

PROTOTIPE SISTEM DETEKSI GAS PROPANA (C₃H₈) BUTANA (C₄H₁₀) DAN KARBON DIOKSIDA (CO₂) HASIL PEMBAKARAN BERBASIS MULTI SENSOR

Zidny Mubarak

Program Studi Teknik Elektro, Fakultas Teknik, Universitas Muhammadiyah Jember

ABSTRAK

Satuan Pelayanan Pemenuhan Gizi (SPPG) pada Program Makan Bergizi Gratis (MBG) sangat bergantung pada *Liquefied Petroleum Gas* (LPG) di ruang tertutup dengan sirkulasi udara minim, sehingga berisiko memicu kebocoran gas propana (C₃H₈) dan butana (C₄H₁₀) yang mudah meledak serta akumulasi karbon dioksida (CO₂) hasil pembakaran yang membahayakan kesehatan pekerja. Penelitian ini bertujuan merancang dan membangun sistem deteksi dini multi-gas berbasis multi sensor yang terintegrasi *Internet of Things* (IoT) guna meningkatkan keselamatan kerja di ruang SPPG. Sistem menggunakan sensor MQ-6 untuk mendeteksi propana dan butana serta sensor MQ-135 untuk mengestimasi CO₂, dengan Arduino Mega 2560 sebagai pengendali, modul ESP-01 dan platform Blynk untuk pemantauan jarak jauh, serta relay *exhaust* fan, DFPlayer Mini, dan indikator LED sebagai mekanisme peringatan dini berdasarkan ambang batas konsentrasi gas. Pengujian akurasi dilakukan dengan membandingkan pembacaan sensor terhadap gas leak detector menggunakan metode *Mean Absolute Percentage Error* (MAPE). Hasil pengujian menunjukkan sensor MQ-6 memiliki MAPE 4,79% dan sensor MQ-135 sebesar 7,10% sehingga keduanya tergolong sangat akurat, sedangkan pengiriman data IoT memiliki rata-rata delay 4,9 detik. Suhu terbukti memengaruhi akurasi sensor, dengan lonjakan *Error* MQ-135 hingga 17,20% pada suhu 29°C akibat *thermal drift*. Secara keseluruhan, sistem terbukti andal memantau kondisi gas secara real-time dan menjalankan mitigasi otomatis sesuai ambang batas yang telah diprogramkan.

Kata kunci: deteksi gas, MQ-6, MQ-135, Internet of Things, sistem peringatan dini

PROTOTYPE OF A MULTI-SENSOR BASED DETECTION SYSTEM FOR PROPANE (C₃H₈), BUTANE (C₄H₁₀), AND CARBON DIOXIDE (CO₂) COMBUSTION GASES

Zidny Mubarok

Electrical Engineering, Faculty of Engineering, Universitas Muhammadiyah Jember

ABSTRACT

Nutrition Fulfillment Service Units (SPPG) supporting the national Free Nutritious Meal program rely heavily on Liquefied Petroleum Gas (LPG) in enclosed, poorly ventilated kitchens, creating a high risk of flammable propane (C₃H₈) and butane (C₄H₁₀) leaks as well as the accumulation of carbon dioxide (CO₂) from combustion that endangers workers' health. This study aims to design and build an IoT-integrated, multi-sensor early-detection system to improve occupational safety in SPPG rooms. The system employs an MQ-6 sensor to detect propane and butane and an MQ-135 sensor to estimate CO₂, with an Arduino Mega 2560 as the controller, an ESP-01 module and the Blynk platform for remote monitoring, and a relay-driven exhaust fan, DFPlayer Mini, and LED indicators as the early-warning mechanism based on gas concentration thresholds. Sensor accuracy was evaluated against a gas leak detector using the Mean Absolute Percentage Error (MAPE) method. The results show a MAPE of 4.79% for the MQ-6 sensor and 7.10% for the MQ-135 sensor, both categorized as highly accurate, while IoT data transmission had an average delay of 4.9 seconds. Ambient temperature was shown to affect sensor accuracy, with the MQ-135 Error spiking to 17.20% at 29°C due to thermal drift. Overall, the system proved reliable in monitoring gas conditions in real time and executing automatic mitigation according to the programmed thresholds.

Keywords: gas detection, MQ-6, MQ-135, Internet of Things, early warning system