "Cases" Entity we can get the Information above the common symptoms and the variants that are currently common in patients.
- This(Common Symptoms and Variants) can also be found with respect to an age group also "Person" Entity has information regarding the variant and the duration of the infection.
- Similarly the Variants affecting a region (District/ State/ Region) the most can be found.

With the above points we can conclude that we can conveniently track symptoms and variants that are currently common (like symptoms common for a particular age group, severity of a particular variant on the public.)

5.2.3 Use of Healthcare Resources and Inventory Management for Future Readiness

- The Government possess data about the cases reported in a region(District, State) in recent times and also the numerical data concerning the same.
- Hence by extrapolating the current use of healthcare resources used in a region and the patients who are being attended we can infer the more amount of healthcare resources and inventory management we would need for future readiness in cases of emergency.

With the above points we can conclude that we can conveniently keep a check the use of healthcare resources and inventory management for future readiness for the betterment of the masses in the concerned region.

5.2.4 Contact Tracing

- The Government know that if a person is tested positive for the Virus in a particular region or not.
- Also using the ID and the Address of the Person we can identify the relatives of the infected person who accommodate in the same house has him, also his neighbours can the potential guys who may be infected we can infer them to take a COVID-19 Test and follow them up in future for further containment.
- Also the Travel Information of a person can be easily accessed from the "Person" Entity. This can come handy to identify the co-passengers of the person and similarly like in the point 2, we can infer them to take a COVID-19 Test and follow them up in future for further containment.

5.2.5 Identification of Containment Zones

The Localities or the Places in a City/Town where the Positivity Rate is greater than the set-forth threshold can be identified and recommended to be declared to High-Priority containment Zones for the well-fare of the citizens of the particular area/region.

5.2.6 Finding the Nearest Health Center

We can easily identify the nearest health care center to a given user in case of emergency and with available health care resources to attend the patient. The Person's, Doctor's and the Hospital Entity will come handy in this query. Also using the Doctor's Information stored for every hospital we can find doctor of a particular speciality at our finger's touch.

5.2.7 Finding the Contact to the Nearest Emergency Government Service

The Government Agencies have their location as an entity and the hospitals too have a ambulance service mentioned as an attributed these can be exploited to find the nearest ambulance available to a user depending upon his location.

5.2.8 Available and Maximum Capacity of Vaccination or Testing for a Particular Region

The Testing and the Vaccination Centers have attributes to store the maximum vaccines/testing kits they possess and the available vaccines/testing kits respectively which give insightful data needed for future readiness by the government bodies.

6 Conclusion

In conclusion, the COVID-19 Information System effectively manages and tracks patient data, providing healthcare professionals with the necessary tools to effectively respond to the pandemic. The system's ER documentation feature allows for accurate and efficient record keeping, ensuring that all patient information is up-to-date and easily accessible for use in treatment and research. Overall, the implementation of this system has greatly assisted in the fight against COVID-19 by streamlining data management and facilitating better decision making.

7 Link to the Work

The link to the work is below :- File