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Smart Cart Robot

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Abstract: This paper describes a smart cart robot that can move and avoid obstacles on its own. The robot is built using an ultrasonic sensor to detect obstacles, DC motors for movement, a Bluetooth module for wireless control, and a motor driver to manage the motors. An Arduino UNO board is used to process all the information and control the robot, while the chassis and wheels form the robot's body. The Arduino IDE is used for programming the robot. The ultrasonic sensor helps the robot "see" and avoid obstacles, while the Bluetooth module allows users to control it remotely. This smart cart robot can be used in various applications like automated shopping carts or warehouse automation, showing how different hardware and software components can work together to create intelligent machines.

Keywords: Autonomous Navigation, Obstacle Detection, Path Planning, Distance Avoidance, Ultrasonic Sensing Real-time Data.

I. INTRODUCTION

The smart cart robot exemplifies the potential of combining different technological components to create an autonomous, user-friendly device. The integration of ultrasonic sensors for navigation, DC motors for movement, a Bluetooth module for wireless control, and the Arduino UNO board for processing demonstrates a cohesive approach to developing practical robotic solutions. This introduction sets the stage for further exploration into the design, implementation, and potential applications of the smart cart robot in modern shopping environments and beyond.

The Bluetooth module allows for wireless communication, enabling remote control and monitoring of the robot. The robot's physical structure consists of a chassis and wheels, providing stability and mobility. The entire system is programmed and controlled using the Arduino Integrated Development Environment (IDE), which simplifies the coding and uploading of control algorithms to the Arduino board.

II. LITERATURE PAPER

[1], the paper "Smart Shopping Cart with Automatic Billing System through RFID and ZigBee" (2018) Presents an intriguing exploration into the application of RFID and ZigBee technologies in the context of smart shopping carts, addressing the unique challenges and complexities associated with real-world shopping scenarios. Unlike traditional carts, which require manual checkout, the adoption of RFID and ZigBee in smart shopping carts proves to be a formidable.

This paper discusses a smart cart system utilizing RFID and ZigBee technologies for automatic billing. The cart is equipped with RFID readers that scan items as they are placed in the cart, and ZigBee modules that communicate with a central server for billing.

[2], A person-following robotic cart controlled via a smartphone application: Design and evaluation (2017) N. A. Rawashdeh, R. M. Haddad, O. A. Jadallah, and A. E. To'ma
This paper presents the design and evaluation of a person-following robotic cart controlled through a smartphone application. The system is designed to enhance the shopping experience by following the user around the store, carrying items, and facilitating the shopping process. The robotic cart uses sensors and a smartphone app for navigation and control.The evaluation shows that the robotic cart successfully following the user and navigates through a environment, proving the feasibility and effectiveness of the design for practical use in shopping scenarios.

[3], the paper "Design and Implementation of a Smart Shopping Cart Using Arduino and Bluetooth" (2020)
Innovative use of Arduino microcontrollers and Bluetooth communication in smart shopping carts, addressing the specific challenges and benefits associated with these technologies. Unlike traditional shopping methods, this approach aims to automate item detection and billing.This study focuses on a smart cart system developed with Arduino microcontrollers and Bluetooth communication. The cart includes sensors for item detection and a mobile application for user interaction.

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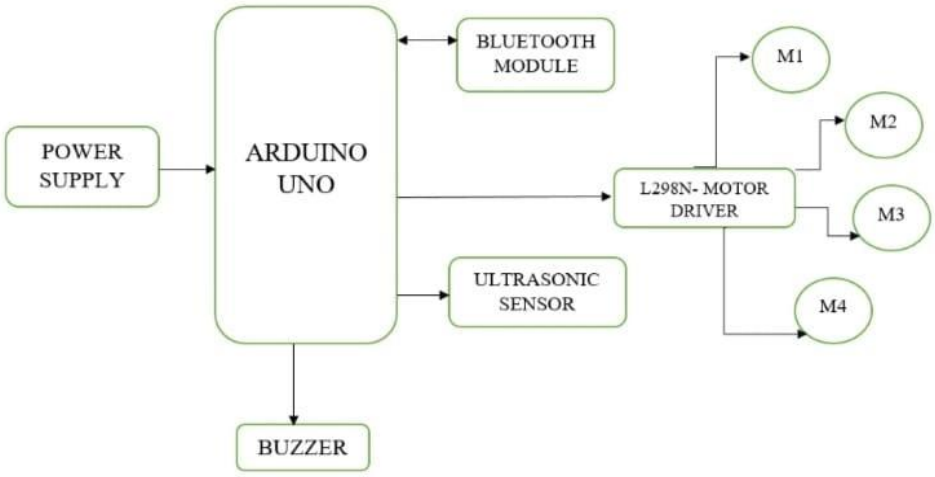
[4], the paper “Human Following Robot Using Arduino” (2022**)** Dhiren Sati, Sanket Avkirkar, Rishi Pandey, Abhijit Somnath
This paper focuses on designing a human-following robot utilizing an Arduino Uno. The robot employs ultrasonic sensors and an L298N motor driver for navigation and obstacle detection. The system components include DC motors for movement and a caster wheel for stability. The robot is programmed to maintain a specific distance from the user and adjust its path to avoid obstacles.The robot effectively follows a human target and navigates its environment, demonstrating the potential for fine-tuning and optimization for varied conditions.

[5], the paper "Automatic Cart Movement Trailer" (2019) Husain Bohra, Megha Akare, Dolly Chouhan, Nikita Guha, Prof. Shailesh Kurzadkar
This research explores the automation of cart movement using a trailer system. The design involves using sensors and microcontrollers to enable the cart to follow a predetermined path or a human guide.The automated cart movement system demonstrates effective navigation and following capabilities, providing a foundation for further development and optimization in automated cart technologies.

III. METHODOLOGY

A. BLOCK DIAGRAM



The block diagram illustrates the components of a smart cart robot project and how they are connected. At the center is the Arduino Uno microcontroller, which acts as the brain of the system. It receives power from a power supply and coordinates the robot's functions. The Arduino communicates wirelessly with other devices through a Bluetooth module, allowing remote control. An ultrasonic sensor is used to detect obstacles in the robot's path, helping it navigate safely. If an obstacle is detected, the Arduino can trigger a buzzer to alert users. The L298N motor driver, controlled by the Arduino, manages the speed and direction of four motors that drive the wheels of the robot, enabling it to move. Together, these components allow the smart cart robot to operate autonomously and respond to its environment.

B. WORKING

The smart cart robot operates by combining several components to work together smoothly.The ultrasonic sensor at the front of the robot measures the distance to nearby objects by sending out sound waves and calculating how long it takes for them to bounce back.

When the supply is given to the Arduino, it initializes all the sensors used.

Ultrasonic sensor – measures the distance between cart and the user. If user detected motor control unit starts working.

Motor control unit- it adjusts the speed of the cart based on the measured distance. The speed is mapped from distance value to a range suitable for user control. This controls the speed and direction of the motor in robot. The wheels move accordingly allowing the robot to move in different directions.

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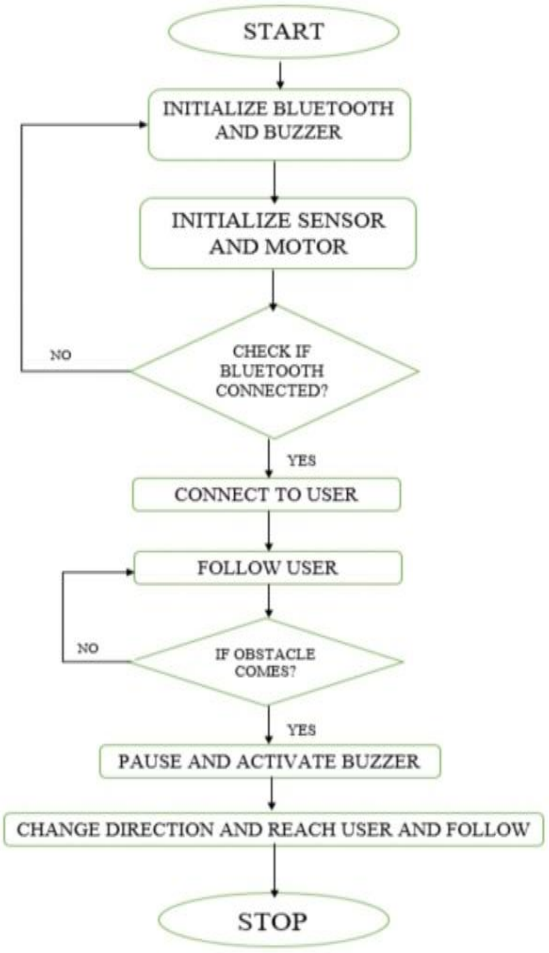
This distance information is sent to the Arduino UNO, which acts as the robot's control center. The Arduino uses this information to decide what actions to take, such as moving forward, stopping, or turning to avoid obstacles.

The Bluetooth module enables connections between user and cart the robot to receive commands from a smartphone or computer, letting you control its movements wirelessly. In robot, this module to determine its distance limitations.

The chassis provides a sturdy frame to hold all these parts together, while the wheels allow the robot to navigate its environment.

Thus this robot navigates the user and gives adaptive speed control and have reliable tracking system making the entire system work as a cohesive unit.

C. FLOWCHART



The operational steps of a smart cart robot project are defined by the following flow chart. We start with initialise bluetooth module and buzzer, then initialises the sensors and motors. From there, the system will verify that a Bluetooth connection with the user has been established. It will keep checking until the connection succeeded. After connecting, the robot starts to track its owner. It watches for road debris while driving behind! If during this movement the system perceives an obstacle, then it stops and activates a buzzer as a warning to change direction. It continues following the user after skipping over it. This loop ends when the process itself is stopped.

IV. RESULTS

The prototype of the proposed system is shown in Figure

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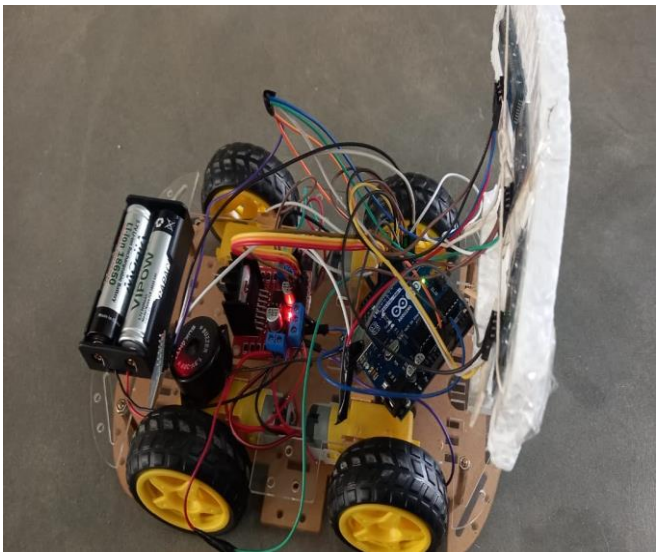

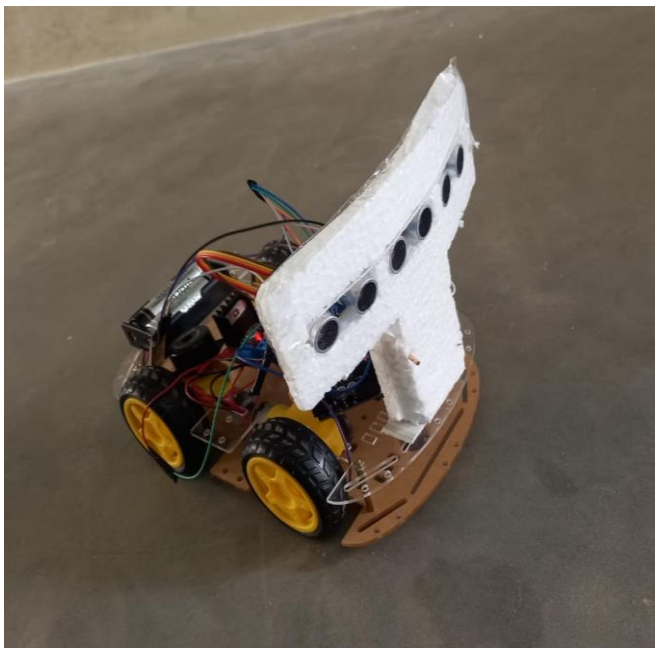

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V. APPLICATIONS

1. Retail Assistance
2. Warehouse Automation
3. Healthcare
4. Hospitality
5. Information and Guidance.

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