



Al Imam Mohammad Ibn Saud Islamic University  
College of Computer and Information Sciences  
**Computer Science Department**

|                      |                               |
|----------------------|-------------------------------|
| <b>Course Title:</b> | Introduction to Databases     |
| <b>Course Code:</b>  | CS 370                        |
| <b>Project:</b>      | Group-based Project           |
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## - Group Leader:

FAISAL ALAMMAR

## - Data Modeling Tool:

Draw.io

## - Assumptions:

Assuming that the plants does not need to be stored.

## - Description: ER Data Model Component:

Based on the requirements, here are the entities and their relationships in the “Smart Urban Farming” system:

The system consists of users, sensors, plants, and inventory. Each sensor has a unique ID and can be either active or inactive depends on the sleep mode. Also, It contains a timestamp and sensed value and location and functional category.

Plants are monitored using sensors and have ideal moisture, temperature, and light conditions for growth, along with different growth stages. The inventory system manages various items with quantities and last restocking dates.

Users can access the system with usernames and passwords and each user has a key user ID, with roles such as supervisor or farmer. Users can manage multiple sensors and inventory items.

### **User:**

User\_ID (Primary Key)

Username

Password

Role (Supervisor, Farmer)

### **Sensor:**

Sensor\_ID (Primary Key)

Location

Functional Category (Soil, Temperature, Light, pH)

Sleep Mode (Active, Inactive)



### **Sensor Data:** (Weak entity)

Data\_ID (Primary Key)  
Timestamp Date  
Sense Value

### **Plants:**

Plant\_ID (Primary Key)  
Plant Name  
Ideal Moisture  
Ideal Temperature  
Ideal Light  
Growth Stage

### **Inventory:**

Inventory\_ID (Primary Key)  
Inventory Name  
Quantity  
Last Restocked Date  
Tools

### **Relationships:**

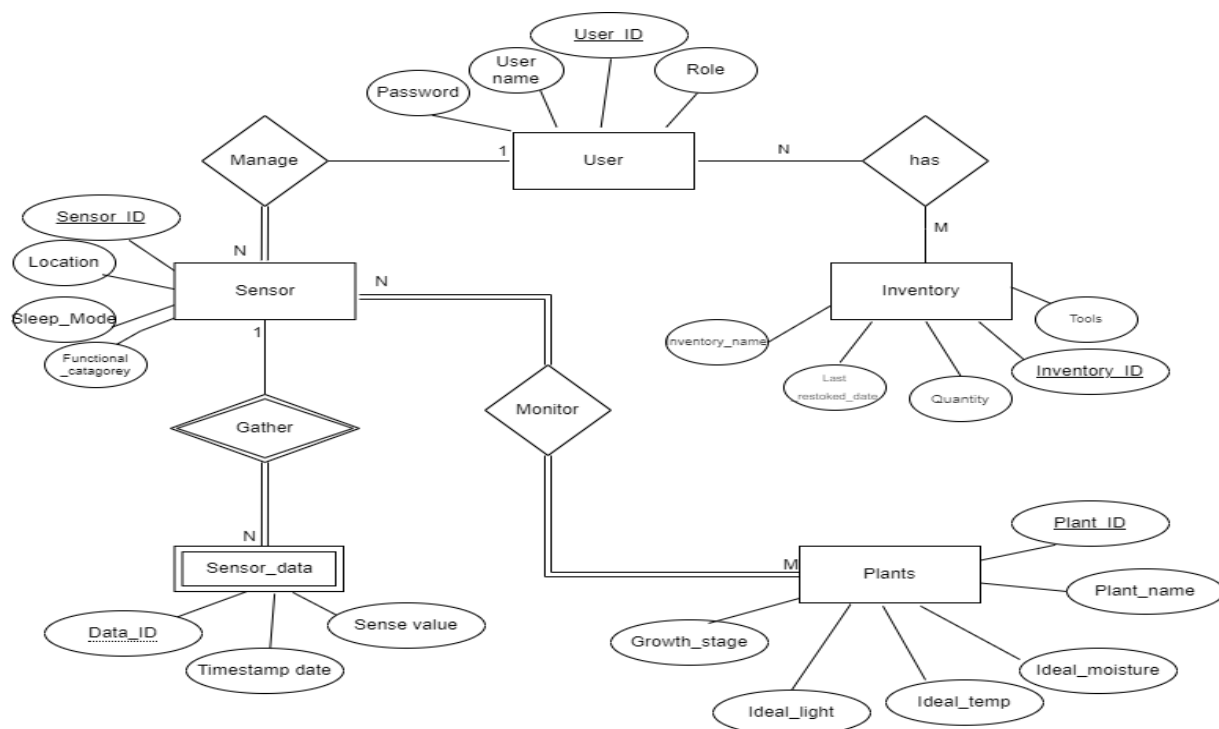
Sensor to Sensor Data: One-to-Many. One Sensor can have multiple Sensor Data entries, but each Sensor Data entry is associated with one Sensor.

Plant to Sensor : Many-to-Many. One Plant can have multiple Sensor entries , and each Sensor can be associated with multiple Plants.

User to Sensor: One-to-Many. One User can manage multiple Sensors, but each Sensor is managed by one User.

User to Inventory: Many -to-Many. One User can has multiple Inventory items, and each Inventory item is managed by multiple User.

## - Conceptual Data Model:





## - Relational Database Schema:





```
CREATE TABLE "IUSER"  
    ("USER_ID" NUMBER(20,0) GENERATED BY DEFAULT ON NULL AS  
IDENTITY MINVALUE 1 MAXVALUE 99999999999999999999999999 INCREMENT  
BY 1 START WITH 1 CACHE 20 NOORDER NOCYCLE NOKEEP NOSCALE NOT  
NULL ENABLE,  
    "ROLE" VARCHAR2(50),  
    "PASSWORD" NUMBER NOT NULL ENABLE,  
    "USERNAME" VARCHAR2(50) NOT NULL ENABLE,  
    CONSTRAINT "IUSER_PK" PRIMARY KEY ("USER_ID")  
USING INDEX ENABLE  
);
```

```
CREATE TABLE "PLANTS"
(
    "PLANT_ID" NUMBER(20,0) GENERATED BY DEFAULT ON NULL AS
IDENTITY MINVALUE 1 MAXVALUE 9999999999999999999999999999 INCREMENT
BY 1 START WITH 1 CACHE 20 NOORDER NOCYCLE NOKEEP NOSCALE NOT
NULL ENABLE,
    "PLANT_NAME" VARCHAR2(20),
    "IDEAL_MOISTURE" VARCHAR2(20),
    "IDEAL_TEMP" NUMBER,
    "IDEAL_LIGHT" NUMBER,
    "GROWTH_STAGE" VARCHAR2(20),
    CONSTRAINT "PLANTS_PK" PRIMARY KEY ("PLANT_ID")
USING INDEX ENABLE
);
```

```
CREATE TABLE "SENSOR"  
(  
    "SENSOR_ID" NUMBER GENERATED BY DEFAULT ON NULL AS IDENTITY  
MINVALUE 1 MAXVALUE 99999999999999999999999999 INCREMENT BY 1  
START WITH 1 CACHE 20 NOORDER NOCYCLE NOKEEP NOSCALE NOT NULL  
ENABLE,  
    "LOCATION" VARCHAR2(20 CHAR),  
    "SLEEP_MODE" NUMBER,  
    "FUNCTIONAL_CATAGORY" VARCHAR2(20 CHAR),  
    "USER_ID" NUMBER,  
    CONSTRAINT "SENSOR_PK" PRIMARY KEY ("SENSOR_ID")  
USING INDEX ENABLE  
);
```



```
ALTER TABLE "SENSOR_DATA" ADD CONSTRAINT "SENSOR_DATA_CON"
FOREIGN KEY ("S_ID")
REFERENCES "SENSOR" ("SENSOR_ID") ON DELETE SET NULL ENABLE;
```

```
ALTER TABLE "MONITOR" ADD CONSTRAINT "MONITOR_CON" FOREIGN KEY
("P_ID")
REFERENCES "PLANTS" ("PLANT_ID") ON DELETE SET NULL ENABLE;
```

```
CREATE TABLE "SENSOR_DATA"
(  "SEN_ID" NUMBER,
```





```
"D_ID" NUMBER,  
"TIMESTAMPDATA" DATE,  
"SENSORVALUE" NUMBER,  
CONSTRAINT "SENSOR_DATA_PK" PRIMARY KEY ("SEN_ID", "D_ID")  
USING INDEX ENABLE  
);
```

```
ALTER TABLE "SENSOR_DATA" ADD CONSTRAINT "SENSOR_DATA_CON"  
FOREIGN KEY ("SEN_ID")  
REFERENCES "SENSOR" ("SENSOR_ID") ON DELETE SET NULL ENABLE;
```

```
CREATE TABLE "HAS"  
(  
    "INVEN_ID" NUMBER,  
    "US_ID" NUMBER,  
    CONSTRAINT "HAS_PK" PRIMARY KEY ("INVEN_ID", "US_ID")  
USING INDEX ENABLE  
);
```

```
ALTER TABLE "HAS" ADD CONSTRAINT "HAS_CON" FOREIGN KEY  
("INVEN_ID")  
REFERENCES "INVENTORY_ID" ("INVENTORY_ID") ON DELETE  
CASCADE ENABLE;  
ALTER TABLE "HAS" ADD CONSTRAINT "HAS_CON1" FOREIGN KEY ("US_ID")  
REFERENCES "IUSER" ("USER_ID") ON DELETE SET NULL ENABLE;
```

## - Database State:

```
INSERT INTO IUSER (USER_ID, ROLE, PASSWORD, USERNAME)  
VALUES  
(1, 'supervisor', '1234567', 'Faisal'),  
(2, 'Farmer', '1234567', 'Ahmed'),  
(4, 'Farmer', '1234567', 'Khaled'),  
(5, 'Farmer', '1234567', 'Yazeed'),  
(3, '-', '1234567', 'Ali');
```

```
INSERT INTO plants (PLANT_ID, PLANT_NAME, IDEAL_MOISTURE, IDEAL_TEMP,  
IDEAL_LIGHT, GROWTH_STAGE)  
VALUES  
(2, 'Basil', 10, 26, 10, 'Seeding'),  
(4, 'Fern', 10, 24, 3, 'Adult'),  
(5, 'Sunflower', 1, 26, 3, 'Seeding'),  
(1, 'Rose', 7, 23, 10, 'Seeding'),  
(3, 'Orchid', 10, 23, 7, 'Mature');
```

```
INSERT INTO inventory (INVENTORY_ID, TOOLS, QUANTITY,  
LASTRESTOCKEDDATA, INVENTORY_NAME)
```



VALUES

```
(1, 'Shovels', 10, '2023-10-21', 'One'),  
(4, 'Wheelbarrows', 5, '2023-10-05', 'Three'),  
(3, 'Rakes', 20, '2023-09-30', 'Two'),  
(2, 'Hoes', 15, '2023-10-01', 'One'),  
(5, 'Pruners', 12, '2023-05-10', 'Four');
```

```
INSERT INTO sensors (SENSOR_ID, LOCATION, SLEEP_MODE,  
FUNCTIONAL_CATAGORY, USER_ID)
```

VALUES

```
(1, 'West', 1, 'Soil', 2),  
(5, 'East', 0, 'Temperature', 5),  
(2, 'South', 1, 'Temperature', 2),  
(3, 'South', 0, 'Light', 2),  
(4, 'North', 0, 'pH', 3);
```

-- Assuming "sensor data" is the name of your table

```
INSERT INTO sensor data (SEN_ID, D_ID, TIMESTAMPDATA, SENSORVALUE)
```

VALUES

```
(3, 3, '2023-10-21', 19),  
(1, 1, '2023-10-26', 25),  
(2, 2, '2023-10-22', 27),  
(4, 4, '2023-10-15', 16);
```

## - Table ScreenShot:

### IUSER TABLE

| IUSER   |         |            |          |          |
|---|---------|------------|----------|----------|
| Columns Data Indexes Constraints Grants Statistics Triggers Dependencies DDL Sample Queries |         |            |          |          |
| + Insert Row Columns... Filter... Count Rows Load Data Download Refresh                     |         |            |          |          |
|   | USER_ID | ROLE       | PASSWORD | USERNAME |
|   | 1       | supervisor | 1234567  | Faisal   |
|   | 2       | Farmer     | 1234567  | Ahmed    |
|   | 4       | Farmer     | 1234567  | Khaled   |
|   | 5       | Farmer     | 1234567  | Yazeed   |
|   | 3       |            | 1234567  | Ali      |



## Inventory Table

| INVENTORY_ID  |              |              |          |                  |                |  |
|---|--------------|--------------|----------|------------------|----------------|--|
| Columns Data Indexes Constraints Grants Statistics Triggers Dependencies DDL Sample Queries |              |              |          |                  |                |  |
| + Insert Row Columns... Filter... Count Rows Load Data Download Refresh                     |              |              |          |                  |                |  |
|   | INVENTORY_ID | TOOLS        | QUANTITY | LASTRESOTKEDDATA | INVENTORY_NAME |  |
|   | 1            | Shovels      | 10       | 10/21/2023       | One            |  |
|   | 4            | Wheelbarrows | 5        | 10/05/2023       | Three          |  |
|   | 3            | Rakes        | 20       | 09/30/2023       | Two            |  |
|   | 2            | Hoes         | 15       | 10/01/2023       | One            |  |
|   | 5            | Pruners      | 12       | 05/10/2023       | Four           |  |

## PLANTS Table

| PLANTS  |          |            |                |            |             |              |
|---|----------|------------|----------------|------------|-------------|--------------|
| Columns Data Indexes Constraints Grants Statistics Triggers Dependencies DDL Sample Queries |          |            |                |            |             |              |
| + Insert Row Columns... Filter... Count Rows Load Data Download Refresh                     |          |            |                |            |             |              |
|   | PLANT_ID | PLANT_NAME | IDEAL_MOISTURE | IDEAL_TEMP | IDEAL_LIGHT | GROWTH_STAGE |
|   | 2        | Basil      | 10             | 26         | 10          | Seeding      |
|   | 4        | Fern       | 10             | 24         | 3           | Adult        |
|   | 5        | Sunflower  | 1              | 26         | 3           | Seeding      |
|   | 1        | Rose       | 7              | 23         | 10          | Seeding      |
|   | 3        | Orchid     | 10             | 23         | 7           | Mature       |



## Sensor Table

| SENSOR  |           |          |            |                      |         |  |
|---|-----------|----------|------------|----------------------|---------|--|
| Columns Data Indexes Constraints Grants Statistics Triggers Dependencies DDL Sample Queries |           |          |            |                      |         |  |
| + Insert Row Columns... Filter... Count Rows Load Data Download Refresh                     |           |          |            |                      |         |  |
|   | SENSOR_ID | LOCATION | SLEEP_MODE | FUNCATIONAL_CATAGORY | USER_ID |  |
|   | 1         | West     | 1          | Soil                 | 2       |  |
|   | 5         | East     | 0          | Temperature          | 5       |  |
|   | 2         | South    | 1          | Temperature          | 2       |  |
|   | 3         | South    | 0          | Light                | 2       |  |
|   | 4         | North    | 0          | pH                   | 3       |  |

## Sensor\_Data Table

| SENSOR_DATA   |        |      |               |             |
|---|--------|------|---------------|-------------|
| Columns Data Indexes Constraints Grants Statistics Triggers Dependencies DDL Sample Queries |        |      |               |             |
| + Insert Row Columns... Filter... Count Rows Load Data Download Refresh                     |        |      |               |             |
|   | SEN_ID | D_ID | TIMESTAMPDATA | SENSORVALUE |
|   | 3      | 3    | 10/21/2023    | 19          |
|   | 1      | 1    | 10/26/2023    | 25          |
|   | 2      | 2    | 10/22/2023    | 27          |
|   | 4      | 4    | 10/15/2023    | 16          |



## - Query Implementation:

### Views list:

- 1- **NonSupervisorUsersView: This view lists the usernames of users who are not supervisors (excluding users with the 'supervisor' role).**

```
CREATE VIEW NonSupervisorUsersView AS
SELECT "USERNAME"
FROM "IUSER"
WHERE "ROLE" <> 'supervisor';
```

- 2- **This view displays plants with their ideal temperature and light conditions.**

```
CREATE VIEW PlantIdealConditionsView AS
SELECT PLANT_NAME, IDEAL_TEMP, IDEAL_LIGHT
FROM PLANTS;
```

- 3- **This view lists inventory items that have not been restocked.**

```
CREATE VIEW InventoryRestockStatusView AS
SELECT INVENTORY_NAME, LASTRESOTKEDDATA
FROM INVENTORY_ID
WHERE LASTRESOTKEDDATA IS NULL;
```

- 4- **This view lists all active sensors (those with SLEEP\_MODE = 0).**

```
CREATE VIEW ActiveSensorsView AS
SELECT SENSOR_ID, LOCATION, FUNCATIONAL_CATAGORY
FROM SENSOR
WHERE SLEEP_MODE = 0;
```



### Queries list:

- 1- Retrieve the users who have added sensors and the number of sensors they added**

```
SELECT U.USERNAME, COUNT(S.SENSOR_ID) AS NUM_SENSORS
FROM IUSER U
LEFT JOIN SENSOR S ON U.USER_ID = S.USER_ID
GROUP BY U.USERNAME;
```

- 2- Find the plants that require an ideal temperature of 25 or higher:**

```
SELECT "PLANT_NAME", "IDEAL_TEMP"
FROM "PLANTS"
WHERE "IDEAL_TEMP" >= 25;
```

- 3- Find the total quantity of each tool in the inventory:**

```
SELECT "TOOLS", SUM("QUANTITY") AS "TOTAL_QUANTITY"
FROM "INVENTORY_ID"
GROUP BY "TOOLS";
```

- 4- Retrieve the user information for a specific user by their username (e.g., 'Ahmed'):**

```
SELECT * FROM "IUSER" WHERE "USERNAME" = 'Ahmed';
```

- 5- Find the plants that are not in the 'Mature' growth stage:**

```
SELECT "PLANT_NAME", "GROWTH_STAGE"
FROM "PLANTS"
WHERE "GROWTH_STAGE" <> 'Mature';
```

- 6- Find the plants with an ideal light level less than 5:**

```
SELECT "PLANT_NAME", "IDEAL_LIGHT"
FROM "PLANTS"
WHERE "IDEAL_LIGHT" < 5;
```

- 7- Calculate the average ideal temperature for all plants:**
- ```
SELECT
    AVG("IDEAL_TEMP") AS "AverageIdealTemperature";
```



**8- Find the plants with an ideal moisture level greater than 5 and an ideal temperature between 20 and 30:**

```
SELECT "PLANT_NAME", "IDEAL_MOISTURE", "IDEAL_TEMP"  
FROM "PLANTS"  
WHERE "IDEAL_MOISTURE" > 5 AND "IDEAL_TEMP" BETWEEN 20 AND  
30;
```

**9- Calculate the total quantity of items in inventory:**

```
SELECT SUM("QUANTITY") AS "TotalQuantity"  
FROM "INVENTORY_ID";
```

**10- List the usernames of users who are not supervisors (excluding users with 'supervisor' role):**

```
SELECT "USERNAME"  
FROM "IUSER"  
WHERE "ROLE" <> 'supervisor';
```

## - Result:

### Views:

- Result from View number 1

| SENSOR_ID | LOCATION | FUNCTIONAL_CATAGORY |
|-----------|----------|---------------------|
| 1         | West     | Soil                |
| 5         | East     | Temperature         |
| 2         | South    | Temperature         |
| 3         | South    | Light               |
| 4         | North    | pH                  |

- Result from View number 2

| PLANT_NAME | IDEAL_TEMP | IDEAL_LIGHT |
|------------|------------|-------------|
| Basil      | 26         | 10          |
| Fern       | 24         | 3           |
| Sunflower  | 26         | 3           |
| Rose       | 23         | 10          |
| Orchid     | 23         | 7           |



### Querys:

- Result from query number 2

| PLANT_NAME | IDEAL_TEMP |
|------------|------------|
| Basil      | 26         |
| Sunflower  | 26         |

- Result from query number 3

| TOOLS        | TOTAL_QUANTITY |
|--------------|----------------|
| Shovels      | 10             |
| Hoes         | 15             |
| Pruners      | 12             |
| Rakes        | 20             |
| Wheelbarrows | 5              |

- Result from query number 4

| USER_ID | ROLE   | PASSWORD | USERNAME |
|---------|--------|----------|----------|
| 2       | Farmer | 1234567  | Ahmed    |

- Result from query number 5

| PLANT_NAME | GROWTH_STAGE |
|------------|--------------|
| Basil      | Seeding      |
| Fern       | Adult        |
| Sunflower  | Seeding      |
| Rose       | Seeding      |

- Result from query number 6

| PLANT_NAME | IDEAL_LIGHT |
|------------|-------------|
| Fern       | 3           |
| Sunflower  | 3           |

- Result from query number 9

| TotalQuantity |
|---------------|
| 62            |

- Result from query number 10

| USERNAME |
|----------|
| Faisal   |
| Ahmed    |
| Khaled   |
| Yazeed   |
| Ali      |





- Result from query number 1

| USERNAME | NUM_SENSORS |
|----------|-------------|
| Yazeed   | 1           |
| Ahmed    | 3           |
| Khaled   | 0           |
| Ali      | 1           |
| Faisal   | 0           |