Greenhouse Automation database design: (Project)

  -design schema, create sample data, CRUD operations  
    possible SQL Queries,  
    potential reusable stored procedures  
    triggers, events,  
    job to be sceduled

  Steps for implementation:

  1:Define Requirements:  
  2.Identify Entities:  
  3.Define Schema:  
  4.Implment the Database:  
  5.Populate Sample data:  
  6.Build Queries:  
  7.Role based permissions:  
  6.Monitor and Optimize:

  1:Define Requirements:  
    Identity the key functionalities of greenhouse automation system.  
      a.Sensors: Temperature , humidity, light, soil moisture, pump status relay,etc.  
      b.Control Systems:Automated watering, heating, cooling and lighting  
      c.User Management:Admins and users , roles who can access or control system.  
      d.Data Logging: Histroical data for analysis and reporting.  
      e.Notifications and alerts: for threshold or failures.

  2.Identify Entities:  
    Based on the requirements, identify the main entities ( tables) for database:  
    1.Users  
    2.Sensors  
    3.Sensor Reading:  
    4.Control Devices:  
    5.Control logs:  
    6.Settings:

  3:Design the Schema createdb.sql file  
  
    CREATE TABLE Users (  
            UserID INT PRIMARY KEY IDENTITY(1,1),  
        Username NVARCHAR(50) NOT NULL,  
        PasswordHash NVARCHAR(255) NOT NULL,  
            Role NVARCHAR(20) NOT NULL, -- e.g., Admin, User  
        CreatedAt DATETIME DEFAULT GETDATE());  
  
    CREATE TABLE Sensors (  
            SensorID INT PRIMARY KEY IDENTITY(1,1),  
            SensorType NVARCHAR(50) NOT NULL, -- e.g., Temperature, Humidity  
            Location NVARCHAR(100) NOT NULL,  
            Description NVARCHAR(255),  
            CreatedAt DATETIME DEFAULT GETDATE());

    CREATE TABLE SensorReadings (  
        ReadingID INT PRIMARY KEY IDENTITY(1,1),  
            SensorID INT FOREIGN KEY REFERENCES Sensors(SensorID),  
            ReadingValue FLOAT NOT NULL,  
            ReadingTime DATETIME DEFAULT GETDATE());

    CREATE TABLE ControlDevices (  
            DeviceID INT PRIMARY KEY IDENTITY(1,1),  
            DeviceType NVARCHAR(50) NOT NULL, -- e.g., Water Pump, Heater  
            Status NVARCHAR(20), -- e.g., On, Off  
            Location NVARCHAR(100) NOT NULL,  
            CreatedAt DATETIME DEFAULT GETDATE());

    CREATE TABLE ControlLogs (  
            LogID INT PRIMARY KEY IDENTITY(1,1),  
        DeviceID INT FOREIGN KEY REFERENCES ControlDevices(DeviceID),  
           Action NVARCHAR(100), -- e.g., Started, Stopped  
            ActionTime DATETIME DEFAULT GETDATE());

    CREATE TABLE Settings (  
            SettingID INT PRIMARY KEY IDENTITY(1,1),  
            SensorType NVARCHAR(50) NOT NULL,  
            ThresholdMin FLOAT,  
            ThresholdMax FLOAT,  
            NotificationEnabled BIT DEFAULT 0);

  4.Implment the Database:  
      SSMS :  
  
  5.Popluate Sample Data:  
        sampledb.sql

1. Insert Sample Data into Users Table

INSERT INTO Users (Username, PasswordHash, Role) VALUES   
('admin', 'hashed\_password\_1', 'Admin'),  
('user1', 'hashed\_password\_2', 'User'),  
('user2', 'hashed\_password\_3', 'User');

2. Insert Sample Data into Sensors Table  
INSERT INTO Sensors (SensorType, Location, Description) VALUES   
('Temperature', 'Greenhouse 1', 'Monitors the temperature inside the greenhouse'),  
('Humidity', 'Greenhouse 1', 'Monitors the humidity level'),  
('Soil Moisture', 'Greenhouse 1', 'Measures moisture level in the soil'),  
('Light', 'Greenhouse 1', 'Measures light intensity');

3. Insert Sample Data into Sensor Readings Table  
INSERT INTO SensorReadings (SensorID, ReadingValue, ReadingTime) VALUES   
(1, 22.5, GETDATE()),  -- Temperature reading  
(2, 60.0, GETDATE()),  -- Humidity reading  
(3, 30.0, GETDATE()),  -- Soil moisture reading  
(4, 500, GETDATE());    -- Light intensity reading

4. Insert Sample Data into Control Devices Table  
INSERT INTO ControlDevices (DeviceType, Status, Location) VALUES   
('Water Pump', 'Off', 'Greenhouse 1'),  
('Heater', 'On', 'Greenhouse 1'),  
('Fan', 'Off', 'Greenhouse 1'),  
('LED Grow Light', 'On', 'Greenhouse 1');

6. Insert Sample Data into Settings Table

INSERT INTO Settings (SensorType, ThresholdMin, ThresholdMax, NotificationEnabled) VALUES   
('Temperature', 18.0, 28.0, 1),  -- Alerts if out of range  
('Humidity', 40.0, 70.0, 1),     -- Alerts if out of range  
('Soil Moisture', 20.0, 50.0, 1), -- Alerts if out of range  
('Light', 200, 800, 1);            -- Alerts if out of range

Application queries :

1.Retrive all users

SELECT \* from users;

2.Retrive Sensor Information with Readings

SELECT s.SensorID, s.SensorType, sr.ReadingValue, sr.ReadingTime

FROM Sensors s

JOIN SensorReadings sr ON s.SensorID =sr.SensorID

ORDER BY sr.ReadingTime DESC;

3.Get Recent Sensor Readings for a Specific Sensor Type

4.Get Control Device Status

5.Get Control logs for a specific Device

6.Find Alerts for Threshold Viloations

7.Count of Sensor Readings per Sensor Types

8.Get users with Admin Role.

9.Get Devices that are currently On

10.Recent actions taken by Control Devices

11.Retrieve Settings for Sensor Types.

12.Average Sensor Reading for Temperature.

13.Find latest Reading for each Sensor.

INSERT INTO ControlLogs(DeviceID,Action,ActionTime) VALUES   
(1,'Started',GETDATE()),  
(2,'Stopped',GETDATE()),  
(3,'Started',GETDATE()),  
(4,'Stopped',GETDATE());

SELECT s.SensorType,sr.ReadingValue,sr.ReadingTime  
FROM SensorReadings sr  
JOIN Sensors s ON sr.SensorID = s.SensorID  
ORDER BY sr.ReadingTime DESC;