

***Automatic Sorting on Omnidirectional Conveyor Four Wheel Based on PLC
and RFID Sensor***

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ABSTRACT

The manual goods sorting process in the expedition industry causes slow distribution and a high risk of misclassification errors. This study designs and implements an automatic sorting system based on a four-wheel omnidirectional conveyor controlled by a Schneider TM221CE16R PLC with a GXU 512 HMI interface. The system employs an RDM6300 125 KHz RFID sensor to read product identity, four ESP32 WROOM-32D units as Modbus RTU slave controllers, three omni conveyor cells equipped with IR proximity sensors and MX1508 motor drivers, and RS-485-based Modbus RTU protocol for inter-component data communication. Goods are sorted according to seven RFID codes (ID 0–ID 6) through a stepped cell-activation mechanism: three cells for IDs 0–2, two cells for IDs 3–4, and one cell for IDs 5–6, with an automatic 3-second stop triggered by the IR proximity sensor at the end of each sorting cycle. The PLC program consists of 54 ladder diagram rungs that cover system initialization, RFID data reading and decoding, motion setpoint transmission to each conveyor slave, feedback monitoring, and automatic cycle reset. Each ESP32 slave is programmed with a dual-core FreeRTOS architecture so that Modbus RTU communication and motor control logic execute in parallel without interference. Test results show an overall sorting accuracy of 98.10% from 105 trials, RFID reading accuracy of 100% at distances of 1–3 cm, Modbus RS-485 communication success rate of 100% from 60 trials, and IR proximity sensor detection accuracy of 100% from 90 trials, demonstrating that the system effectively automates the goods sorting process in a reliable and efficient manner.

Keywords: *automatic sorting, four-wheel omnidirectional conveyor, Schneider TM221CE16R PLC, RDM6300 RFID, Modbus RTU, ESP32, FreeRTOS*