INTISARI

Penelitian ini bertujuan merancang dan implementasi alat ukur kualitas jalan menggunakan sensor MPU6050 dan modul GPS NEO-6M yang terintegrasi dengan IoT dan metode machine learning pada mikrokontroler ESP32. Sistem dirancang untuk mengklasifikasikan kondisi jalan secara real time menjadi tiga kategori: jalan mulus, jalan berlubang, dan polisi tidur (speed bump), serta menampilkan lokasi hasil pengukuran berdasarkan koordinat GPS melalui Google Sheets dan Google My Maps.

Perangkat keras berupa ESP32 Dev Kit, sensor MPU6050, modul GPS NEO-6M, LCD 16×2 I2C, dan catu daya baterai. Perangkat lunak dikembangkan menggunakan Arduino IDE, sedangkan proses pelatihan model machine learning dilakukan menggunakan platform Edge Impulse dengan metode Spectral Analysis berbasis Fast Fourier Transform (FFT). Data sensor accelerometer dan gyroscope digunakan sebagai input proses klasifikasi kondisi jalan. Hasil klasifikasi kemudian dikirimkan via Wi-Fi ke Google Sheets menggunakan Google Apps Script sebagai media integrasi IoT. Data yang dikirim meliputi data sensor, probabilitas klasifikasi, koordinat GPS, kecepatan kendaraan, dan hasil klasifikasi kondisi jalan.

Pengujian lapangan menghasilkan 326 data uji yang terdiri dari 258 data jalan mulus, 50 data jalan berlubang, dan 18 data polisi tidur. Evaluasi sistem dilakukan menggunakan confusion matrix dan validasi kondisi aktual jalan berdasarkan koordinat GPS serta dokumentasi visual lapangan. Sistem berhasil mengklasifikasikan jalan berlubang sebanyak 84%, jalan mulus sebanyak 90,31% data, dan polisi tidur sebanyak 88% data secara benar. Data koordinat GPS berhasil digunakan untuk menampilkan lokasi hasil klasifikasi pada Google My Maps sehingga mempermudah proses identifikasi kondisi jalan berdasarkan lokasi pengujian.

Kata kunci: ESP32; GPS NEO-6M; kualitas; jalan; MPU6050; pembelajaran mesin

ABSTRACK

This research aims to design and implement an road quality measuring device using the MPU6050 sensor and GPS NEO-6M module integrated with a machine learning method on the ESP32 microcontroller. The system classifies road conditions in real-time into three categories: smooth roads, potholed roads, and speed bumps, and displays the measurement location based on GPS coordinates via Google Sheets and Google My Maps.

The hardware consists of an ESP32, MPU6050 sensor, GPS NEO-6M module, 16×2 I2C LCD, and a battery power supply. The software was developed using the Arduino IDE, while the machine learning model training was conducted using the Edge Impulse with the Spectral Analysis method based on the Fast Fourier Transform (FFT). Accelerometer and gyroscope data were used as inputs for the road condition classification process. The classification results were then sent in real-time via Wi-Fi connection to Google Sheets using Google Apps Script as an IoT integration medium. The transmitted data includes sensor data, classification probability, GPS coordinates, vehicle speed, and road condition classification results.

Field testing yielded 326 test data points consisting of 258 smooth road data points, 50 potholed road data points, and 18 speed bump data points. System evaluation was performed using a confusion matrix and validation of actual road conditions based on GPS coordinates and visual field documentation. The system successfully classified potholed roads at 84%, smooth roads at 90.31%, and speed bumps at 88% correctly.

Keywords: ESP32; GPS NEO-6M; machine learning; MPU6050; road quality,