

INTISARI

Proses pemindahan barang memerlukan sistem yang mampu melakukan perpindahan secara otomatis serta mendeteksi posisi barang secara akurat agar proses *pick and place* berjalan optimal. Penelitian ini bertujuan merancang dan membangun sistem kendali crane otomatis berbasis *Programmable Logic Controller* (PLC) yang terintegrasi dengan *Supervisory Control and Data Acquisition* (SCADA) menggunakan sensor ultrasonik untuk memindahkan box secara otomatis dari tiga posisi sumber menuju tiga posisi tujuan.

Metode penelitian meliputi perancangan perangkat keras dan perangkat lunak. Perangkat keras terdiri atas PLC sebagai pusat kendali, sensor ultrasonik sebagai pendeteksi posisi dan jumlah box, Arduino Uno sebagai pengolah data sensor, modul *PWM to Voltage*, motor DC, relay, gripper, dan catu daya. Perangkat lunak menggunakan program ladder pada PLC dan SCADA sebagai media pemantauan serta pengendalian secara *real-time* melalui *Human Machine Interface* (HMI).

Hasil pengujian menunjukkan bahwa sistem bekerja sesuai rancangan. Sistem mencapai tingkat keberhasilan 100% apabila gripper diarahkan pada proses *pick* dan *place*, sehingga seluruh box berhasil dipindahkan dan tersusun rapi pada posisi tujuan. Ketika gripper hanya diarahkan saat proses *pick*, berdasarkan 14 kali percobaan dengan total 57 box, sistem berhasil memindahkan 48 box dengan tingkat keberhasilan 84,21%, sedangkan 9 box (15,79%) tidak berhasil dipindahkan atau ditempatkan dengan baik akibat ayunan tali gripper saat proses *place*. Apabila gripper tidak diarahkan saat proses *pick*, sistem tidak dapat melakukan proses *pick and place* karena gripper gagal mencapit box. Error jarak sebesar 2.00% Waktu rata-rata satu siklus pemindahan tiga box pada setiap posisi sumber adalah 3,46 menit.

Kata kunci: PLC, SCADA, Crane Otomatis, Sensor Ultrasonik, *Pick and Place*.

ABSTRACT

The material handling process requires a system capable of automatically transferring objects while accurately detecting their positions to ensure that the pick-and-place operation is performed efficiently. This study aims to design and develop an automatic crane control system based on a Programmable Logic Controller (PLC) integrated with a Supervisory Control and Data Acquisition (SCADA) system using an ultrasonic sensor to automatically transfer boxes from three source positions to three destination positions.

The research method consisted of hardware and software design. The hardware included a PLC as the main controller, an ultrasonic sensor for detecting the position and number of boxes, an Arduino Uno for processing sensor data, a PWM-to-Voltage module, DC motors, relays, a gripper, and a power supply. The software was developed using a ladder program on the PLC, while the SCADA system served as a real-time monitoring and control interface through a Human Machine Interface (HMI).

The experimental results showed that the system operated according to the designed specifications. The system achieved a 100% success rate when the gripper was guided during both the pick and place processes, allowing all boxes to be successfully transferred and neatly arranged at the destination positions. When the gripper was guided only during the pick process, based on 14 experimental trials involving a total of 57 boxes, the system successfully transferred 48 boxes, resulting in a success rate of 84.21%, while 9 boxes (15.79%) failed to be transferred or properly placed due to the swinging motion of the gripper rope during the place process. When the gripper was not guided during the pick process, the system was unable to perform the pick-and-place operation because the gripper failed to grasp the boxes. The distance measurement error of the ultrasonic sensor was 2.00%. The average time required to complete one cycle of transferring three boxes from each source position was 3.46 minutes.

Keywords: PLC, SCADA, Automatic Crane, Ultrasonic Sensor, Pick and Place.