

Project Description

A large internet merchandising firm, which operates a network of automated warehouses, issued a Request for Proposals (RFP) for the development of autonomous machines capable of moving heavy loads efficiently within warehouse environments. The requirements specified that the machine must transport loads in minimal time without leaving marks on the warehouse floor from its rubber wheels.

In response, our engineering team developed a small-scale prototype robotic vehicle designed to demonstrate the feasibility of such a system. The prototype weighs under 17 pounds and is capable of autonomously pushing a 25-pound payload over a distance of 20 feet. The system must then come to a full stop within 5 feet.

Key Requirements

- **Drive System:**
 - Two independently driven wheels enable differential steering.
 - Each wheel is powered by a Banebots RS775 24V DC motor with an attached gearbox.
 - Wheels are 2-inch diameter shore 60 rubber, which are soft enough to leave marks, so careful control is required.
 - Wheels must remain unmodified and are mounted using supplied hubs.
- **Performance Targets:**
 - Autonomous initiation of payload pushing within 5 seconds of being placed against a load.
 - No impact against the payload when initiating motion.
 - Vehicle must contact the payload at a height of 3 inches (± 0.2 in).
 - Must stop fully within 5 feet after pushing the load 20 feet.
- **Control and Monitoring:**
 - The drivetrain must be paired with a custom control system.
 - A wireless force plate measures and transmits the pushing force, which must be recorded and plotted as a function of time.
 - If the vehicle cannot move the payload, the system should maximize pushing force instead.
- **Safety and Compliance:**
 - Equipped with both a kill switch and a tether switch to disconnect the 24V DC supply in emergencies.
 - Integrated 30A fuse to limit current draw.
 - Only sealed lead-acid batteries are permitted.
 - The chassis must be constructed from metal for durability and a professional finish.
 - The system must not release substances onto the floor or payload.

This project demonstrates the design and integration of mechanical, electrical, and control systems into a functional autonomous prototype. It balances strict performance requirements, safety considerations, and real-world constraints relevant to warehouse automation.