ABSTRACT

IoT-Based Inpatient Room Monitoring System as Part of a Smart Hospital

By
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The implementation of Internet of Things (IoT) technology in hospital environments has become a critical component in the development of smart hospitals. This research aims to design and implement a real-time inpatient room monitoring system based on IoT, capable of continuously tracking environmental conditions. The system integrates multiple sensors, including temperature, humidity, light intensity, carbon dioxide (CO_2), carbon monoxide (CO), and ultrasonic sensors to detect the number of people in the room. All data are transmitted to the *ThingsBoard* platform via Wi-Fi using the ESP32 microcontroller and are visualized in real-time through a web-based user interface. Sensor calibration was conducted using linear regression to ensure high measurement accuracy. Network performance tests were also carried out to assess connectivity quality between nodes, focusing on parameters such as throughput, delay, and packet loss.

Test results demonstrated that the system was capable of detecting and transmitting environmental data with high accuracy, while providing responsive and informative visualizations. The system successfully maintained stable connectivity over distances of up to 12 meters, achieving throughput values of 135,545.9 to 165,887.9 *Bytes*. Meanwhile, throughout the packet loss test sessions, no data was lost during transmission. Therefore, both values fall into the "Perfect" category. This demonstrates that the network is capable of transmitting data very quickly and stably, making it highly suitable for real-time IoT-based monitoring needs. The system is also capable of counting people in rooms. This system implementation is considered effective in supporting hospital operational efficiency, improving patient comfort, and providing early warning of environmental risks that could impact patient condition.

Keywords: IoT, inpatient room, ESP32, *ThingsBoard*, smart hospital, environmental monitoring, linear regression, network performance.

ABSTRAK

SISTEM MONITORING RUANG RAWAT INAP RUMAH SAKIT BERBASIS IOT SEBAGAI BAGIAN DARI *SMART HOSPITAL*

Oleh

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Penerapan teknologi *Internet of Things* (IoT) di lingkungan rumah sakit telah menjadi bagian penting dalam pengembangan konsep *smart hospital*. Penelitian ini bertujuan untuk merancang dan mengimplementasikan sistem monitoring ruang rawat inap berbasis IoT yang mampu memantau kondisi lingkungan secara *real-time*. Sistem ini mengintegrasikan beberapa sensor, termasuk sensor suhu, kelembapan, intensitas cahaya, karbon dioksida (CO_2), karbon monoksida (CO), dan sensor ultrasonik untuk mendeteksi jumlah orang di dalam ruangan. Seluruh data dikirimkan ke platform ThingsBoard melalui koneksi Wi-Fi menggunakan mikrokontroler ESP32 dan ditampilkan secara *real-time* dalam antarmuka web. Proses kalibrasi dilakukan menggunakan metode regresi linier untuk meningkatkan akurasi pembacaan sensor. Selain itu, uji kinerja jaringan dilakukan untuk mengevaluasi kualitas konektivitas antar *node*, mencakup parameter *throughput, delay,* dan *packet loss.*

Hasil pengujian menunjukkan bahwa sistem mampu mendeteksi dan mengirimkan data lingkungan dengan akurasi tinggi, serta memberikan visualisasi yang responsif dan informatif. Sistem berhasil menjaga konektivitas stabil dalam jarak hingga 12 meter, nilai *throughput* yang diperoleh 135.545,9 hingga 165.887,9 *Bytes*.Sementara itu, seluruh sesi pengujian nilai *packet loss* tidak terdapat kehilangan data selama proses transmisi berlangsung. Dengan demikian, kedua nilai ini berada pada kategori "*Perfect*", Hal ini menunjukkan bahwa jaringan mampu mengirimkan data dengan sangat cepat dan stabil, sehingga sangat sesuai untuk kebutuhan pemantauan secara *real time* berbasis IoT. Sistem juga mampu menghitung orang dalam ruangan. Implementasi sistem ini dinilai efektif dalam mendukung efisiensi operasional rumah sakit, meningkatkan kenyamanan pasien, serta memberikan peringatan dini terhadap risiko lingkungan yang dapat mempengaruhi kondisi pasien.

Kata Kunci: IoT, ruang rawat inap, ESP32, ThingsBoard, *smart hospital*, monitoring lingkungan, regresi linier, kualitas jaringan.