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Airon Project: IoT-Based Agriculture System for the Optimization of Irrigation Water Consumption

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Abstract : The irrigation systems of traditional agriculture, such as gravity-fed irrigation, produce a great waste of water because, generally, there is no control over the amount of water supplied in relation to the water needed. The AIRON Project tries to solve this problem by implementing an IoT-based system to sensor the irrigation plots so that the state of the crops and the amount of water used for irrigation can be known remotely. The IoT system consists of a sensor network that measures the humidity of the soil, the weather conditions (temperature, relative humidity, wind and solar radiation) and the irrigation water flow. The communication between this network and a central gateway is conducted by means of long-range wireless communication that depends on the characteristics of the irrigation plot. The main objective of the AIRON project is to deploy an IoT sensor network in two different plots of the irrigation community of Aranjuez in the Spanish region of Madrid. The first plot is 2 km away from the central gateway, so LoRa has been used as the base communication technology. The problem with this plot is the absence of mains electric power, so devices with energy-saving modes have had to be used to maximize the external batteries' use time. An ESP32 SOC board with a LoRa module is employed in this case to gather data from the sensor network and send them to a gateway consisting of a Raspberry Pi with a LoRa hat. The second plot is located 18 km away from the gateway, a range that hampers the use of LoRa technology. In order to establish reliable communication in this case, the long-term evolution (LTE) standard is used, which makes it possible to reach much greater distances by using the cellular network. As mains electric power is available in this plot, a Raspberry Pi has been used instead of the ESP32 board to collect sensor data. All data received from the two plots are stored on a proprietary server located at the irrigation management company's headquarters. The analysis of these data by means of machine learning algorithms that are currently under development should allow a short-term prediction of the irrigation water demand that would significantly reduce the waste of this increasingly valuable natural resource. The major finding of this work is the real possibility of deploying a remote sensing system for irrigated plots by using Commercial-Off-The-Shelf (COTS) devices, easily scalable and adaptable to design requirements such as the distance to the control center or the availability of mains electrical power at the site.

Keywords : internet of things, irrigation water control, LoRa, LTE, smart farming
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