

DBMS Lab Assignment 2

SQL

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Database Design Analysis: Gram Panchayat Management System

Part 1: Entity-Relationship (ER) Diagram Analysis

Overview

The ER diagram illustrates the relationships between various entities in the Gram Panchayat system, with the Citizen entity serving as the central node connecting different administrative functions.

Entity Relationships

1. Citizen-Centric Relationships

- Citizen —(Property)— Household: Represents family unit associations
- Citizen —(Requests)— Certificate: Manages document issuance
- Citizen —(Owns)— Asset: Tracks property ownership
- Citizen —(Enrolls)— SchemeBeneficiary: Handles welfare program participation.
- Citizen —(Members)— PanchayatMember: Represents council membership
- Citizen —(Files Taxes)— TaxRecord: Manages tax submissions

2. Relationship Cardinalities

- One-to-many relationships dominate the design
- Appropriate use of weak and strong entities
- Clear representation of participation constraints

Part 2: Schema Design Analysis

Table Structures

1. Core Tables

- **Citizen:** Primary entity with comprehensive personal information
 - Unique identifiers (citizen_id, aadhar_no)
 - Personal details (first_name, last_name, dob, gender)
 - Contact information (phone, email, address)

2. Administrative Tables

- **Certificate:** {certificate_id, certificate_type, issue_date, valid_until, status}
- **PanchayatMember:** {member_id, role, term_start, term_end, status, committee_name}
- **Household:** {household_id, head_citizen_id, house_no, category, total_members}

3. Financial Management Tables

- **Income:** {income_id, source, amount, receipt_date, financial_year}
- **Expenditure:** {expenditure_id, category, amount, expense_date, purpose}
- **Asset:** {asset_id, asset_type, name, value, status, location}
- **TaxRecord:** {tax_id, tax_type, amount, due_date, payment_status}

4. Welfare Scheme Tables

- **WelfareScheme:** {scheme_id, scheme_name, description, budget_allocated, status}
- **SchemeBeneficiary:** {beneficiary_id, citizen_id, enrollment_date, benefit_amount}

5. Development Monitoring Tables

- **EnvironmentData:** {record_id, rainfall_mm, groundwater_level, waste_collection_status}
- **AgriculturalData:** {record_id, crop_type, area_hectares, estimated_yield}

Implementation Details

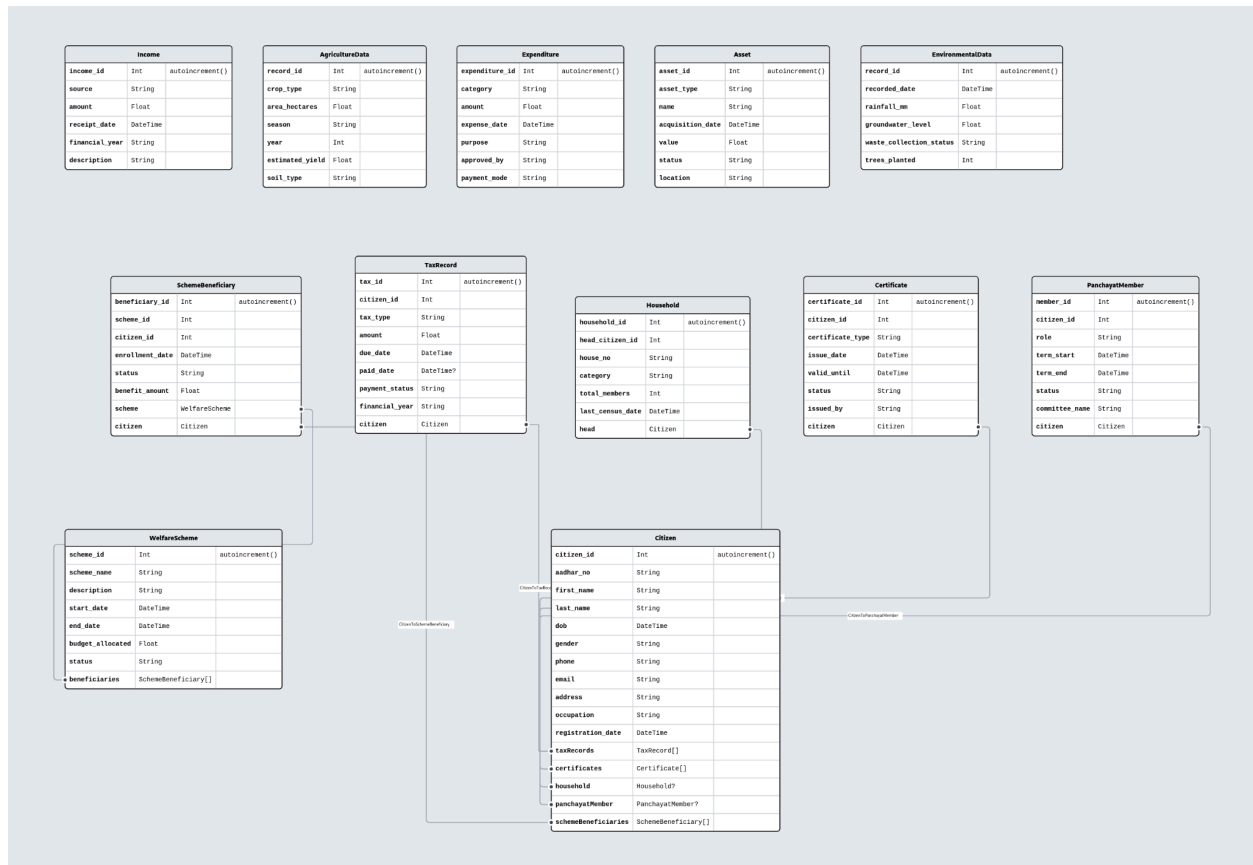
1. Data Type Choices

- Int: For ID fields and numeric counts

- String: For descriptive and categorical data
- DateTime: For temporal information
- Float: For measurements and financial values

2. Key Constraints

- Primary Keys: Consistent use of autoincrement()
- Foreign Keys: Properly defined relationships
- Unique Constraints: Applied where necessary



Assignment Report

1. Design Philosophy: Central Role of the Citizen Entity

The Citizen entity, acting as the pivotal node, connects different administrative functions within the Gram Panchayat system. Its centrality ensures a hierarchical organization of relationships, enabling an efficient, citizen-centric design.

Implementation in the Schema:

- **Citizen Table:**
 - Includes primary fields such as `citizen_id` and `aadhar_no` for uniqueness and identification across the system.
 - Contact (`phone`, `email`, `address`) and demographic (`first_name`, `last_name`, `dob`, `gender`) fields were chosen to support operations like welfare scheme participation, tax filing, and property management.

2. Hierarchical Relationships and Key Entity Mapping

Citizen — Household

- **ER Diagram Analysis:** Citizens belong to a household unit that represents the family structure.
- **Schema:** The `Household` table is created with a `household_id` and references the `Citizen` table via `head_citizen_id`.
 - **Justification:** This ensures that family groupings are well-maintained while allowing the flexibility to manage `total_members`, housing categories (`category`), and `house_no`.

Citizen — Certificate

- **ER Diagram Analysis:** Citizens request certificates for various purposes.
- **Schema:** The `Certificate` table tracks details such as `certificate_type`, `issue_date`, and `status`.
 - **Justification:** Maintaining certificate information separately but linked to the `Citizen` table through a foreign key avoids redundancy and allows centralized tracking of document issuance.

Citizen — Asset

- **ER Diagram Analysis:** Citizens own physical or immovable property.
- **Schema:** The `Asset` table manages information on assets with fields like `asset_type`, `name`, `value`, and `location`.

- **Justification:** A dedicated table enables efficient property management without overwhelming the **Citizen** table.

Citizen — PanchayatMember

- **ER Diagram Analysis:** Citizens may become members of the Panchayat.
- **Schema:** The **PanchayatMember** table keeps records of roles, terms, and committees, linking them to citizens via **member_id**.
 - **Justification:** Encapsulating council membership in a separate table simplifies role management and term tracking for governance.

3. Financial and Administrative Records

Income and Expenditure Tracking

- **Schema:** The **Income** and **Expenditure** tables are created to monitor financial data crucial for Gram Panchayat administration.
 - **Fields:**
 - **Income** includes **source**, **amount**, **receipt_date**, and **financial_year**.
 - **Expenditure** includes **category**, **amount**, **expense_date**, and **purpose**.
 - **Justification:** Maintaining separate financial tables ensures the system is robust enough to track fiscal activities and provide transparency in financial management.

Citizen — TaxRecord

- **ER Diagram Analysis:** Citizens file taxes linked to properties and financial responsibilities.
- **Schema:** The **TaxRecord** table includes fields like **tax_type**, **amount**, **due_date**, and **payment_status**, ensuring that every tax-related detail is well-organized.

4. Welfare Schemes

Citizen — SchemeBeneficiary — WelfareScheme

- **Schema:**

- The **WelfareScheme** table outlines programs offered, while the **SchemeBeneficiary** table connects citizens to these schemes via **citizen_id**.
- Fields like **enrollment_date** and **benefit_amount** track participation details.
- **Justification:** A normalized structure ensures scalability for adding more schemes and accurately recording benefit distribution.

5. Environmental and Agricultural Monitoring

Schema Tables:

- **EnvironmentData** includes metrics such as **rainfall_mm**, **groundwater_level**, and **waste_collection_status**.
- **AgriculturalData** tracks **crop_type**, **area_hectares**, and **estimated_yield**.
- **Justification:** These tables focus on developmental data relevant to Gram Panchayat operations, allowing efficient storage and analysis for planning and improvement.

6. Key Constraints in the Schema

- **Primary Keys:** All tables have primary keys (e.g., **citizen_id**, **tax_id**) to ensure data uniqueness.
- **Foreign Keys:** Relationships between entities, like **Citizen** and **Certificate**, are reinforced through foreign key constraints to maintain data integrity.
- **Unique Constraints:** Unique constraints on fields such as **aadhar_no** prevent duplication.

7. Data Type Selection

- **Int:** ID fields and numeric data (e.g., **amount**, **total_members**).
- **String:** Descriptive fields such as **certificate_type**, **category**, and **crop_type**.
- **DateTime:** Temporal fields such as **enrollment_date**, **issue_date**, and **valid_until**.

- **Float:** Used for financial or measured values such as `rainfall_mm` and `asset value`.

How to run the Queries?

This write-up explains how to use the Makefile to set up and query the Gram Panchayat Management System database.

Main Commands

This will insert,drop,delete the tables,and then finally run the queries in the Database.

Python

Run this Command

```
PGPASSWORD=$(DB_PASSWORD) psql -U $(DB_USER) -h $(DB_HOST) -d  
$(DB_NAME) -p $(DB_PORT) -f 22CS30056.sql
```

Provide the required credentials.

The queries will fetch:

1. Citizens with more than 1 acre land
2. Female students with household income < 1 lakh
3. Total rice cultivation area
4. Citizens born after 2000 with 10th class education
5. Panchayat employees with >1 acre land
6. Household members of Pradhan
7. Street lights in Phulera in 2024
8. Vaccinations for 10th class citizens in 2024
9. Male births in 2024
10. Citizens in panchayat employee households