

# Development of an IoT-based Platform for Smart Irrigation in Olive Groves Using Open-source Technologies - Abstract

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## Summary

Agriculture consumes more than 80% of available water in the Mediterranean, while climate change restricts the availability of water resources. The Internet of things (IoT) technology can contribute significantly to water use efficiency and crop productivity, providing real-time and accurate information on soil moisture and weather data. Recent advances in the IoT have increased the available open-source software and hardware needed to collect and transmit real-time data. The development of economically viable solutions for irrigation management includes the integration of different elements such as signal processing, data recording, transmission devices, data analysis, and visualization. Message Queuing Telemetry Transport (MQTT) is a lightweight messaging protocol, with a small code footprint, used in IoT types of connections. The use of MQTT over mobile networks combined with low-cost IoT sim cards provides a low-cost solution for long-distance M2M data transfer. An important parameter for the rational management of available irrigation water in olive groves is the use of reliable soil moisture sensors capable of measuring low soil moisture levels. Among many technologies available for the measurement of volumetric water content (VWC), capacitance-based moisture sensors are a reliable and relatively low-cost solution. TEROS 12 sensors provide precise soil moisture measurements with simultaneous measurement of soil temperature and electrical conductivity.

This work presents an IoT-based monitoring system for irrigation management using IoT end nodes with TEROS 12 moisture sensors, deployed in the olive grove area of Merambelo in Eastern Crete. Each node i) uses an ESP32 devkit development board programmed with Arduino IDE to take measurements from the moisture sensor every two hours and transmit data to the MQTT broker in the cloud, ii) is powered with two 18650 rechargeable lithium-ion batteries, iii) is charged with a photovoltaic solar panel providing enough power even during winter days, iv) is equipped with SIM800L GSM modem for connectivity. Microcontroller firmware and data upload frequency can be updated over the air. ESP32 board uses SDI 12 communication protocol to read VWC, electrical conductivity and temperature from TEROS 12 intelligent sensor. The MQTT broker forwards the information to ThingsBoard, an open-source IoT platform for data visualization, which allows creating rich dashboards. Meteorological data from neighboring weather stations are integrated into the same platform offering accurate and reliable real-time information on a unified dashboard. Data from weather stations and end nodes are stored in a database and are available to any internet-connected user. The service is available to the farmers offering spatial and temporal information for irrigation scheduling and decision-making.

## Keywords

Internet of things, open software, volumetric water content, remote sensing, GSM module

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