

PEMANFAATAN MQTT DALAM PENGEMBANGAN SISTEM INFORMASI PERINGATAN RISIKO BANJIR BERBASIS IOT

Oleh

I Komang Darma Wiguna, NIM 2255011004

Program Studi Teknologi Rekayasa Perangkat Lunak

ABSTRAK

Penelitian ini bertujuan untuk merancang dan mengimplementasikan sistem informasi peringatan banjir berbasis IoT dengan protokol MQTT, serta menganalisis performa komunikasi data dan *usability* sistem. Banjir sering terjadi di Indonesia, khususnya Kabupaten Buleleng yang memiliki 78 desa rawan banjir, namun sistem mitigasi masih mengandalkan pemantauan manual tanpa peringatan dini *real-time*. Metode *waterfall* digunakan meliputi analisis, desain, implementasi, pengujian, dan pemeliharaan. Sistem terdiri dari tiga komponen utama: perangkat ESP32 dengan sensor ultrasonik JSN-SR04T, DHT22, *rain drop*, dan GPS; *Gateway* Flask yang memproses data sensor melalui MQTT *broker*; serta *backend* Laravel dan *frontend* React.js yang menampilkan *dashboard monitoring* dan peta interaktif. Data sensor dikirim secara periodik melalui protokol MQTT dan notifikasi peringatan dikirim otomatis melalui Telegram ketika ketinggian air melampaui ambang batas. Pengujian mencakup unit, integrasi *blackbox*, performa MQTT dengan variasi laju 1–10 Hz, UAT, dan SUS. Hasilnya, seluruh komponen berhasil terintegrasi dan data ketinggian air tampil *real-time* pada *dashboard*. Pengujian MQTT pada 2–5 Hz menghasilkan *latency* 206–218 ms, *throughput* 896–2011 B/s, dan *packet delivery ratio* di atas 96%. Seluruh pengujian *blackbox* dan UAT berjalan sesuai perancangan. Evaluasi SUS dari 22 responden memperoleh skor rata-rata 70,0 pada kategori *Acceptable* predikat *Good*, menunjukkan sistem layak digunakan sebagai pendukung mitigasi banjir berbasis IoT.

Kata kunci: MQTT, IoT, Sistem Peringatan Banjir, ESP32, Real-Time Monitoring.

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I Komang Darma Wiguna, NIM 2255011004

Software Engineering Technology Study Program

ABSTRACT

This research aims to design and implement an IoT-based flood early warning system using the MQTT protocol, and analyze its data communication performance and usability. Flooding frequently occurs in Indonesia, particularly in Buleleng Regency which has 78 flood-prone villages, yet mitigation systems still rely on manual monitoring without real-time early warning. The waterfall method was used, encompassing analysis, design, implementation, testing, and maintenance. The system consists of three main components: ESP32 devices with JSN-SR04T ultrasonic, DHT22, rain drop, and GPS sensors; a Flask Gateway processing sensor data through an MQTT broker; and a Laravel backend with React.js frontend displaying monitoring dashboards and interactive maps. Sensor data is sent periodically via the MQTT protocol and warning notifications are sent automatically through Telegram when water levels exceed thresholds. Testing covered unit, blackbox integration, MQTT performance at 1–10 Hz data rates, UAT, and SUS. Results showed all components integrated successfully with real-time water level data displayed on the dashboard. MQTT testing at 2–5 Hz showed 206–218 ms latency, 896–2011 B/s throughput, and packet delivery ratio above 96%. All blackbox and UAT tests performed as designed. SUS evaluation with 22 respondents yielded an average score of 70.0, categorized as Acceptable with a Good rating, indicating the system is feasible as an IoT-based flood mitigation support system.

Keywords: MQTT, IoT, Flood Early Warning System, ESP32, Real-Time Monitoring