# **Crop Disease Management System Design Document**

**1. Topic**

**Crop Disease Management System**

The project aims to design and implement a database-driven system for managing crop diseases, pesticides, irrigation schedules, and yield predictions. The system integrates various agricultural data to provide insights, optimize irrigation, and recommend suitable pesticides to farmers for effective disease management and improved crop yield.

**2. Requirements**

**Functional Requirements**

1. **Crop Management**
   * Store details of various crops, their planting dates, disease resistance levels, and average yield.
   * Allow users to view and update crop information.
2. **Disease Monitoring**
   * Store information on diseases affecting crops, including symptoms, severity levels, and treatments.
   * Provide recommendations for controlling diseases using appropriate pesticides.
3. **Irrigation Scheduling**
   * Maintain irrigation schedules for crops based on their water requirements and current weather conditions.
   * Enable optimization of water usage for higher yields.
4. **Pesticide Management**
   * Track pesticides, including types, recommended dosages, and approved crops.
   * Provide pesticide recommendations based on disease type and crop requirements.
5. **Weather Conditions**
   * Integrate weather data to provide insights into optimal farming conditions.
   * Use weather data to predict potential disease outbreaks and irrigation needs.
6. **Yield Prediction**
   * Maintain historical yield data for crops.
   * Predict yield based on irrigation, weather, and disease conditions.

**Entity Sets and Attributes**

1. **Crop**
   * **Attributes:** 
     + **CropID:** Unique identifier for the crop (Primary Key).
     + **Type:** Type of crop (e.g., Wheat, Rice).
     + **PlantingDate:** The date when the crop was planted.
     + **DiseaseResistanceLevel:** Resistance to diseases (e.g., High, Medium, Low).
     + **AverageYield:** The expected average yield per crop**.**
2. **Disease**
   * **Attributes:** 
     + **DiseaseID:** Unique identifier for the disease (Primary Key).
     + **Name:** Name of the disease (e.g., Blight, Powdery Mildew).
     + **Symptoms:** Describes symptoms of the disease.
     + **SeverityLevel:** Severity of the disease (e.g., High, Medium, Low).
     + **Treatment:** Recommended treatment for the disease.
3. **Pesticide**
   * **Attributes:** 
     + **PesticideID:** Unique identifier for the pesticide (Primary Key).
     + **Name:** Name of the pesticide (e.g., BlightShield, SpotRemedy).
     + **Type:** Type of pesticide (e.g., Fungicide, Herbicide).
     + **RecommendedDosage:** The recommended dosage for usage.
     + **ApprovedCrops:** List of crops for which the pesticide is approved.
4. **IrrigationSchedule**
   * **Attributes:** 
     + **ScheduleID:** Unique identifier for the irrigation schedule (Primary Key).
     + **CropID:** Associated crop identifier (Foreign Key to Crop).
     + **LastWateredDate:** Date when the crop was last watered.
     + **WaterRequirement:** The amount of water required by the crop.
     + **WaterFrequency:** Frequency of irrigation (e.g., daily, weekly).
5. **WeatherConditions**
   * **Attributes:** 
     + **WeatherID:** Unique identifier for the weather entry (Primary Key).
     + **Date:** Date of the weather data entry.
     + **Temperature:** Temperature on the specific date.
     + **Rainfall:** Amount of rainfall on the specific date.
     + **Humidity:** Humidity level on the specific date.
6. **CropYield**
   * **Attributes:**
     + **YieldID:** Unique identifier for the yield record (Primary Key).
     + **YieldAmount:** The amount of yield (quantity) produced by the crop for a given year (e.g., in kilograms or tons).
     + **IrrigationScheduleID:** Identifier linking the yield record to a specific irrigation schedule (Foreign Key to IrrigationSchedule).
     + **Date:** Date when the yield was measured or harvested.

**Relationship Sets**

1. **Crop-Disease (One-to-Many):**
   * A single crop can be affected by multiple diseases, but each disease is specific to one crop.
   * **Participation:** Diseases have total participation (must be linked to a crop), while crops have partial participation (can be free from disease).
2. **Disease-Pesticide (Many-to-Many):**
   * A disease can be treated by multiple pesticides, and a single pesticide can be used to treat multiple diseases.
   * **Participation:** Total participation for disease.
3. **Crop-IrrigationSchedule (One-to-One):**
   * Each crop has exactly one associated irrigation schedule, and each schedule pertains to a single crop.
   * **Participation:** Total for irrigation schedule entities.
4. **Crop-Disease (Many-to-Many):**
   * A crop can have multiple diseases, and each disease can be linked to multiple weather conditions.
   * **Participation:** Total participation for Crop, partial for Disease.
5. **Pesticide-Yieldinfo (One-to-Many):**
   * A pesticide applied to a crop may impact its yield, and multiple pesticides may affect one crop's yield.
   * **Participation:** Total participation for yield entities.
6. **Irrigation-Yeildinfo (One-to-Many):**
   * A particular irrigation schedule might be influenced by multiple yeilds, and one yield belongs one irrigation schedule.
   * **Participation:** Total on irrigation side.
7. **Disease-Weather (Many-to-Many):**
   * A disease can be influenced by various weather conditions, and certain weather patterns can correlate with multiple diseases.
   * **Participation:** Partial for both.

**Cardinalities**

1. **One-to-One:**
   * Each Crop has one associated IrrigationSchedule. A crop can be linked to only one schedule, and vice versa.
2. **One-to-Many:**
   * A Crop can be linked to multiple Disease entries, but a Disease can only be related to one Crop at a time.
3. **Many-to-Many:**
   * The relationship between Disease and Pesticide is many-to-many, as one disease can have multiple pesticides, and one pesticide can treat several diseases.
4. **Many-to-Many (for Disease and Weather):**
   * Weather conditions may correlate with multiple diseases, and diseases may occur under various weather conditions.
5. **Many-to-Many (for Crop and Disease):**
   * A crop may be affected by multiple diseases, and diseases can affect multiple crops

**Normalization Process**

* **First Normal Form (1NF):**
  + Each table has unique rows, and each column contains atomic (indivisible) values. For example, Crop\_Disease and Pesticide\_Application are separate tables to avoid storing multiple diseases or pesticide applications in a single column.
* **Second Normal Form (2NF):**
  + All non-key attributes are fully dependent on the primary key. For instance, in the Crop\_Disease table, the composite key (CropID, DiseaseID) ensures that all attributes are related to the combination of these two entities.
* **Third Normal Form (3NF):**
  + There are no transitive dependencies. Attributes like crop-specific details (e.g., Type, PlantingDate, AverageYield) are stored only in the Crop table, while disease-specific details (e.g., Symptoms, SeverityLevel) are stored in the Disease table.

**3: ER Diagram:**

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**4: Relation Schema with out Reduction**

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**5: Relation schema with Reduction**

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**Implementation Details**

The project uses a relational database schema implemented in MySQL. Below are the key elements:

1. **Crop Table:** Stores crop details, including planting dates and average yield.
2. **Disease Table:** Details of crop diseases, symptoms, severity, and treatments.
3. **Pesticide Table:** Information about pesticides, their usage, and approved crops.
4. **Irrigation Schedule Table:** Schedules for crop irrigation based on water requirements.
5. **Weather Condition Table:** Monitors temperature, humidity, and rainfall thresholds.
6. **Yield Info Table:** Historical data on crop yields for prediction and analysis.