

DBMS SQL PROJECT

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BT23CSE212

**SMART IRRIGATION & SMART FARM MANAGEMENT
SYSTEM**

Submitted to – Dr. Karan Potdukhe

CODE + QUERIES

```
CREATE DATABASE project;
```

```
USE project;
```

■ TABLES

```
CREATE TABLE farmers (  
    farmer_id INT PRIMARY KEY,  
    name VARCHAR(50),  
    phone VARCHAR(15),  
    village VARCHAR(50)  
);
```

```
INSERT INTO farmers VALUES  
  
(1, 'Ravi Singh', '9876543210', 'Rampur'),  
(2, 'Asha Devi', '9123456780', 'Lakhnipur'),  
(3, 'Mohit Yadav', '9988776655', 'Kesar Nagar'),  
(4, 'Suman Rao', '9012345678', 'Jaitpur'),  
(5, 'Harish Kumar', '8899776655', 'Bairiya'),  
(6, 'Nisha Verma', '9811122233', 'Lakhnipur'),  
(7, 'Pawan Mehta', '9090909090', 'Rampur'),  
(8, 'Komal Singh', '9345677889', 'Goripur'),  
(9, 'Arjun Chauhan', '9556677889', 'Kesar Nagar'),  
(10, 'Krishna Patel', '9001122334', 'Bairiya');
```

	farmer_id	name	phone	village
▶	1	Ravi Singh	9876543210	Rampur
	2	Asha Devi	9123456780	Lakhnipur
	3	Mohit Yadav	9988776655	Kesar Nagar
	4	Suman Rao	9012345678	Jaitpur
	5	Harish Kumar	8899776655	Bairiya
	6	Nisha Verma	9811122233	Lakhnipur
	7	Pawan Mehta	9090909090	Rampur
	8	Komal Singh	9345677889	Goripur
	9	Arjun Chauhan	9556677889	Kesar Nagar
	10	Krishna Patel	9001122334	Bairiya
	NULL	NULL	NULL	NULL

```
CREATE TABLE fields (
    field_id INT PRIMARY KEY,
    farmer_id INT,
    area_acres DECIMAL(5,2),
    soil_type VARCHAR(20),
    crop_type VARCHAR(30),
    FOREIGN KEY (farmer_id) REFERENCES farmers(farmer_id)
);
```

```
INSERT INTO fields VALUES
(101, 1, 2.5, 'Loamy', 'Wheat'),
(102, 1, 1.8, 'Clay', 'Sugarcane'),
(103, 2, 3.2, 'Sandy', 'Rice'),
(104, 3, 1.0, 'Loamy', 'Vegetables'),
(105, 4, 4.5, 'Clay', 'Cotton'),
(106, 5, 2.2, 'Silty', 'Wheat'),
(107, 6, 3.0, 'Loamy', 'Maize'),
(108, 7, 1.5, 'Sandy', 'Rice'),
(109, 8, 2.0, 'Clay', 'Sugarcane'),
(110, 9, 3.3, 'Loamy', 'Wheat');
```

	field_id	farmer_id	area_acres	soil_type	crop_type
▶	101	1	2.50	Loamy	Wheat
	102	1	1.80	Clay	Sugarcane
	103	2	3.20	Sandy	Rice
	104	3	1.00	Loamy	Vegetables
	105	4	4.50	Clay	Cotton
	106	5	2.20	Silty	Wheat
	107	6	3.00	Loamy	Maize
	108	7	1.50	Sandy	Rice
	109	8	2.00	Clay	Sugarcane
	110	9	3.30	Loamy	Wheat
✱	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE devices (
    device_id VARCHAR(10) PRIMARY KEY,
    field_id INT,
    device_type VARCHAR(30),
    install_date DATE,
    status VARCHAR(20),
    FOREIGN KEY (field_id) REFERENCES fields(field_id)
);
```

```
INSERT INTO devices VALUES
('D01',101,'moisture_sensor','2024-01-11','active'),
('D02',101,'camera','2024-01-15','active'),
('D03',102,'moisture_sensor','2024-01-20','inactive'),
('D04',103,'pump','2024-02-01','active'),
('D05',104,'light','2024-02-14','active'),
('D06',105,'camera','2024-02-20','active'),
('D07',106,'pump','2024-03-01','inactive'),
('D08',107,'moisture_sensor','2024-03-04','active'),
('D09',108,'light','2024-03-10','active'),
('D10',109,'camera','2024-03-12','active'),
('D11',110,'moisture_sensor','2024-03-14','active'),
('D12',103,'camera','2024-03-18','inactive');
```

	device_id	field_id	device_type	install_date	status
▶	D01	101	moisture_sensor	2024-01-11	active
	D02	101	camera	2024-01-15	active
	D03	102	moisture_sensor	2024-01-20	inactive
	D04	103	pump	2024-02-01	active
	D05	104	light	2024-02-14	active
	D06	105	camera	2024-02-20	active
	D07	106	pump	2024-03-01	inactive
	D08	107	moisture_sensor	2024-03-04	active
	D09	108	light	2024-03-10	active
	D10	109	camera	2024-03-12	active
	D11	110	moisture_sensor	2024-03-14	active
	D12	103	camera	2024-03-18	inactive
	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE sensor_data (
    data_id INT PRIMARY KEY,
    device_id VARCHAR(10),
    timestamp DATETIME,
    moisture_level INT,
    temperature DECIMAL(5,2),
    ph_level DECIMAL(4,2),
    FOREIGN KEY (device_id) REFERENCES devices(device_id)
);
```

```
INSERT INTO sensor_data VALUES
(1,'D01','2024-03-10 10:00',40,28.5,6.5),
(2,'D01','2024-03-10 14:00',38,29.0,6.4),
(3,'D03','2024-03-11 09:00',22,32.1,6.8),
(4,'D08','2024-03-11 11:00',33,31.0,6.7),
(5,'D11','2024-03-11 13:00',45,27.5,6.3),
(6,'D01','2024-03-12 10:00',42,30.2,6.6),
(7,'D08','2024-03-12 11:30',35,29.8,6.6),
(8,'D11','2024-03-12 14:00',47,30.1,6.4),
(9,'D03','2024-03-13 08:00',20,33.2,7.0),
(10,'D01','2024-03-13 10:00',39,28.2,6.5),
(11,'D08','2024-03-14 12:00',36,30.0,6.8),
```

```

(12,'D11','2024-03-14 15:30',50,28.8,6.2),
(13,'D04','2024-03-10 09:00',NULL,27.0,6.5),
(14,'D04','2024-03-11 09:00',NULL,26.8,6.4),
(15,'D05','2024-03-12 18:00',NULL,25.0,6.2),
(16,'D09','2024-03-12 19:00',NULL,24.0,6.3),
(17,'D10','2024-03-12 20:00',NULL,25.2,6.5),
(18,'D12','2024-03-13 22:00',NULL,27.2,6.7),
(19,'D06','2024-03-14 21:00',NULL,26.5,6.1),
(20,'D07','2024-03-14 23:00',NULL,29.0,6.4);

```

	data_id	device_id	timestamp	moisture_level	temperature	ph_level
▶	1	D01	2024-03-10 10:00:00	40	28.50	6.50
	2	D01	2024-03-10 14:00:00	38	29.00	6.40
	3	D03	2024-03-11 09:00:00	22	32.10	6.80
	4	D08	2024-03-11 11:00:00	33	31.00	6.70
	5	D11	2024-03-11 13:00:00	45	27.50	6.30
	6	D01	2024-03-12 10:00:00	42	30.20	6.60
	7	D08	2024-03-12 11:30:00	35	29.80	6.60
	8	D11	2024-03-12 14:00:00	47	30.10	6.40
	9	D03	2024-03-13 08:00:00	20	33.20	7.00
	10	D01	2024-03-13 10:00:00	39	28.20	6.50
	11	D08	2024-03-14 12:00:00	36	30.00	6.80
	12	D11	2024-03-14 15:30:00	50	28.80	6.20
	13	D04	2024-03-10 09:00:00	NULL	27.00	6.50
	14	D04	2024-03-11 09:00:00	NULL	26.80	6.40
	15	D05	2024-03-12 18:00:00	NULL	25.00	6.20
	16	D09	2024-03-12 19:00:00	NULL	24.00	6.30
	17	D10	2024-03-12 20:00:00	NULL	25.20	6.50
	18	D12	2024-03-13 22:00:00	NULL	27.20	6.70
	19	D06	2024-03-14 21:00:00	NULL	26.50	6.10
	20	D07	2024-03-14 23:00:00	NULL	29.00	6.40
⌵	NULL	NULL	NULL	NULL	NULL	NULL

```

CREATE TABLE irrigation_log (
    log_id INT PRIMARY KEY,
    field_id INT,
    start_time DATETIME,
    end_time DATETIME,
    water_used_ltrs INT,
    triggered_by VARCHAR(20),
    FOREIGN KEY (field_id) REFERENCES fields(field_id)
);

```

INSERT INTO irrigation_log VALUES

```
(1,101,'2024-03-10 06:00','2024-03-10 06:20',120,'auto'),
(2,102,'2024-03-10 07:00','2024-03-10 07:30',150,'manual'),
(3,103,'2024-03-10 08:00','2024-03-10 08:10',80,'auto'),
(4,104,'2024-03-11 06:40','2024-03-11 06:55',90,'manual'),
(5,105,'2024-03-11 07:10','2024-03-11 07:40',160,'auto'),
(6,106,'2024-03-11 08:00','2024-03-11 08:35',200,'manual'),
(7,107,'2024-03-12 06:00','2024-03-12 06:15',110,'auto'),
(8,108,'2024-03-12 07:20','2024-03-12 07:35',95,'manual'),
(9,109,'2024-03-12 08:00','2024-03-12 08:20',130,'auto'),
(10,110,'2024-03-13 06:00','2024-03-13 06:18',125,'auto'),
(11,101,'2024-03-13 07:00','2024-03-13 07:25',140,'manual'),
(12,102,'2024-03-14 09:00','2024-03-14 09:30',155,'auto');
```

	log_id	field_id	start_time	end_time	water_used_ltrs	triggered_by
▶	1	101	2024-03-10 06:00:00	2024-03-10 06:20:00	120	auto
	2	102	2024-03-10 07:00:00	2024-03-10 07:30:00	150	manual
	3	103	2024-03-10 08:00:00	2024-03-10 08:10:00	80	auto
	4	104	2024-03-11 06:40:00	2024-03-11 06:55:00	90	manual
	5	105	2024-03-11 07:10:00	2024-03-11 07:40:00	160	auto
	6	106	2024-03-11 08:00:00	2024-03-11 08:35:00	200	manual
	7	107	2024-03-12 06:00:00	2024-03-12 06:15:00	110	auto
	8	108	2024-03-12 07:20:00	2024-03-12 07:35:00	95	manual
	9	109	2024-03-12 08:00:00	2024-03-12 08:20:00	130	auto
	10	110	2024-03-13 06:00:00	2024-03-13 06:18:00	125	auto
	11	101	2024-03-13 07:00:00	2024-03-13 07:25:00	140	manual
	12	102	2024-03-14 09:00:00	2024-03-14 09:30:00	155	auto
*	NULL	NULL	NULL	NULL	NULL	NULL

CREATE TABLE alerts (

 alert_id INT PRIMARY KEY,

 device_id VARCHAR(10),

 timestamp DATETIME,

 alert_type VARCHAR(30),

 description VARCHAR(255),

 FOREIGN KEY (device_id) REFERENCES devices(device_id)

);

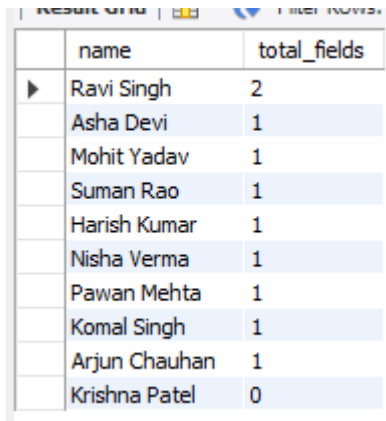
```
INSERT INTO alerts VALUES
(1,'D01','2024-03-10 10:10','low_moisture','Moisture dropped below threshold'),
(2,'D03','2024-03-10 11:00','device_inactive','Sensor not responding'),
(3,'D08','2024-03-11 12:00','low_moisture','Low moisture detected'),
(4,'D11','2024-03-11 14:10','high_temp','Temperature above normal'),
(5,'D12','2024-03-12 22:10','device_inactive','Camera offline'),
(6,'D05','2024-03-12 19:10','low_light','Light level very low'),
(7,'D09','2024-03-13 14:00','low_light','Light intensity low'),
(8,'D04','2024-03-13 10:30','pump_error','Pump pressure unstable'),
(9,'D01','2024-03-13 11:30','low_moisture','Repeated low moisture'),
(10,'D03','2024-03-14 09:00','device_inactive','Sensor remains offline'),
(11,'D10','2024-03-14 20:00','camera_blocked','Camera view obstructed'),
(12,'D06','2024-03-14 21:10','low_light','Low light warning detected');
```

	alert_id	device_id	timestamp	alert_type	description
▶	1	D01	2024-03-10 10:10:00	low_moisture	Moisture dropped below threshold
	2	D03	2024-03-10 11:00:00	device_inactive	Sensor not responding
	3	D08	2024-03-11 12:00:00	low_moisture	Low moisture detected
	4	D11	2024-03-11 14:10:00	high_temp	Temperature above normal
	5	D12	2024-03-12 22:10:00	device_inactive	Camera offline
	6	D05	2024-03-12 19:10:00	low_light	Light level very low
	7	D09	2024-03-13 14:00:00	low_light	Light intensity low
	8	D04	2024-03-13 10:30:00	pump_error	Pump pressure unstable
	9	D01	2024-03-13 11:30:00	low_moisture	Repeated low moisture
	10	D03	2024-03-14 09:00:00	device_inactive	Sensor remains offline
	11	D10	2024-03-14 20:00:00	camera_blocked	Camera view obstructed
	12	D06	2024-03-14 21:10:00	low_light	Low light warning detected
▲	NULL	NULL	NULL	NULL	NULL

■ QUERIES

- 1) Write a query to display the name of each farmer along with the total number of fields owned by that farmer.

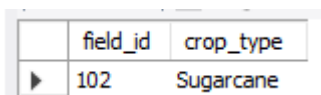
```
SELECT f.name, COUNT(field_id) AS total_fields
FROM farmers f
LEFT JOIN fields fl ON f.farmer_id = fl.farmer_id
GROUP BY f.name;
```



	name	total_fields
▶	Ravi Singh	2
	Asha Devi	1
	Mohit Yadav	1
	Suman Rao	1
	Harish Kumar	1
	Nisha Verma	1
	Pawan Mehta	1
	Komal Singh	1
	Arjun Chauhan	1
	Krishna Patel	0

- 2) Write a query to find all moisture sensors that are currently inactive and show the field ID and crop planted in those fields.

```
SELECT fl.field_id, fl.crop_type
FROM fields fl
JOIN devices d ON fl.field_id = d.field_id
WHERE d.device_type='moisture_sensor'
AND d.status='inactive';
```



	field_id	crop_type
▶	102	Sugarcane

- 3) Write a query to list all devices which have generated at least one alert in the month of March 2024.

```
SELECT DISTINCT d.device_id, d.device_type
FROM devices d
JOIN alerts a ON d.device_id = a.device_id
WHERE MONTH(a.timestamp)=3 AND YEAR(a.timestamp)=2024;
```

	device_id	device_type
▶	D01	moisture_sensor
	D03	moisture_sensor
	D04	pump
	D05	light
	D06	camera
	D08	moisture_sensor
	D09	light
	D10	camera
	D11	moisture_sensor
	D12	camera

- 4) Write a query to display the total amount of water used by each field, arranged from highest to lowest water consumption.

```
SELECT field_id, SUM(water_used_ltrs) AS total_water
FROM irrigation_log
GROUP BY field_id
ORDER BY total_water DESC;
```

	field_id	total_water
▶	102	305
	101	260
	106	200
	105	160
	109	130
	110	125
	107	110
	108	95
	104	90
	103	80

- 5) Write a query to find all farmers whose fields have received manual irrigation at least two times.

```
SELECT f.name
FROM farmers f
JOIN fields fl ON f.farmer_id = fl.farmer_id
JOIN irrigation_log il ON fl.field_id = il.field_id
WHERE il.triggered_by='manual'
GROUP BY f.name
HAVING COUNT(*) >= 2;
```

	name
▶	Ravi Singh

- 6) Write a query to display all fields whose latest recorded moisture value is above 40.

```
SELECT fl.field_id, sd.moisture_level
```

```

FROM fields fl
JOIN devices d ON fl.field_id = d.field_id
JOIN sensor_data sd ON d.device_id = sd.device_id
WHERE sd.moisture_level > 40;

```

	field_id	moisture_level
▶	110	45
	101	42
	110	47
	110	50

- 7) Write a query to display the field ID and the highest temperature recorded for that field.

```

SELECT fl.field_id, MAX(sd.temperature) AS max_temp
FROM fields fl
JOIN devices d ON fl.field_id = d.field_id
JOIN sensor_data sd ON d.device_id = sd.device_id
GROUP BY fl.field_id;

```

	field_id	max_temp
▶	101	30.20
	102	33.20
	103	27.20
	104	25.00
	105	26.50
	106	29.00
	107	31.00
	108	24.00
	109	25.20
	110	30.10

- 8) Write a query to find all cameras installed before 20 January 2024.

```

SELECT device_id, field_id
FROM devices
WHERE device_type='camera'
AND install_date < '2024-01-20';

```

	device_id	field_id
▶	D02	101
*	NULL	NULL

- 9) Write a query to show the monthly total water usage for each farmer.

```

SELECT f.name,
       MONTH(il.start_time) AS month,
       SUM(il.water_used_ltrs) AS total_used
FROM farmers f

```

```

JOIN fields fl ON f.farmer_id = fl.farmer_id
JOIN irrigation_log il ON fl.field_id = il.field_id
GROUP BY f.name, month
ORDER BY month;

```

	name	month	total_used
▶	Ravi Singh	3	565
	Asha Devi	3	80
	Mohit Yadav	3	90
	Suman Rao	3	160
	Harish Kumar	3	200
	Nisha Verma	3	110
	Pawan Mehta	3	95
	Komal Singh	3	130
	Arjun Chauhan	3	125

10) Write a query to count how many alerts each device has generated.

```

SELECT d.device_id, COUNT(a.alert_id) AS alert_count
FROM devices d
LEFT JOIN alerts a ON d.device_id = a.device_id
GROUP BY d.device_id;

```

	device_id	alert_count
▶	D01	2
	D02	0
	D03	2
	D04	1
	D05	1
	D06	1
	D07	0
	D08	1
	D09	1
	D10	1
	D11	1
	D12	1

11) Write a query to list fields that have both a camera and a light device installed.

```

SELECT field_id
FROM devices
WHERE device_type IN ('camera','light')
GROUP BY field_id
HAVING COUNT(DISTINCT device_type)=2;

```

field_id

12) Write a query to display average moisture, temperature, and pH value of each field.

```

SELECT fl.field_id,

```

```

    AVG(sd.moisture_level) AS avg_moisture,
    AVG(sd.temperature) AS avg_temp,
    AVG(sd.ph_level) AS avg_ph
FROM fields fl
JOIN devices d ON fl.field_id = d.field_id
JOIN sensor_data sd ON d.device_id = sd.device_id
GROUP BY fl.field_id;

```

	field_id	avg_moisture	avg_temp	avg_ph
▶	101	39.7500	28.975000	6.500000
	102	21.0000	32.650000	6.900000
	103	NULL	27.000000	6.533333
	104	NULL	25.000000	6.200000
	105	NULL	26.500000	6.100000
	106	NULL	29.000000	6.400000
	107	34.6667	30.266667	6.700000
	108	NULL	24.000000	6.300000
	109	NULL	25.200000	6.500000
	110	47.3333	28.800000	6.300000

13) Write a query to list all fields where auto irrigation was triggered due to low moisture alerts.

```

SELECT DISTINCT il.field_id
FROM irrigation_log il
JOIN fields fl ON il.field_id = fl.field_id
JOIN devices d ON fl.field_id = d.field_id
JOIN alerts a ON d.device_id = a.device_id
WHERE il.triggered_by='auto'
AND a.alert_type='low_moisture';

```

	field_id
▶	101
	107

14) Write a query to display all farmers whose fields have recorded temperatures above 32 degrees at least once.

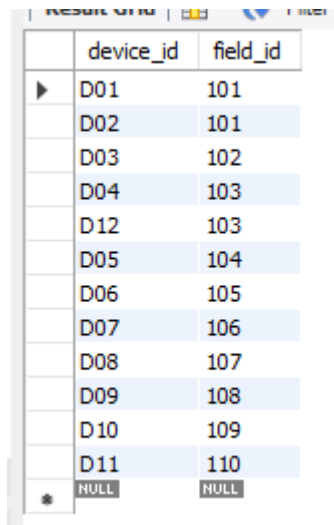
```

SELECT DISTINCT f.name
FROM farmers f
JOIN fields fl ON f.farmer_id = fl.farmer_id
JOIN devices d ON fl.field_id = d.field_id
JOIN sensor_data sd ON d.device_id = sd.device_id
WHERE sd.temperature > 32;

```


18) Find devices that are currently active

```
SELECT device_id, field_id, start_time  
FROM DEVICES  
WHERE end_time IS NULL;
```

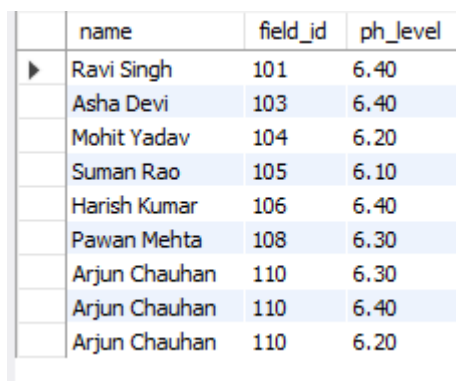


A screenshot of a database query result window. The window title is 'Result Grid'. It shows a table with two columns: 'device_id' and 'field_id'. The table contains 12 rows of data, with the last row showing 'NULL' for both fields. The rows are: D01, 101; D02, 101; D03, 102; D04, 103; D12, 103; D05, 104; D06, 105; D07, 106; D08, 107; D09, 108; D10, 109; D11, 110; and a final row with NULL and NULL.

device_id	field_id
D01	101
D02	101
D03	102
D04	103
D12	103
D05	104
D06	105
D07	106
D08	107
D09	108
D10	109
D11	110
NULL	NULL

19) Check which farmers have fields with pH less than 6.5 OR more than 7.5

```
SELECT DISTINCT f.name, fi.field_id, s.ph_level  
FROM SENSOR_DATA s  
JOIN DEVICES d ON s.device_id = d.device_id  
JOIN FIELDS fi ON d.field_id = fi.field_id  
JOIN FARMERS f ON fi.farmer_id = f.farmer_id  
WHERE s.ph_level < 6.5 OR s.ph_level > 7.5;
```



A screenshot of a database query result window. The window title is 'Result Grid'. It shows a table with three columns: 'name', 'field_id', and 'ph_level'. The table contains 9 rows of data. The rows are: Ravi Singh, 101, 6.40; Asha Devi, 103, 6.40; Mohit Yadav, 104, 6.20; Suman Rao, 105, 6.10; Harish Kumar, 106, 6.40; Pawan Mehta, 108, 6.30; Arjun Chauhan, 110, 6.30; Arjun Chauhan, 110, 6.40; and Arjun Chauhan, 110, 6.20.

name	field_id	ph_level
Ravi Singh	101	6.40
Asha Devi	103	6.40
Mohit Yadav	104	6.20
Suman Rao	105	6.10
Harish Kumar	106	6.40
Pawan Mehta	108	6.30
Arjun Chauhan	110	6.30
Arjun Chauhan	110	6.40
Arjun Chauhan	110	6.20

20) Identify fields that have not been irrigated in last 7 days

```
SELECT fi.field_id, f.name AS farmer_name
FROM FIELDS fi
JOIN FARMERS f ON fi.farmer_id = f.farmer_id
WHERE fi.field_id NOT IN (
    SELECT DISTINCT field_id
    FROM IRRIGATION_LOG
    WHERE start_time >= NOW() - INTERVAL 7 DAY
);
```

	field_id	farmer_name
▶	101	Ravi Singh
	102	Ravi Singh
	103	Asha Devi
	104	Mohit Yadav
	105	Suman Rao
	106	Harish Kumar
	107	Nisha Verma
	108	Pawan Mehta
	109	Komal Singh
	110	Arjun Chauhan

ER DIAGRAM

