

ABSTRAK

Perancangan dan implementasi sistem monitoring lingkungan ruang rawat inap rumah sakit menggunakan sensor suhu, kelembapan, kebisingan, dan cahaya berbasis *Internet of Things* (IoT) telah berhasil dilakukan. Sistem ini dirancang untuk memantau empat parameter lingkungan secara *real-time*, yaitu suhu, kelembapan udara, tingkat kebisingan, dan intensitas cahaya, sesuai dengan standar Peraturan Menteri Kesehatan Republik Indonesia Nomor 7 Tahun 2019 tentang Kesehatan Lingkungan Rumah Sakit (suhu 20-26°C, kelembapan 40-60%, kebisingan ≤ 40 dB siang/ ≤ 35 dB malam, cahaya ≥ 250 lux).

Sistem menggunakan mikrokontroler ESP32 sebagai pusat pemrosesan dan komunikasi data, sensor DHT22 untuk suhu dan kelembapan, sensor BH1750 untuk intensitas cahaya, serta sensor MAX9814 untuk tingkat kebisingan. Data hasil pengukuran ditampilkan secara lokal pada LCD 20x4 I2C dan dikirimkan ke Firebase Realtime Database melalui jaringan WiFi untuk diakses melalui *dashboard web monitoring*. Sistem juga dilengkapi dengan empat LED indikator (merah, kuning, biru, hijau) sebagai sistem peringatan dini (*early warning system*) ketika parameter berada di luar batas standar.

Pengujian akurasi sensor menunjukkan hasil yang baik: sensor suhu DHT22 memiliki rata-rata error 2,99%, sensor kelembapan DHT22 1,85%, dan sensor cahaya BH1750 2,63%. Adapun sensor kebisingan MAX9814 memberikan indikasi tingkat kebisingan yang masih memerlukan kalibrasi lanjutan menggunakan Sound Level Meter terkalibrasi untuk memperoleh nilai desibel absolut yang sesuai standar. Performa pengiriman data melalui WiFi menunjukkan waktu tunda (*delay*) rata-rata kurang dari 2 detik dengan tingkat kestabilan transmisi 98% selama 10 jam pengujian. Sistem telah berhasil diimplementasikan dalam bentuk prototipe yang dapat digunakan untuk monitoring lingkungan ruang rawat inap secara *real-time* dan terintegrasi.

Kata kunci: Sistem monitoring, ruang rawat inap, *Internet of Things* (IoT), ESP32, DHT22, BH1750, MAX9814, Firebase.

ABSTRACT

The design and implementation of a hospital inpatient room environmental monitoring system using temperature, humidity, noise, and light sensors based on the Internet of Things (IoT) has been successfully carried out. This system is designed to monitor four environmental parameters in real-time: temperature, humidity, noise level, and light intensity, in accordance with the standards of Indonesian Ministry of Health Regulation Number 7 of 2019 concerning Hospital Environmental Health (temperature 20-26°C, humidity 40-60%, noise ≤ 40 dB daytime/ ≤ 35 dB nighttime, light ≥ 250 lux).

The system uses an ESP32 microcontroller as the processing and data communication center, a DHT22 sensor for temperature and humidity, a BH1750 sensor for light intensity, and a MAX9814 sensor for noise level. Measurement data is displayed locally on an LCD 20x4 I2C and sent to the Firebase Realtime Database via WiFi network for access through a web monitoring dashboard. The system is also equipped with four LED indicators (red, yellow, blue, green) as an early warning system when parameters are outside standard limits.

Sensor accuracy testing showed good results: the DHT22 temperature sensor had an average error of 2.99%, the DHT22 humidity sensor 1.85%, and the BH1750 light sensor 2.63%. Meanwhile, the MAX9814 noise sensor provides an indication of noise level that still requires further calibration using a calibrated Sound Level Meter to obtain absolute decibel values that comply with standards. WiFi data transmission performance showed an average delay of less than 2 seconds with a transmission stability rate of 98% during 10 hours of testing. The system has been successfully implemented as a prototype that can be used for real-time and integrated inpatient room environmental monitoring.

Keywords: Monitoring system, inpatient room, Internet of Things (IoT), ESP32, DHT22, BH1750, MAX9814, Firebase.