ABSTRAK

PENGENDALIAN POMPA OTOMATIS BERDASARKAN KETINGGIAN AIR MENGGUNAKAN ADAPTIVE THRESHOLD BERBASIS IOT MELALUI PROTOKOL MQTT DENGAN PENGOLAHAN DATA PADA NODE-RED

(2026:XIII + 90 halaman + 26 gambar + 15 tabel + 9 lampiran)

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Banjir merupakan salah satu bencana yang sering terjadi dan menimbulkan kerugian bagi masyarakat serta infrastruktur. Penelitian ini bertujuan mengembangkan sistem monitoring dan pengendalian ketinggian air berbasis Internet of Things *menggunakan metode Adaptive Threshold untuk meningkatkan kemampuan sistem dalam menentukan kondisi air secara adaptif dan mengendalikan pompa secara otomatis. Sistem memanfaatkan sensor ketinggian air yang mengirimkan data melalui protokol MQTT menuju Node-RED untuk diproses menggunakan parameter statistik berupa nilai rata-rata, standar deviasi, dan konstanta penyesuaian sehingga menghasilkan nilai threshold dinamis. Hasil klasifikasi digunakan sebagai dasar pengiriman perintah ke PLC untuk mengaktifkan atau menonaktifkan pompa sesuai kondisi yang terdeteksi. Hasil pengujian menunjukkan sistem berhasil bekerja secara terintegrasi dengan nilai threshold sebesar 1709,95 mm. Selama pengujian dua puluh empat jam diperoleh 2.100 data kategori SAFE, 780 data kategori ALERT, dan tidak ditemukan kondisi DANGER. Pengujian fungsional membuktikan komunikasi MQTT, pengolahan data pada Node-RED, komunikasi dengan PLC, serta pengendalian pompa berlangsung sesuai rancangan. Penerapan metode Adaptive Threshold mampu meningkatkan adaptivitas pengolahan data sekaligus mendukung monitoring real-time dan pengendalian otomatis secara efektif serta memberikan dasar pengambilan keputusan yang lebih responsif terhadap perubahan ketinggian air untuk mendukung upaya mitigasi banjir berbasis* Internet of Things *yang andal efisien mudah diterapkan pada sistem peringatan dini banjir modern berkelanjutan.*

Kata kunci: Water Level Monitoring, Adaptive Threshold, IoT, Flood Mitigation, Monitoring Real-time.

ABSTRACT

IoT-Based Automatic Water Pump Control Using the Adaptive Threshold Method via MQTT Protocol and Node-RED Data Processing

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*Flooding is one of the most frequent natural disasters, causing significant damage to communities and critical infrastructure. This study aims to develop an Internet of Things (IoT)-based water level monitoring and control system that incorporates the Adaptive Threshold method to improve the adaptive classification of water level conditions and enable automatic water pump control. The proposed system uses a water level sensor to collect measurement data, which are transmitted via the MQTT protocol to Node-RED for processing. The Adaptive Threshold is dynamically calculated using statistical parameters, including the mean, standard deviation, and an adjustment constant, allowing the system to classify water level conditions more adaptively than conventional fixed-threshold approaches. The classification results are then used to generate control commands, which are sent to a Programmable Logic Controller (PLC) to automatically activate or deactivate the water pump based on the detected water level condition. Experimental results show that the system operated successfully as an integrated monitoring and control platform, producing an adaptive threshold value of **1709.95 mm**. During a 24-hour monitoring period, the system recorded **2,100 SAFE** classifications and **780 ALERT** classifications, with no **DANGER** conditions observed. Functional testing also confirmed the reliable performance of MQTT communication, data processing in Node-RED, PLC communication, and automatic pump control. Overall, the implementation of the Adaptive Threshold method enhanced the system's adaptability in processing water level data while enabling effective real-time monitoring and automatic pump control. These findings demonstrate the potential of the proposed system to support more responsive decision-making for water level variations and contribute to the development of reliable, efficient, and practical IoT-based flood early warning systems.*

Keywords: Water Level Monitoring, Adaptive Threshold, Internet of Things (IoT), Flood Mitigation, Real-Time Monitoring.