

INTISARI

Penelitian ini bertujuan merancang dan mengimplementasikan Human Machine Interface (HMI) pada sistem Supervisory Control and Data Acquisition (SCADA) untuk crane otomatis menggunakan Programmable Logic Controller (PLC) dan sensor jarak dengan tampilan animasi gerakan *crane*. Sistem dirancang untuk memudahkan operator dalam memantau dan mengendalikan proses pemindahan barang secara real-time melalui HMI.

Metode yang digunakan meliputi perancangan sistem kontrol menggunakan PLC Schneider TM221CE40R, penggunaan sensor ultrasonik sebagai pendeteksi jarak, serta perancangan HMI menggunakan AVEVA Wonderware InTouch. Komunikasi antara PLC dan HMI dilakukan melalui *ethernet* menggunakan protokol Modbus TCP. HMI menyediakan dua mode operasi, yaitu mode manual dan mode otomatis, serta menampilkan animasi pergerakan *crane*, jumlah tumpukan barang, dan data real-time sensor ultrasonik.

Hasil implementasi dan pengujian menunjukkan bahwa komunikasi antara PLC dan HMI dapat berjalan dengan baik. HMI berhasil menampilkan animasi gerakan *crane*, jumlah tumpukan barang, dan data *real-time* sensor ultrasonik. Sistem juga mampu menjalankan proses pemindahan barang pada mode manual maupun mode otomatis sesuai dengan perintah pengguna. Pada pengujian mode manual, dari **21 tahapan pengamatan, 20 tahapan berhasil dan 1 tahapan tidak berhasil** karena animasi HMI belum sepenuhnya sesuai dengan kondisi *real-time plant*, sehingga diperoleh tingkat keberhasilan sebesar **95,24%**. Hasil pengujian kalibrasi menunjukkan bahwa sensor ultrasonik memiliki karakteristik keluaran yang linear dengan rata-rata error pembacaan jarak pada PLC sebesar 1,28%, sehingga mampu memberikan data pengukuran yang akurat dan dapat digunakan sebagai masukan pada sistem PLC dan HMI. Secara keseluruhan, HMI pada sistem SCADA berhasil diimplementasikan dan mampu mendukung proses pemantauan serta pengendalian *crane* otomatis secara *real-time*.

Kata kunci: PLC, SCADA, HMI, Crane Otomatis, Sensor Ultrasonik.

ABSTRACT

This research aims to design and implement a Human Machine Interface (HMI) for a Supervisory Control and Data Acquisition (SCADA) system applied to an automatic crane using a Programmable Logic Controller (PLC) and an ultrasonic distance sensor with crane motion animation. The system is designed to assist operators in monitoring and controlling the material handling process in real time through the HMI.

The research method includes designing a control system using a Schneider TM221CE40R PLC, utilizing an ultrasonic sensor for distance measurement, and developing the HMI using AVEVA Wonderware InTouch. Communication between the PLC and HMI is established via Ethernet using the Modbus TCP protocol. The HMI provides two operating modes, namely manual mode and automatic mode, and displays crane movement animation, the number of stacked objects, and real-time ultrasonic sensor data.

The implementation and testing results demonstrate that communication between the PLC and HMI operates properly. The HMI successfully displays crane movement animation, the number of stacked objects, and real-time ultrasonic sensor data. The system is also capable of performing the material handling process in both manual and automatic modes according to user commands. During manual mode testing, 20 out of 21 observation stages were successfully completed, while one stage failed because the HMI animation did not fully match the real-time condition of the plant, resulting in a success rate of 95.24%. The calibration results indicate that the ultrasonic sensor has a linear output characteristic with an average PLC distance measurement error of 1.28%, enabling it to provide accurate measurement data for use as input to the PLC and HMI. Overall, the SCADA-based HMI was successfully implemented and is capable of supporting real-time monitoring and control of the automatic crane.

Keywords: PLC, SCADA, HMI, Automatic Crane, Ultrasonic Sensor.