



UNDERGRADUATE THESIS

SUBMERSIBLE PUMP CONTROL SYSTEM USING FUZZY TYPE-2 BASED ON IOT AND ANDROID FOR RICE IRRIGATION

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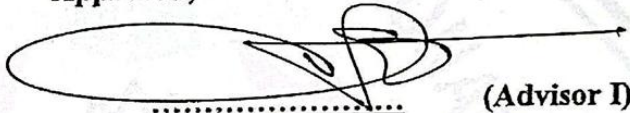
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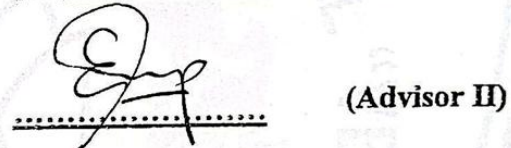
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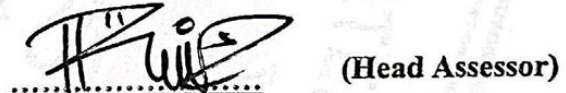
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ABSTRACT

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An Internet of Things (IoT) based automatic submersible pump irrigation system with type-2 fuzzy logic control (Interval Type-2 Fuzzy Logic System) has been designed and implemented to address water and energy inefficiencies in rice paddy irrigation. This system uses an ESP32 microcontroller as the main control unit integrated with two soil moisture sensors, a tipping bucket rain sensor, and a PZEM-004T sensor for monitoring electrical power consumption. Sensor data is sent in real-time to a web server that runs a type-2 fuzzy algorithm with 36 rule bases, a type-2 membership function, and a Karnik-Mendel type reduction method, resulting in pump ON/OFF decisions that are more robust to sensor data uncertainty. The results of data processing can be monitored and controlled via an android based mobile application. Tests on rice paddies show that the system functions well and is able to detect variations in soil moisture conditions and rainfall accurately. Compared to manual methods, this system successfully saves electricity consumption by 40% and water use by 41% in a 24-hour test. The results of this study prove that the integration of IoT, type-2 fuzzy logic, and mobile applications can be an effective solution in supporting the implementation of efficient and resource-saving smart farming.

Keywords: Type-2 fuzzy logic, submersible pumps, Internet of Things (IoT), water and energy efficiency, smart agriculture

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Surabaya, July 6th 2026

A handwritten signature in black ink, consisting of stylized, overlapping loops and strokes, likely representing the author's name.

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