AUTOMATED IRRIGATION SYSTEM BASED ON WIRELESS SENSOR NETWORK AND INTERNET OF THINGS USING SOLAR PANELS FOR CHILI PLANTS

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ABSTRACT

The cultivation of chili plants, a high-value agricultural commodity in Indonesia, often faces inefficiencies due to manual watering methods. These conventional approaches lead to time and labor inefficiencies, as well as inaccurate water volumes that can negatively affect plant growth. To address these issues, this study aims to design and develop a fully integrated automated irrigation system powered by solar energy and based on a Wireless Sensor Network (WSN) and Internet of Things (IoT). The system is built using four ESP32 microcontrollers: three units function as monitoring devices to measure soil moisture and secure the system using infrared sensors, while one unit serves as the central controller to operate a water pump and solenoid valve. Communication between nodes and with the user application is handled via the MQTT protocol for real-time data transmission. Testing results demonstrate excellent performance, with soil moisture sensors achieving accuracy levels between 94.3% and 99.0%, and infrared sensors capable of detecting objects at a range of 10–14 cm. A 10 Wp solar panel reliably meets the system's daily power requirement of 20.05 Wh, with surplus energy ensuring stable battery operation. Overall, the system achieved a 100% success rate across various testing scenarios and can be remotely monitored through the IoT MQTT Panel application.

Keywords: automated irrigation, Internet of Things, solar panel, soil moisture, MQTT.