

Original Proposal with Analysis

Project Title: Autonomous Trash Can on Tracks

Project Goals:

1. Design and construct a trash can mounted on a platform with tracks.
 2. Program the Arduino to enable the trash can to navigate autonomously in a predefined area.
 3. Incorporate a manual stop function to pause the trash can for loading garbage.
 4. Ensure the system is user-friendly and robust for practical use.
 5. Evaluate the feasibility of scaling the project for larger, industrial applications.
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Analysis of Outcomes

Achieved Goals:

1. **Design and Construction:** The platform with tracks was successfully built, and the trash can was securely mounted. The tracked design proved effective for smooth movement across different surfaces.
 - Evidence: The prototype performed well on tile and carpeted surfaces during testing.
2. **Manual Stop Function:** A manual stop function was implemented using a push-button module connected to the Arduino. Pressing the button halted the movement of the tracks as expected.
 - Evidence: Repeated tests showed consistent stopping behavior without delay.

Partially Achieved Goals:

1. **Autonomous Navigation:** While the trash can could navigate predefined paths using basic line-following sensors, the system struggled with obstacles and complex environments.
 - Evidence: The robot successfully followed a black tape path but failed to react appropriately when encountering obstacles, such as walls or objects in its path.

Unachieved Goals:

1. **User-Friendliness:** The control interface for the manual stop and path setup requires improvement. Non-technical users found it challenging to reset the predefined path or troubleshoot issues.
 - Reason: Limited time for user interface design and testing.
 2. **Feasibility for Industrial Applications:** The project did not advance far enough to evaluate scalability effectively. The system's lack of robust navigation and obstacle avoidance is a significant limitation for real-world use.
 - Reason: Hardware constraints and insufficient testing of advanced algorithms due to time limitations.
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Improvements and Changes with Additional Time/Resources:

1. **Enhanced Navigation:** Upgrade the system to include ultrasonic or infrared sensors for obstacle detection and avoidance, enabling more dynamic and flexible movement.
2. **Improved User Interface:** Develop a mobile app or simple remote-control interface for better usability, allowing users to start, stop, and set paths more intuitively.
3. **Robust Testing:** Allocate more time for testing in varied environments to identify and address issues early in the development process.
4. **Stronger Hardware:** Use higher-quality motors and a more powerful battery to improve movement reliability and extend operating time.
5. **Scalability Research:** Investigate the integration of larger trash bins and assess the feasibility of solar power for sustainable operation.

Reflection: This project demonstrated the potential for using Arduino-based systems in practical applications, but several limitations need to be addressed for real-world functionality. The lessons learned, especially about navigation and user interaction, will be valuable for future iterations.