Project: SRS

Demeter

Career: TSU in Information Technology, Multiplatform Software Development Area.

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Group: 5B **Delivery date:**03/06/2025

Content

1. Introduction

1.1 Purpose

This document defines the software and hardware requirements for the Deméter IoT system, which is focused on monitoring hydroponic cultivation systems in rural and urban areas of Tijuana. The system is designed to monitor critical water and nutrient solution parameters in real time, improving efficiency, reducing waste, and increasing yield. It will serve as a reference for the analysis, design, development, testing, and implementation of the system.

1.2 Problems to solve

Hydroponic growers face problems such as:

- Lack of control over the pH and EC (electrical conductivity) of the nutrient solution.
- Inadequate water temperature.
- Low water levels.
- Crop losses due to lack of early warnings.
- Lack of low-cost and accessible technology.

Demeter provides a smart solution that enables:

- Continuous monitoring of key system variables.
- Automatic alerts for critical conditions.
- Water and resource savings.
- Improved agronomic decision-making.
- Clear visualization of crop metrics.

1.3 Solution

To solve this problem, a system will be implemented to monitor crops in real time daily. Farmers can see the status of their crops using their mobile app, and managers can obtain data to help them make decisions. This provides a simple solution to monitor crops in real time throughout the day without having to be physically present unless necessary.

1.4 Scope of the system

- Real-time measurement of parameters: water temperature, pH, EC, water level.
- Secure transmission to a backend using Node.js.
- Storage in MongoDB Atlas.
- Automatic analysis and alert generation.
- Mobile app for producers.
- Web dashboard for administrators.
- Reports aligned with the 2030 SDGs.

1.5 Definitions and abbreviations

- **EC:** Electrical Conductivity.
- **pH:** Scale that measures acidity or alkalinity.
- **TDS:** Total Dissolved Solids (related to EC).
- **ESP32:** Microcontroller with Wi-Fi/Bluetooth.
- **DS18B20:** Submersible temperature sensor.
- **PH-4502C:** pH sensor.
- **MongoDB Compass:** NoSQL cloud database.
- **Node.js:** Server-side JavaScript runtime.
- **Express.js:** Node.js backend framework.
- **SDG:** Sustainable Development Goals.

2. Overview

2.1 Product context

Demeter was developed to address the monitoring needs of hydroponic growing systems, enabling constant and efficient control of water conditions. It is a scalable, low-cost, and easy-to-implement solution aimed at improving sustainable local production.

2.2 IoT System and Data Integration for Hydroponic Monitoring

The Demeter system uses IoT sensors—EC, pH (PH-4502C), TDS, and DS18B20 temperature sensor—connected to an ESP32 microcontroller with Wi-Fi/Bluetooth. Sensor data is collected at regular intervals and sent in real time to a backend database.

3. Specific requirements

3.1 Functional requirements

- **RF-1: Sensor Reading**

  Measurement every 60 seconds of: pH, temperature, EC, water level.

- **RF-2: Data Transmission**

  Data sent in JSON format via HTTP to the Express.js backend.

- **RF-3: Storage in MongoDB**

  Structured insertion of data into collections by crop and sensor.

- **RF-4: Condition Classification**

  Alert Types:

  Green: Normal conditions

  Yellow: Warning (values outside of ideal)

  Red: Critical (risk to the crop)

- **RF-5: Mobile Notifications**

  Via Expo Push Notifications or an external service such as OneSignal.

- **RF-6: Web Dashboard**

  Display of variables, alerts, history, and performance.

- **RF-7: Mobile App**

  Real-time view of crop logs, photos, and history.

- **RF-8: SDG Reports**

  Export of sustainability and water efficiency reports in PDF.

3.2 Non-functional requirements

- **RNF-1: Performance**

Response time < 3 seconds.

- **RNF-2: Security**

  Encrypted transmission, user login with JWT or Auth0.

- **RNF-3: Reliability**

  Stable operation with automatic ESP32 reconnection.

- **RNF-4: Availability**

  Uptime > 99.5%

- **RNF-5: Maintainability**

  Modular and documented code.

- **RNF-6: Portability**

  Compatibility with Android/iOS and common browsers.

- **RNF-7: Usability**

  Intuitive, accessible, and clear interface.

4. System Roles

1. Farmer (Mobile App)

- **Platform**: Mobile application (Android/iOS)
- **Responsibilities**:
  - View real-time data: water temperature, pH, EC, water level
  - Filter and review historical data by date
  - Upload photos showing the current state of the crops
  - Receive alerts and push notifications for abnormal conditions
  - Visualize basic sustainability reports

    - Monitor crop status through color-coded indicators (green/yellow/red)

2. Administrator (Web Dashboard)

- **Platform**: Web-based dashboard
- **Responsibilities**:
    - Full access to all registered crops and users
    - Analyze sensor data and detect anomalies (e.g., low water level, abnormal pH)
    - Generate technical reports for evaluations and decision-making

5. Restrictions

- **The system does not perform automatic control** of pumps, valves, or actuators; its functionality is limited to monitoring, alerting, and report generation.
- **An active internet connection is required** to transmit data in real time and synchronize with the backend. In the absence of connectivity, data will not be sent.
- **The system will not handle the management of the sale** of the crop once it is ready for distribution.
- **Large areas will not be monitored**, nor will there be any map of their capacity.

6. Roles

Name	Sánchez Gómez Citlali sarai
Role	Project Leader
Responsibilities	General coordination, time management, supervision of development, presentation and documentation.
Contact information	0323105963@ut-tijuana.edu.mx

Name	Cardenas Algandar Ana Paula
Role	Hardware developer
Responsibilities	ESP32 installation, sensor configuration and programming.
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Name	Lemus Tarango Naomi Denisse
Role	Database Specialist
Responsibilities	Collection, storage and administration of the data required in the project. Creation and configuration of the database.
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Name	Garcia Yañez Yesenia Guadalupe
Role	Mobile Developer
Responsibilities	Website development, management and design.
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Name	Sánchez Gómez Citlali sarai
Role	Web Developer
Responsibilities	Website development, management and design.
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