PROTOTYPE AUTOMATED MULTI-FUNCTIONAL ROBOT FOR WAREHOUSE CARGO HANDLING

Vidanapathirana K. D., Nanayakkara P. G. A. I., Sajanapriya K. A. H.* and Jayasuriya L. T.
Department of Electrical and Electronic Technology, Faculty of Technology, Rajarata University of Sri Lanka, Mihinthale, Sri Lanka
**himashaetput1993@gmail.com*

Manual picking and sorting in warehouses were identified as slow, costly, and labor-intensive processes, with labor contributing to 65% of total operational costs, and picking accounting for 55%. To address these inefficiencies, a robot was designed to follow a multi-functional approach for efficient warehouse cargo handling, integrating Radio Frequency Identification (RFID) scanning, line following, comparison, and pick-and-drop capabilities. The robot's QTR IR (Infrared Rays) sensor array was calibrated upon activation for precise surface detection. RFID codes were used to identify packages and their drop locations, enabling the correct items to be picked. Navigation was managed through an IR sensor array, with two motors attached to wheels and a balancing wheel for smooth movement between pickup and drop locations. Secure package handling was achieved with an articulated robot arm powered by servo motors. The robot was made fully programmable via Arduino, allowing customizable and flexible control over operations. After receiving a command via a wireless signal or push button, packages were picked up and delivered to specified locations. Initial testing revealed issues with reflective surfaces affecting sensor accuracy, which were resolved by using non-reflective material to ensure reliable line following. Significant benefits in warehouse automation were achieved by reducing human error, lowering costs, and improving efficiency, making it a valuable solution for logistics operations. The prototype was tested in a controlled environment with designated pick-up and drop-off locations. Future improvements included the addition of higher-torque motors, expanded pick-up and drop-off points, and integration with a networked database. The system could be upgraded for large-scale applications with a pneumatic or hydraulic arm and a PLC-based control system.

Keywords: *Automation, Line following, Remote control, Robot, Warehouse.*

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