

ABSTRAK

Perkembangan teknologi otomasi industri mendorong penerapan sistem kontrol yang mampu meningkatkan efisiensi dan akurasi proses pemilahan sampah logam dan non-logam. Penelitian ini bertujuan merancang dan mengimplementasikan sistem kontrol dan monitoring berbasis *Programmable Logic Controller* (PLC) Outseal dan *Human Machine Interface* (HMI) Modbus. Kebaruan penelitian terletak pada integrasi PLC Outseal, sensor proximity induktif, modul Wi-Fi DT-06, dan HMI Modbus dalam satu sistem pemilahan berbasis komunikasi nirkabel. Metode penelitian meliputi perancangan prototipe, integrasi perangkat keras dan perangkat lunak, pemrograman *ladder diagram*, serta pengujian kinerja sistem yang mencakup komunikasi, akurasi sensor, waktu respons, dan keberhasilan pemilahan. Hasil pengujian menunjukkan bahwa komunikasi antara PLC dan HMI berlangsung stabil hingga jarak 10 m, sensor proximity menghasilkan rata-rata persentase error sebesar 1,84%, sedangkan hasil evaluasi keseluruhan menunjukkan akurasi sensor sebesar 93,15%, keberhasilan *sorting* sebesar 95%, dan stabilitas sistem sebesar 95%, dengan waktu respons 1–2 s. Hasil tersebut menunjukkan bahwa integrasi PLC Outseal dan HMI Modbus berhasil melakukan pemilahan material secara otomatis serta memantau proses secara *real-time*, sehingga layak diterapkan pada industri skala kecil maupun sebagai media pembelajaran sistem kendali berbasis PLC.

Kata Kunci : PLC Outseal, HMI Modbus, Sistem Otomasi, Sensor Proximity, Pemilahan Logam dan Non Logam.

Design and Development of a Control and Monitoring System for Metal and Non-Metal Waste Sorting Based on Outseal PLC and Modbus HMI

ABSTRACT

The advancement of industrial automation has encouraged the implementation of control systems capable of improving the efficiency and accuracy of metal and non-metal waste sorting processes. This study aims to design and implement a control and monitoring system based on an Outseal Programmable Logic Controller (PLC) and a Modbus Human Machine Interface (HMI). The novelty of this research lies in the integration of an Outseal PLC, an inductive proximity sensor, a DT-06 Wi-Fi module, and a Modbus HMI into a wireless-based waste sorting system. The research methodology consisted of prototype design, hardware and software integration, ladder diagram programming, and system performance evaluation, including communication performance, sensor accuracy, response time, and sorting performance. The experimental results demonstrated that communication between the PLC and HMI remained stable at distances of up to 10 m. The inductive proximity sensor achieved an average error of 1.84%, while the overall system evaluation yielded a sensor accuracy of 93.15%, a sorting success rate of 95%, and a system stability of 95%, with a response time ranging from 1 to 2 s. These findings indicate that the proposed system is capable of performing automated waste sorting while providing real-time monitoring. Therefore, it has strong potential to serve as a cost-effective automation solution for small-scale industries and as an educational platform for PLC-based control system applications.

Keywords : *Outseal PLC, Modbus HMI, Automation System, Proximity Sensor, Metal and Non-Metal Sorting.*