An Intelligent Indoor Transportation System for Visually Impaired Individuals Using Magnetic Guidance and Voice Commands

Husham F Saied
Department of Biomedical Technology, Prince Sultan Military College of Health Sciences, Dammam, Saudi Arabia

Abstract

This paper presents a low-cost Automated Guided Vehicle (AGV) designed to assist individuals with visual or musculoskeletal disabilities in indoor navigation. The platform is based on a commercially available electric scooter (Optimus Up) modified with a Programmable Logic Controller (JZ20-T18 PLC), two DRV5032AJ linear Hall-effect sensors for magnetic-path following, Bluetooth Low Energy (BLE) beacons (HC-08) for coarse indoor localization, and a voice-command interface (openWakeWord) handled by a Raspberry Pi. The vehicle follows electromagnetic routes selectively activated by a relay matrix (Navigation Map), enabling destination-based routing across a five-room environment. The control algorithm operates on a differential sensor comparison scheme: lateral imbalance between left and right sensors triggers corrective steering via electromagnetically actuated wheel control. Experiments across 15 trials yielded a mean lateral error of 1.52 cm, an RMSE of 2.25 cm, a 100% path-completion rate, an average control-system response time of 0.558 s, and a fail-safe stopping distance of 7.37 cm. A fuzzy-logic module estimates the risk of route deviation under varying operating conditions.

Keywords

Automated Guided Vehicle (AGV), visually impaired, route navigation, programmable logic controller (PLC), Hall-effect sensors, magnetic-path guidance, indoor localization.