

ABSTRAK

SISTEM VENDING MACHINE PEMILAH BOTOL MINUMAN BERBASIS SENSOR PROXIMITY INDUKTIF DAN KAPASITIF

(2026: xiv + 53 Halaman + 22 Gambar + 7 Tabel + Daftar Puataka + Lampiran)

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Peningkatan jumlah sampah botol minuman menjadi salah satu permasalahan lingkungan yang memerlukan solusi berbasis teknologi untuk mendukung proses pemilahan dan daur ulang secara efektif. Penelitian ini bertujuan untuk merancang dan membangun sistem *vending machine* pemilah botol minuman berbasis sensor *proximity* induktif dan kapasitif, serta menganalisis kinerja kedua sensor dalam mendeteksi berbagai jenis material botol. Sensor *proximity* induktif LJ12A3-4-Z/BY digunakan untuk mendeteksi material logam, sedangkan sensor *proximity* kapasitif LJC18A3-H-Z/BY digunakan untuk mendeteksi material non-logam seperti botol plastik. Sistem dikendalikan menggunakan PLC yang diprogram dengan *ladder diagram* untuk mengatur proses identifikasi dan pemilahan botol secara otomatis. Metode penelitian yang digunakan adalah metode rekayasa (*engineering research*) yang meliputi studi literatur, perancangan sistem, pembuatan prototipe, pengujian, analisis data, dan evaluasi. Pengujian dilakukan dengan memberikan variasi jarak antara sensor dan objek, kemudian mengukur nilai tegangan keluaran, arus keluaran, serta kemampuan deteksi sensor. Hasil pengujian menunjukkan bahwa nilai tegangan dan arus keluaran kedua sensor mengalami penurunan seiring bertambahnya jarak objek terhadap sensor. Sensor *proximity* induktif mampu mendeteksi objek logam secara stabil pada jarak kerja hingga 1 cm dengan tegangan keluaran berkisar antara 4,98 V hingga 2,80 V dan

arus keluaran antara 19,8 mA hingga 7,5 mA. Sensor *proximity* kapasitif juga menunjukkan respons yang baik dalam mendeteksi objek non-logam sesuai karakteristik material yang diuji. Berdasarkan hasil penelitian dapat disimpulkan bahwa integrasi sensor *proximity* induktif dan kapasitif pada sistem *vending machine* mampu meningkatkan kemampuan identifikasi dan pemilahan botol minuman secara otomatis. Sistem yang dirancang bekerja sesuai dengan fungsi yang diharapkan dan memiliki potensi untuk diterapkan sebagai solusi pengelolaan sampah botol minuman yang lebih efektif, efisien, serta mendukung konsep daur ulang dan pelestarian lingkungan.

Kata Kunci: *Vending Machine*, Sensor *Proximity* Induktif, Sensor *Proximity* Kapasitif, PLC, Pemilah Botol Minuman.

ABSTRACT

VENDING MACHINE SYSTEM FOR BEVERAGE BOTTLE SORTING BASED ON INDUCTIVE AND CAPACITIVE PROXIMITY SENSORS

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The increasing amount of beverage bottle waste has become an environmental issue that requires technological solutions to support effective sorting and recycling processes. This study aims to design and develop a beverage bottle sorting vending machine based on inductive and capacitive proximity sensors and to analyze the performance of both sensors in detecting different bottle materials. The LJ12A3-4-Z/BY inductive proximity sensor is used to detect metallic objects, while the LJC18A3-H-Z/BY capacitive proximity sensor is employed to detect non-metallic materials such as plastic bottles. The system is controlled by a Programmable Logic Controller (PLC) programmed using a ladder diagram to perform automatic bottle identification and sorting. The research employed an engineering research method consisting of literature study, system design, prototype development, testing, data analysis, and system evaluation. Testing was conducted by varying the distance between the sensors and the detected objects while measuring the output voltage, output current, and detection capability of each sensor. The results showed that the output voltage and current of both sensors decreased as the distance between the sensor and the object increased. The inductive proximity sensor was able to detect metallic objects stably within a working distance of up to 1 cm, producing an output voltage ranging from 4.98 V to 2.80 V and an output current ranging from 19.8 mA to 7.5 mA. Meanwhile,

the capacitive proximity sensor demonstrated reliable performance in detecting non-metallic objects according to their material characteristics. Based on the research results, it can be concluded that the integration of inductive and capacitive proximity sensors in the vending machine system successfully improves the automatic identification and sorting of beverage bottles. The developed system operates as expected and has the potential to be implemented as an effective and efficient solution for beverage bottle waste management while supporting recycling and environmental sustainability.

Keywords: *Vending Machine, Inductive Proximity Sensor, Capacitive Proximity Sensor, Programmable Logic Controller (PLC), Beverage Bottle Sorting.*