DIGITAL EVAPORIMETER

IOT LAB EVALUATION REPORT

GROUP-3

ARUN KUMAR J **[CB.EN.U4CSE21106]**

ASHWIN SHARMA **[CB.EN.U4CSE21108]**

KAMALESH L **[CB.EN.U4CSE21127]**

TABLE OF CONTENTS

1.MODEL OVERVIEW

The Digital Evaporimeter is a sophisticated IoT-based system designed for agricultural purposes, specifically tailored for optimizing irrigation management. By integrating ESP32 microcontrollers and CoAP (Constrained Application Protocol) for communication, this system monitors evaporation rates, temperature, humidity, and wind speed. The collected data is then transmitted to the AWS cloud platform, enabling real-time analysis and informed decision-making for water resource management.

The Digital Evaporimeter offers a user-friendly dashboard accessible through web or mobile applications. This interface provides farmers with real-time insights into evaporation rates, weather conditions, and irrigation needs. Users can access historical data, receive alerts, and remotely control irrigation systems, fostering a more efficient and sustainable agricultural environment.

1.1 DATA ACQUISITION

1. ***Evaporimeter****: Measures the water level in the evaporation pan, providing primary data for calculating evaporation rates.*
2. ***Temperature Senso****r: Monitors air temperature, a crucial factor influencing evaporation rates.*
3. ***Humidity Senso****r: Measures humidity levels, aiding in assessing the impact of atmospheric moisture on evaporation.*
4. ***Wind Speed Sensor****: Records wind speed, a significant parameter affecting the rate of evaporation.*
5. ***Rain Drop Module****: Detects and quantifies rainfall by measuring the size and frequency of raindrops.*
6. ***Water Quality Sensor****: Analyses the quality of water in real-time, offering crucial information for irrigation and reservoir management.*

1.2 SUPERVISORY CONTROL

1. **Irrigation Scheduling:** Based on the collected data and calculated evaporation rates, the supervisory control system can assist in optimizing irrigation schedules. It can recommend precise timings and quantities for water application, minimizing water wastage and ensuring optimal crop growth.
2. **Sensor Integration:** The evaporimeter system typically includes sensors for measuring various environmental parameters such as temperature, humidity, wind speed, solar radiation, and water levels. These sensors provide real-time data that is essential for calculating evaporation rates and determining irrigation requirements.
3. **Alarm and Notification Systems:** The supervisory control system can incorporate alarm and notification systems to alert operators or farmers in case of deviations from desired parameters, equipment malfunctions, or critical events that require immediate attention.
4. **Data Logging and Analysis:** The system can log and store historical data, enabling trend analysis, performance monitoring, and informed decision-making for long-term water resource management and crop planning.
5. **User Interfaces and Reporting:** Intuitive user interfaces and reporting tools allow users to visualize data, analyze trends, and generate reports for better decision-making and record-keeping purposes.

2.SENSOR PLACEMENT MODEL

1. ***Evaporation Pan Water Level Sensor:***
    - *Position the sensor at the center of the evaporation pan to accurately measure water level changes.*
    - *Ensure that the sensor is securely fixed to prevent misalignment or disturbance during environmental conditions.*
2. ***Temperature Sensor:***
    - *Install the temperature sensor at a height above the evaporation pan to capture air temperature accurately.*
    - *Avoid placing the sensor in direct sunlight to prevent temperature readings from being influenced by external factors.*
3. ***Humidity Sensor:***
    - *Position the humidity sensor at a level where it can capture ambient moisture levels.*
    - *Avoid areas with potential water splashes to maintain sensor accuracy.*
4. ***Wind Speed Sensor:***
    - *Mount the wind speed sensor at an elevated position to capture undisturbed wind flow.*
    - *Ensure it faces the predominant wind direction for accurate readings.*

Fig 1: Evaporimeter Placement sample picture

3.CONTROL UNIT DESIGN

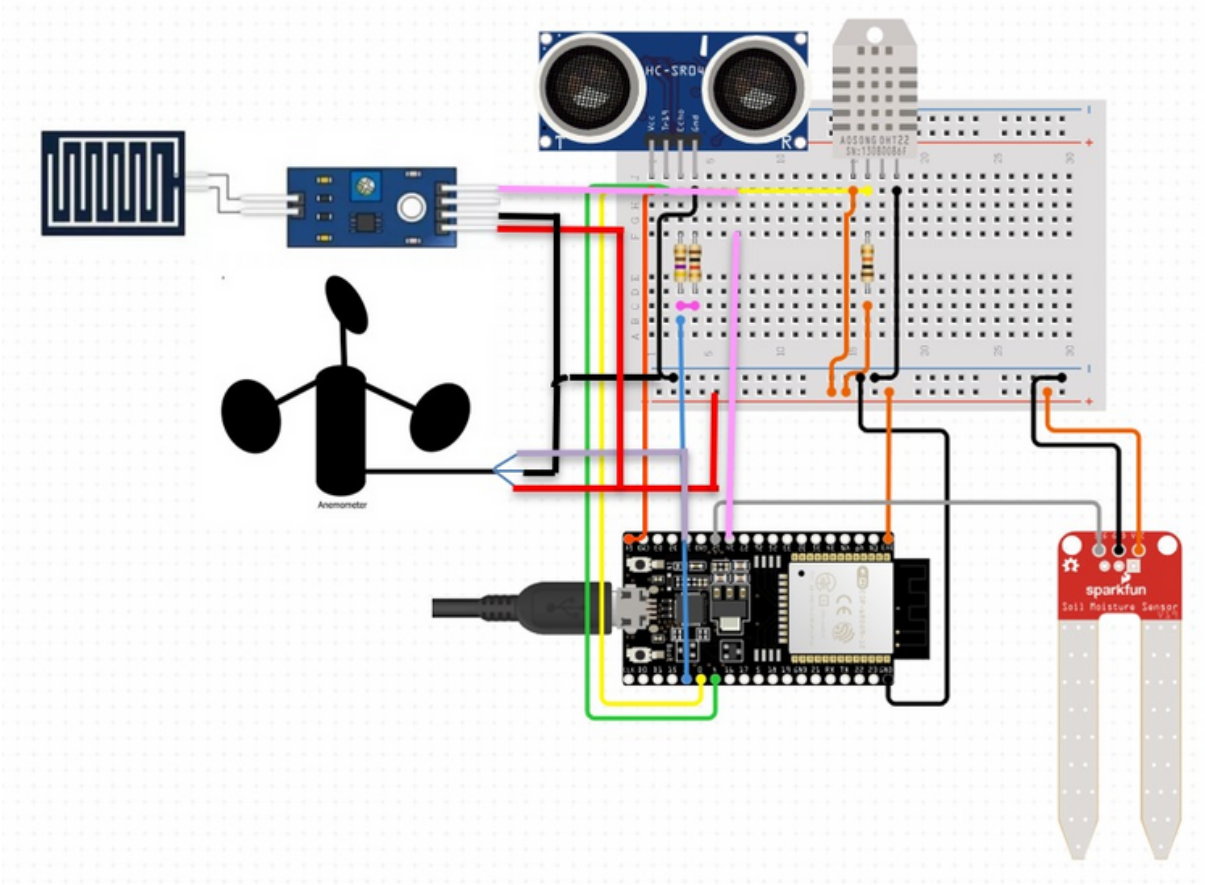


Fig 2: Schematic Representation

- The system comprises an ESP32 microcontroller connected to various sensors: an evaporimeter for measuring evaporation rate(depth is measured using ultrasonic sensor), temperature and humidity sensor for environmental conditions, soil moisture sensor for soil moisture levels, anemometer for wind speed measurement, and a raindrop sensor for detecting rainfall. Each sensor is appropriately wired to the ESP32, with power, ground, and signal connections established. This setup enables real-time monitoring of crucial agricultural parameters for effective crop management.
- The data from these sensors are recorded at periodic intervals to analyze the meteorological data and make insightful interpretations, thus predicting important agricultural decisions based on the climate data.

4.COMMUNICATION TECHNOLOGY AND TRANSMISSION PROTOCOL:

Wireless Fidelity IEEE 802.11.

- Leveraging Wi-Fi technology allows for high-speed data transfer and compatibility with existing infrastructure.
- Enables easy integration with local networks and ensures robust connectivity for data transmission.

COAP (Constrained Application Protocol)

- CoAP is chosen as the transmission protocol for its efficiency in constrained IoT environments.
- Specifically designed for resource-constrained devices, CoAP enables lightweight communication and minimizes overhead.

CoAP
Constrained Application
Protocol

HTTPS (Hypertext Transfer Protocol Secure)

- To secure data transmission between the ESP32 and AWS cloud, HTTPS is implemented.
- This protocol encrypts data, safeguarding it from potential security threats.

5. SELECTION OF HARDWARE COMPONENTS

1. Microcontroller: ESP32

The ESP32 is chosen as the microcontroller for its versatility, low power consumption, and built-in Wi-Fi capabilities. Its dual-core processor and ample memory make it suitable for handling sensor data and communication tasks efficiently. Additionally, the ESP32's compatibility with the Arduino IDE simplifies the development process.

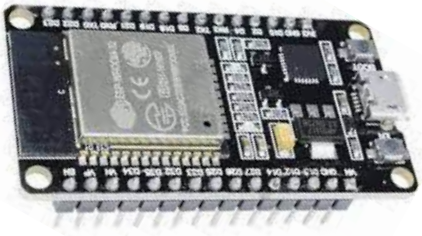


Fig 3: ESP32

2. Evaporation Pan Water Level Sensor

This sensor is crucial for measuring water levels in the evaporation pan, providing primary data for calculating evaporation rates. A reliable and accurate water level sensor ensures the precision of the system's core functionality.

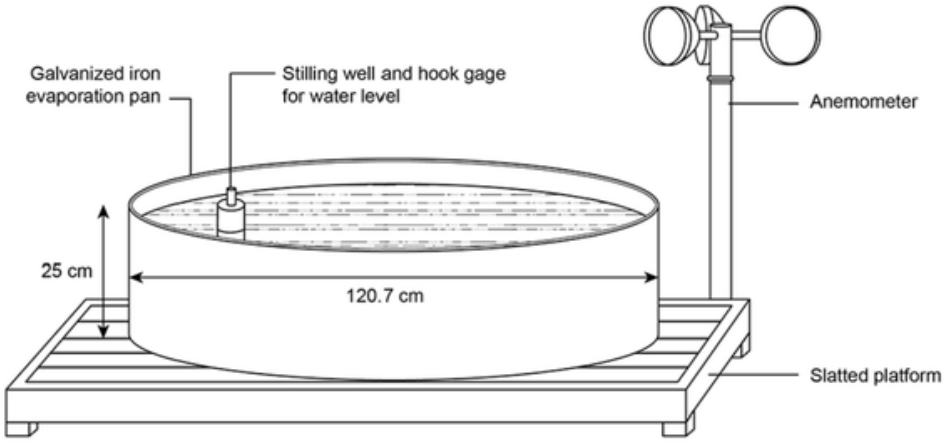


Fig 4: Evaporimeter

3. Temperature and humidity Sensor

Monitoring air temperature is essential for understanding its impact on evaporation rates. A temperature sensor enhances the Digital Evaporimeter's ability to make informed decisions about irrigation and water management based on environmental conditions. Measuring humidity levels aids in assessing the influence of atmospheric moisture on evaporation. This sensor contributes to a more comprehensive understanding of the environmental factors affecting water loss.

Fig 5: Temperature Sensor

4. Wind Speed Sensor

Wind speed is a significant parameter influencing evaporation rates. Integrating a wind speed sensor allows the system to consider this factor in its calculations, providing more accurate data for irrigation optimization.

Fig 6: Wind Speed Sensor

5. Soil Moisture Sensor

A soil moisture sensor measures the volumetric water content in the soil. It typically consists of probes or sensors that are inserted into the soil, and the readings are used to determine how much water is present in the soil at a given depth. This information helps in optimizing irrigation schedules, preventing over-watering or under-watering of crops.

Fig 7: Soil Moisture Sensor

6. UltraSonic Sensor

The ultrasonic sensor can measure the water level in the evaporation pan, providing an additional method for accurate water level readings. This data is essential for calculating evaporation rates.

.

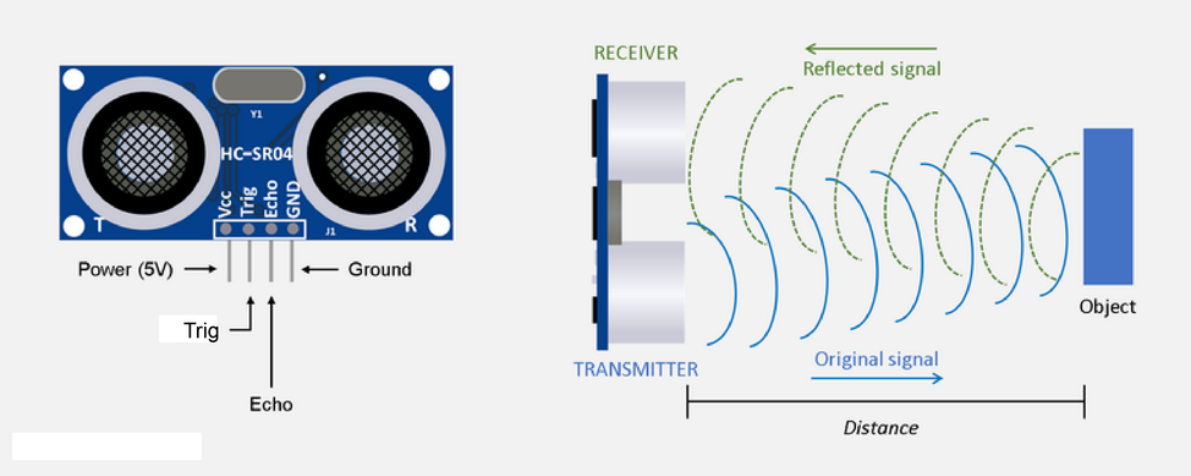


Fig 8: UltraSonic Sensor

6.DEPLOYMENT LEVEL DIAGRAM

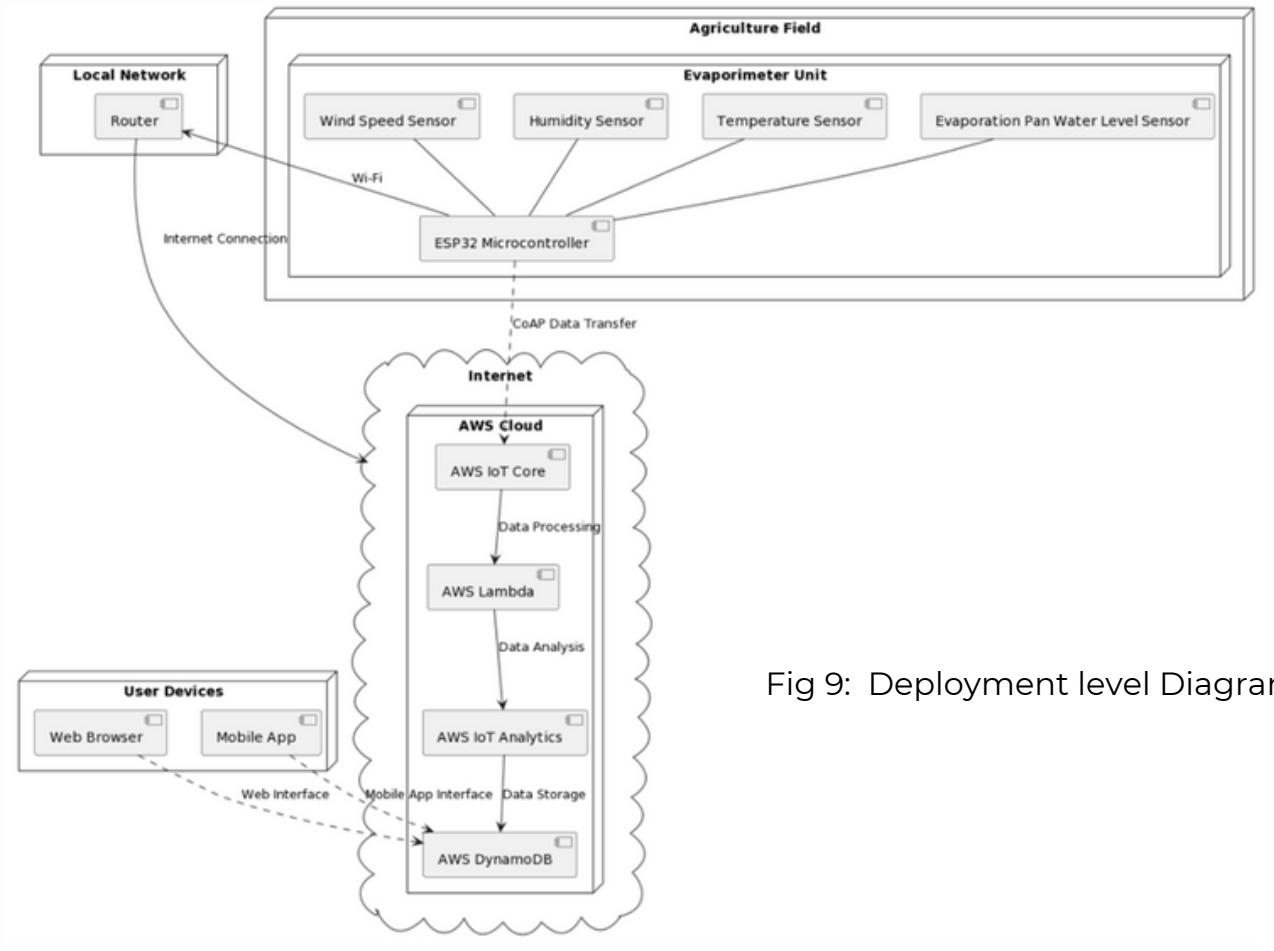
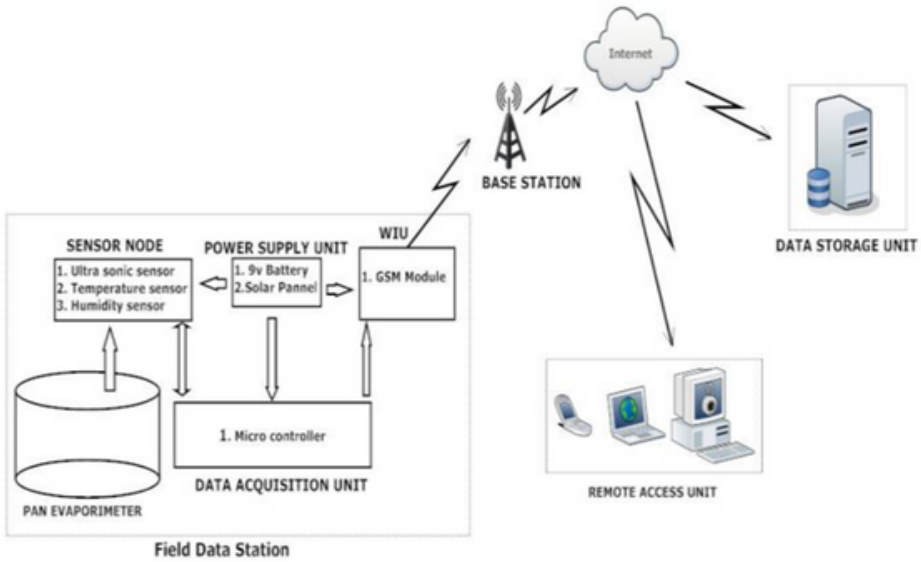
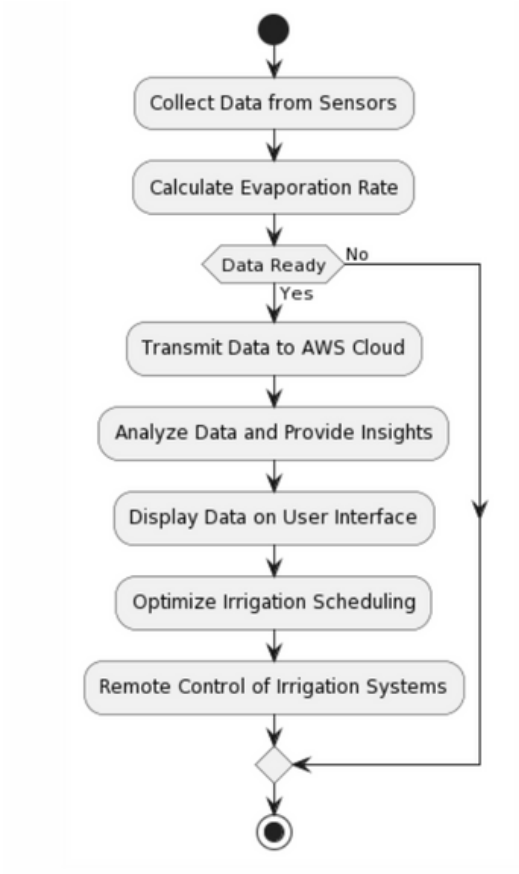


Fig 9: Deployment level Diagram



7.FLOW DIAGRAMS



Sensor data collection: Measures soil moisture, air temperature, and humidity.
Evaporation rate calculation: Used to determine plant water needs.
Data validation loop: Ensures data accuracy before further processing.
Cloud integration: AWS cloud stores and analyses sensor data.
Data analysis for insights: Provides recommendations for optimal watering.
User interface: Displays data and insights for user control.
Irrigation schedule optimization: Waters plants based on actual needs.
Remote irrigation control: Enables automated watering based on the schedule.
Benefits: Water conservation, improved plant growth, cost reduction.

Fig 10: Flow Chart

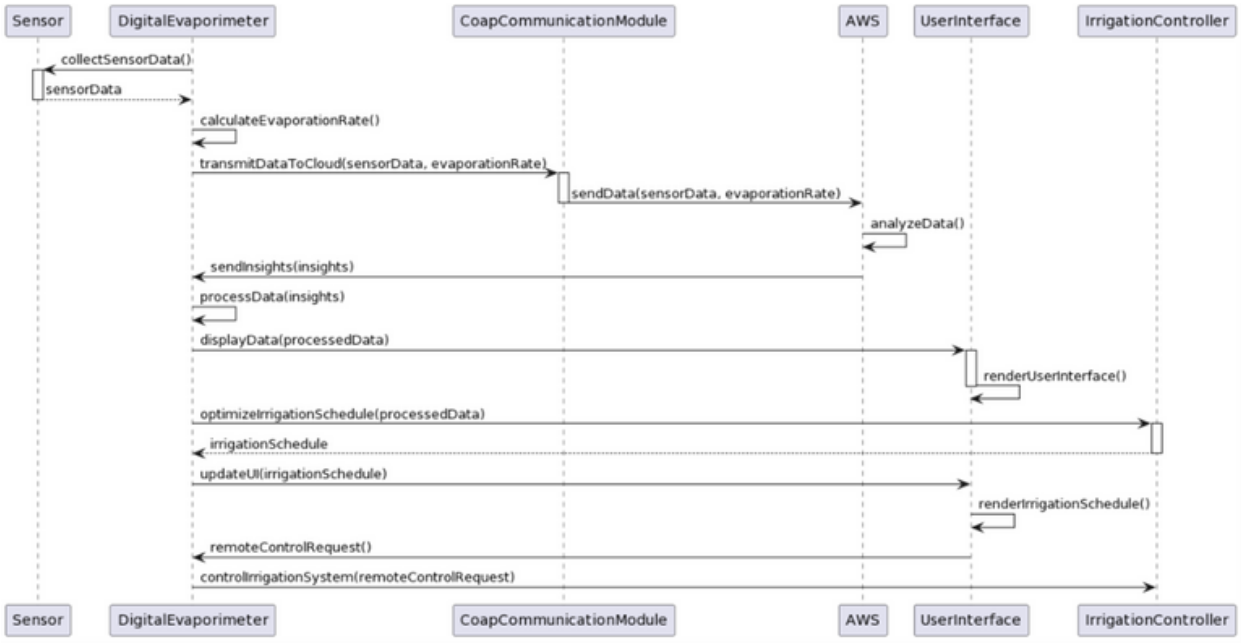


Fig 11: Sequence Diagram

8.DATA ANALYTICS

Edge (Local) Data Analytics:

- The document mentions that the Digital Evaporimeter calculates the evaporation rate based on the sensor data collected from the evaporation pan water level sensor, temperature sensor, humidity sensor, and wind speed sensor.
- This calculation is likely performed locally by the ESP32 microcontroller or an associated data processing component within the Evaporimeter Unit. The collected sensor data is used to calculate the evaporation rate. By performing this data processing at the edge level, the system can make timely decisions and optimize irrigation scheduling without relying solely on cloud-based computations. This local data analytics capability is essential for real-time control and responsiveness.

Cloud Data Analytics:

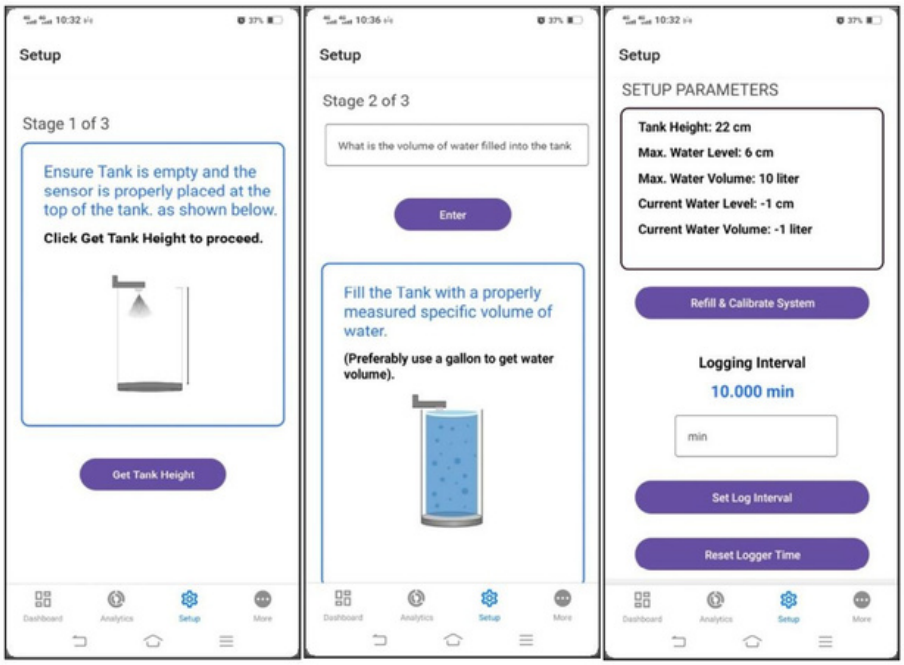
- The document also indicates that the collected sensor data and calculated evaporation rate are transmitted to the AWS cloud using the CoAP (Constrained Application Protocol) for further analysis and insights.
- *The calculated evaporation rate and sensor data are transmitted to the AWS cloud using the CoAP (Constrained Application Protocol). The data is analyzed in the cloud, providing insights into evaporation rates, weather conditions, and irrigation needs.*

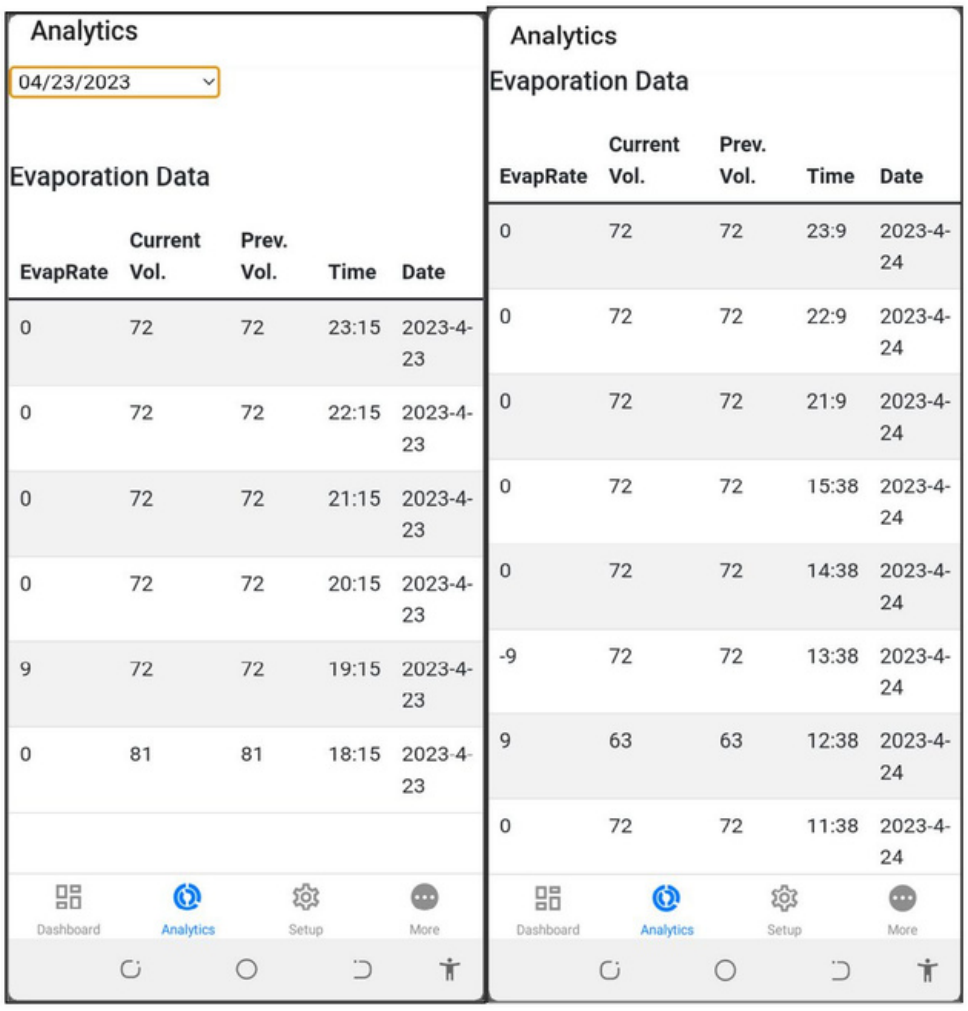
The AWS cloud infrastructure, including services like AWS IoT Core, AWS Lambda, and AWS IoT Analytics, likely performs more extensive data analysis, trend analysis, and advanced analytics on the received data. This cloud-based analytics capability allows for scalable processing, historical data storage, and generation of comprehensive insights that can be leveraged for long-term water resource management and decision-making.

By combining edge and cloud data analytics, the Digital Evaporimeter system achieves a balanced approach:

- **Edge Analytics:** Enables real-time calculations, quick decision-making, and immediate control of irrigation systems based on local data processing.
- **Cloud Analytics:** Provides more powerful and scalable data analysis capabilities, historical data storage, and generation of comprehensive insights for long-term planning and optimization.

9.USER INTERFACE/USER EXPERIENCE





Analytics

04/23/2023

Evaporation Data

EvapRate	Current Vol.	Prev. Vol.	Time	Date
0	72	72	23:15	2023-4-23
0	72	72	22:15	2023-4-23
0	72	72	21:15	2023-4-23
0	72	72	20:15	2023-4-23
9	72	72	19:15	2023-4-23
0	81	81	18:15	2023-4-23

Dashboard Analytics Setup More

Analytics

Evaporation Data

EvapRate	Current Vol.	Prev. Vol.	Time	Date
0	72	72	23:9	2023-4-24
0	72	72	22:9	2023-4-24
0	72	72	21:9	2023-4-24
0	72	72	15:38	2023-4-24
0	72	72	14:38	2023-4-24
-9	72	72	13:38	2023-4-24
9	63	63	12:38	2023-4-24
0	72	72	11:38	2023-4-24

Dashboard Analytics Setup More