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Team No:28

Title : Automated Book Sorting with Robotic arm Integration

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1RV24IS097 | IRV24CS025 | 1RV24IM007 |1RV24CS019 | **Theme: Manufacturing Process**

Introduction

In modern libraries, the manual process of returning and re-shelving books is often time-consuming and prone to human error. To address this challenge, the proposed project presents a semi-automated book sorting system utilizing a mobile rover integrated with a robotic gripper. The system operates based on predefined logic programmed into an Arduino microcontroller. When a book is manually placed at the pickup position, the robotic gripper lifts the book and places it onto the platform. The rover then moves a fixed distance to a designated location. Upon reaching the target point, the gripper transfers the book into a fixed storage slot. The entire process is executed without the use of barcode scanning, wireless communication, or autonomous navigation, relying solely on a programmed sequence of motions for task execution.

Problem Definition

1. In large libraries and academic institutions, managing and organizing physical books is a time-consuming and error-prone task. Librarians often spend significant time locating the correct shelves and placing books manually. This becomes inefficient, especially when dealing with high volumes of returned books or reorganizing collections.

2. There is a need for an automated system that can reduce human effort by autonomously transporting books from a central collection point to their respective shelves and accurately placing them without manual intervention.

Objectives

1. To design and develop a mobile rover integrated with a robotic gripper capable of performing basic pick-and-place operations for book handling.

2. To automate the physical movement of books from a fixed pickup location to a designated slot using predefined motion sequences.

3. To demonstrate efficient coordination between rover movement and robotic arm actions for reliable book transport and placement.

Methodology

Design Stage
A 3D model of the robotic arm was created in SolidWorks. The layout of components on a plywood platform was planned to ensure a compact and mobile system.

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Development Stage
Components such as Arduino Uno, DC motors, servo motors, L298N and HC-05 were selected. The rover platform was assembled, and the arm was 3D-printed.

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Testing Stage
Testing focused on the rover's movement and the arm's pick-and-place performance, with QR codes scanned for book sorting decisions.

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Implementation Stage
The code was uploaded, and the integrated system was tested as a functional prototype. Demonstrations were conducted.

Tools used

HARDWARE COMPONENTS

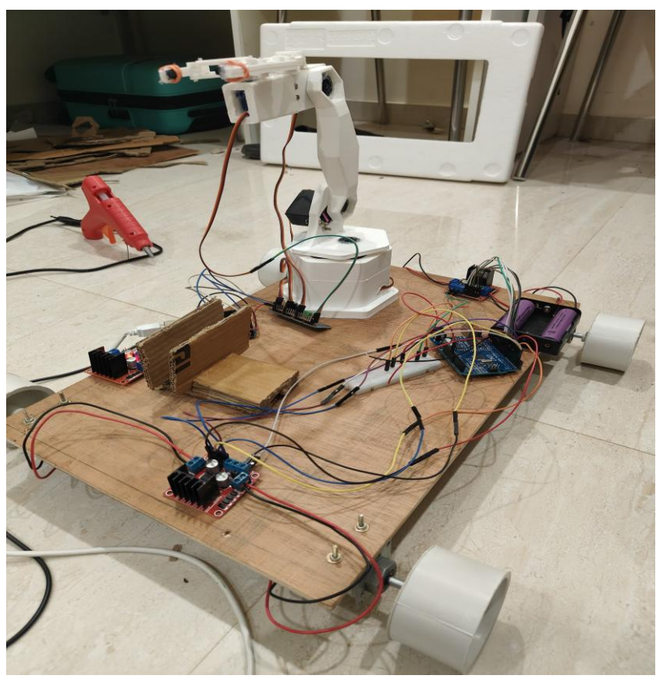
Arduino Uno
DC Motors (×4)
L298N Motor Drivers (×3)
MG996R Servo Motors (×3)
SG90 Servo Motor (×1)
Servo Driver Module
Plywood platform
Breadboard and Jumper Wires
Wheels (×4)
3D Printed Robotic Arm Parts
Li-Ion Battery

SOFTWARE TOOLS

Arduino IDE
Solid works (CAD)

Results and Discussions

The developed prototype successfully demonstrated the essential functionalities of automated book pickup, transport, and placement using a mobile rover integrated with a 3D-printed robotic arm. The system is designed to handle returned books by lifting them from a fixed location and placing them into a single onboard slot. After collecting the book, the rover moves toward a simulated shelf where the arm places the book in its intended location.



Outcomes:

1. All core objectives were achieved, including reliable pick-and-place operations, smooth movement, and integration of all components on a single platform.
2. The project validated the feasibility of building a low-cost, semi-automated book handling system using simple components and Arduino programming.

Conclusions

We implemented a functional mobile rover integrated with a robotic gripper to automate book pickup and placement within a controlled library-like environment. The robotic arm performs predefined movements to lift books from a pickup zone and place them into designated slots. The system operates without any barcode scanner, wireless communication, or autonomous navigation, relying instead on hardcoded instructions programmed through the Arduino platform.By eliminating the need for a conveyor belt and using a mobile base, the system offers improved flexibility for future expansion. Although the prototype does not include real-time scanning or smart shelf identification, it successfully demonstrates a cost-effective and scalable approach for reducing manual effort in book handling tasks.

References

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QR codes