Development of Smart Shopping Trolley Using Arduino UNO

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Abstract—**The growing adoption of automation and embedded systems has significantly transformed modern retail environments by enabling intelligent solutions that enhance operational efficiency and customer convenience. Traditional shopping trolleys rely entirely on manual handling and centralized billing, which often results in physical strain, longer waiting times, and reduced shopping comfort, particularly for elderly and differently abled users. This paper presents the design and implementation of a smart shopping trolley based on the Arduino UNO microcontroller that is capable of autonomously following a customer. The proposed system integrates ultrasonic and infrared sensors to detect human presence, estimate distance, and maintain a safe following range during operation. A motor driver module is employed to control DC gear motors, allowing smooth and controlled movement of the trolley without the need for external device connectivity or complex infrastructure. Sensor data are continuously processed by the microcontroller to generate real-time control decisions, ensuring stable motion and basic obstacle avoidance. Experimental results demonstrate that the developed system effectively reduces manual effort while improving user comfort and mobility within retail spaces. Owing to its low-cost components, simple control architecture, and scalability, the proposed smart shopping trolley provides a practical and reliable solution for enhancing customer experience and supporting automation in modern retail environments.**
Aim: The primary aim of this project is to design a cost-effective, Arduino UNO-based smart shopping trolley that autonomously follows customers using ultrasonic and infrared sensors. This system minimizes physical strain for elderly and differently-abled users by eliminating manual pushing, while ensuring safe navigation and reliable obstacle avoidance in retail environments

Index Terms—**Smart Shopping Trolley, Arduino UNO, Embedded Systems, Ultrasonic Sensor, Infrared Sensor, Autonomous Following, Retail Automation, Assistive Technology**

I. INTRODUCTION:

The increasing adoption of automation and embedded systems has significantly influenced the modernization of retail environments. Conventional shopping methods in supermarkets and malls often involve manual trolley handling and centralized billing, leading to long waiting times, inefficiencies, and physical discomfort for customers. These challenges necessitate the development of intelligent systems that can improve shopping convenience and operational efficiency.

A smart shopping trolley integrates embedded electronics and sensing technologies to assist customers during shopping while enabling real-time billing. Such systems reduce checkout delays and minimize human intervention by decentralizing the billing process. Recent research demonstrates that microcontroller-based smart trolleys employing sensors and wireless communication can enhance customer experience and reduce operational overhead in retail stores.

II. PROBLEM STATEMENT:

Conventional shopping trolleys require continuous manual pushing, causing physical strain, particularly for elderly and differently abled users. Existing systems lack autonomous movement assistance. Therefore, a low-cost Arduino UNO based smart shopping trolley capable of automatically following a customer is required to improve convenience and shopping comfort.

III. METHODOLOGY:

IV. OBJECTIVE:

Following are the Objectives of the Project:

1. To design and develop an Arduino UNO–based smart shopping trolley capable of autonomously following a customer.
2. To implement sensor-based human detection and distance estimation using ultrasonic and infrared sensors.
3. To develop real-time control logic for smooth and safe trolley movement without external device connectivity.
4. To minimize physical effort required for manual trolley handling, particularly for elderly and differently abled users.
5. To ensure safe-distance maintenance and basic obstacle avoidance during operation.
6. To provide a cost-effective and scalable solution suitable for deployment in retail environments.

V. COMPONENT REQUIRE:

We have use following components to make Shopping Trolley,

5.1 Arduino UNO:

Arduino UNO is an open-source microcontroller board based on the ATmega328P, designed for embedded system applications. It operates at 5 V with a 16 MHz clock and provides digital and analog Input/Output pins for device interfacing. The board supports serial communication protocols such as UART, SPI, and I²C. In the proposed system, it serves as the main control unit for sensor data processing and actuator control.

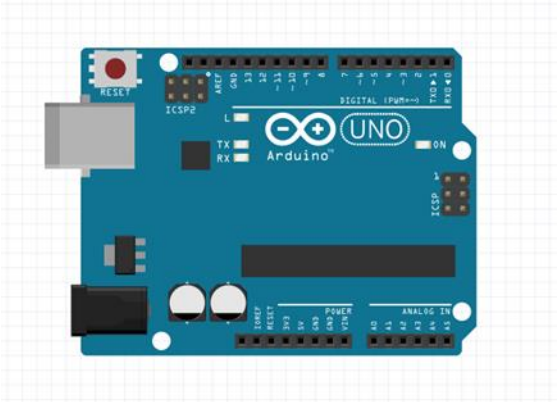

Fig.1 Arduino Board

5.2 IR Sensor

An Infrared (IR) sensor is an electronic device used to detect the presence or movement of objects by sensing infrared radiation. It consists of an IR transmitter and receiver that operate based on reflection principles. The sensor generates an output signal when an object is detected within its range. In the proposed system, the IR sensor is used for object detection and motion sensing.

Fig.2 IR Sensor

5.3 Ultrasonic Sensor:

An ultrasonic sensor is an electronic device used to measure distance by transmitting high-frequency ultrasonic sound waves and receiving the reflected echo from an object. Distance is computed from the time interval between sending and receiving the signal. It provides accurate non-contact distance measurement. In the proposed system, the ultrasonic sensor is used for obstacle detection and proximity sensing.

Fig.3 Ultrasonic Sensor

5.4 MOTOR DRIVER L298D:

The L298D is a dual H-bridge motor driver integrated circuit used to control the direction and speed of DC motors. It enables motor operation by amplifying low-power control signals from a microcontroller. The driver supports bidirectional motor control and pulse-width modulation (PWM) for speed regulation. In the proposed system, the L298D is used to drive and control the motors based on control commands from the Arduino UNO.

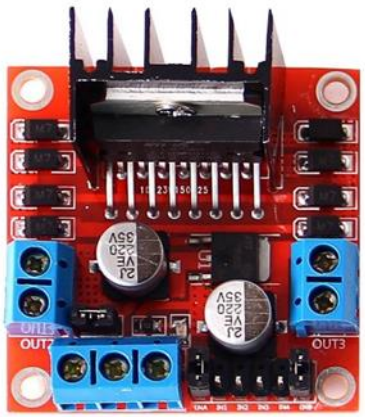

Fig.4 MOTOR DRIVER L298D

5.5 Lithium Iron Battery:

A Lithium Iron battery is a rechargeable power source known for high energy efficiency, thermal stability, and long cycle life. It provides a stable output voltage suitable for embedded and motor-driven systems. The battery offers reliable power delivery with improved safety compared to conventional lithium batteries. In the proposed system, it supplies power to the controller, sensors, and motor driver.

5.6 DC Gear Motor:

A DC gear motor is an electric motor coupled with a gearbox to provide high torque at low speed. It converts electrical energy into mechanical motion with precise control over rotation speed and direction. In the proposed system, the DC gear motor drives the wheels of the smart trolley, enabling controlled movement and navigation.

Fig.5 DC Gear Motors

VI. DEVELOPMENT OF SMART SHOPPING TROLLEY:

The circuit diagram illustrates the hardware configuration of the smart shopping trolley, with Arduino UNO serving as the central control unit. It is powered by a battery supply and interfaces with the ultrasonic and infrared (IR) sensors. The ultrasonic sensor measures the distance between the trolley and the customer, while the IR sensor assists in detecting customer presence and movement direction. Sensor data is continuously processed by the Arduino to determine appropriate trolley actions.

The L298D motor driver is used to control the DC motors, as the Arduino cannot directly drive high-current loads. Based on the sensor inputs, control signals from the Arduino are sent to the motor driver, enabling forward, directional, or stop movements of the trolley. This coordinated operation allows the trolley to autonomously follow the customer while maintaining a safe distance.

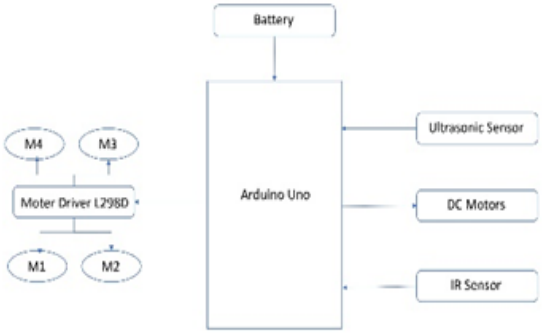

Fig.6 Circuit Diagram of Smart Shopping Trolley

VII. RESULT

Fig.7 Final Project

VIII. CONCLUSION:

This research successfully demonstrates the design and implementation of an Arduino UNO based smart shopping trolley capable of autonomously following a customer using ultrasonic and IR sensors. The system effectively reduces manual effort and enhances shopping convenience, especially for elderly and differently abled users. By utilizing low-cost components and simple control logic, the proposed solution provides a practical, reliable, and scalable approach for improving efficiency and user experience in modern retail environments.

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