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Design & Development of AGV for Enhancing Hospitality

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Abstract: *With the help of technological breakthroughs, the project introduces an ESP32-based line follower robot created especially for hospital logistics, revolutionizing supply chain management in healthcare facilities. The robot is outfitted with infrared (IR) sensors for accurate line following and an ultrasonic sensor for obstacle identification. This combination of sensors reduces the likelihood of collisions and improves operational reliability by guaranteeing safe and effective navigation across predetermined courses. Additionally, a siren and an IR sensor placed in a strategic location act as a theft deterrent by warning staff members when medical goods in the robot's basket are accessed without authorization. The ESP32 microcontroller's flexibility allows for the smooth integration of several sensors and actuators, and its wireless capabilities enable remote monitoring and control, which optimizes hospital logistics operations. All things considered, this creative approach fulfills the pressing demand for automation in healthcare logistics can enhance staff productivity and patient care by providing scalability and flexibility.*

Keywords: ESP32-based line follower robot, hospital logistics, IR sensors, ultrasonic sensor,automation, supply chain management, healthcare industry, operational efficiency

I. INTRODUCTION

Organizing medical supplies and logistics is a significant challenge to hospitals that affects patient care and operational effectiveness. Hospitals are dynamic, ever-moving settings, thus a smooth supply flow is essential to the continuous provision of treatment. Traditionally, handling goods by hand is labor-intensive, time-consuming, and prone to error—especially during emergencies like pandemics or natural catastrophes. Therefore, automated solutions designed specifically for hospital logistics are necessary to maximize resource utilization, lower mistake rates, and boost productivity. Security is critical because unapproved access compromises the integrity of the institution and patient care. For asset protection, it is therefore essential to incorporate theft detection into automated systems. Promising new technologies include robotics and sensor networks. Hospital logistics may be revolutionized with solutions like the ESP32-based line follower robot, which is outfitted with IR and ultrasonic sensors as well as prompt supply management. All things considered, this initiative emphasizes how important it is for technology to progress in order to streamline logistics, guarantee supply delivery on time, and improve patient outcomes. Keywords: medical supplies, hospital logistics, automated solutions, theft detection, and cutting-edge technologies.

II. BLOCK DIAGRAM

This block diagram illustrates a system architecture commonly found in robotics or automation projects. At its core is the ESP32 microcontroller, serving as the central processing unit. The microcontroller receives inputs from various sensors: two IR sensors, likely used for detecting obstacles or proximity sensing, and an ultrasonic sensor, typically employed for distance measurement or obstacle avoidance. These sensors provide environmental data to the ESP32, which processes it to make decisions. The microcontroller then sends signals to the motor driver, which controls the movement and direction of motors. This setup enables the system to act upon the information gathered by the sensors, allowing for dynamic responses to the surrounding environment. Additionally, there's a buzzer included, presumably for generating auditory alerts or feedback signals. The entire system is powered by a battery, providing the necessary

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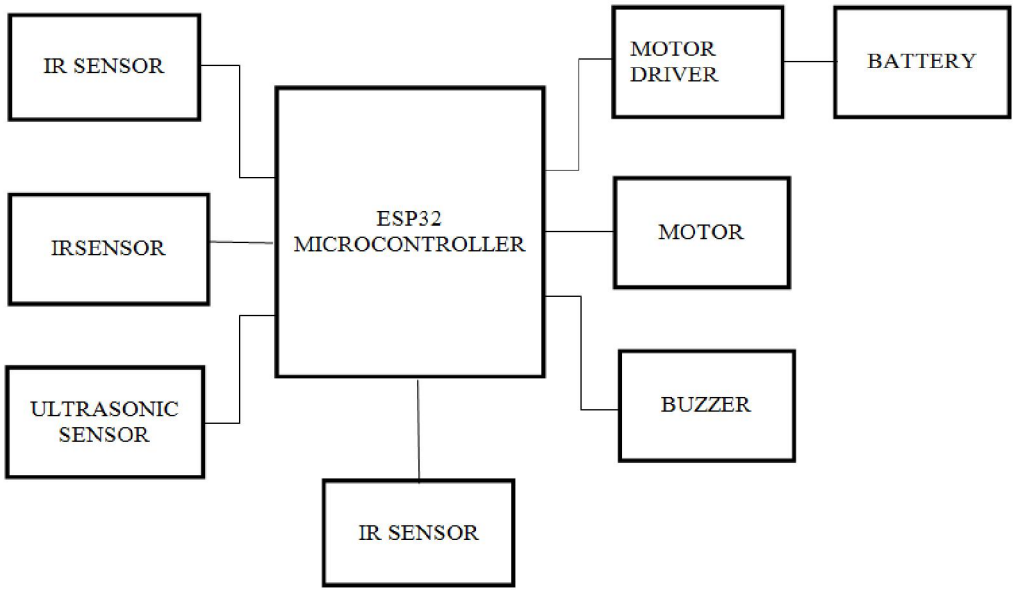
electrical energy for operation. Overall, this architecture forms the basis of an intelligent system capable of autonomously navigating or interacting with its surroundings based on sensor inputs and programmed logic



III. METHODOLOGY

The methodology involves the following steps:

- Hardware Assembly: Build the robot's chassis and integrate components such as IR sensors, ultrasonic sensors, ESP8266 controller, and LN298 Motor driver.
- Line Following: Develop algorithms to process IR sensor data for accurate line detection and path tracking.
- Obstacle Detection: Implement obstacle detection algorithms using ultrasonic sensors to ensure safe navigation.
- Food Delivery Mechanism: Design and incorporate a mechanism to carry and deliver food and beverages.
- Motor Control: Implement motor control logic using the LN298 Motor driver to achieve precise movement.
- Communication: Program the ESP8266 for wireless communication, allowing remote control and status updates

IV. COMPONENT AND SPECIFICATION

Sr. No.	Components	Specifications
1	Battery	Capacity: 12V 1.3Ah
2	DC Motor	Speed: 60 RPM
3	IR Sensor	Detection Range: Up to 30 cm
4	Ultrasonic Sensor	Detection Range: Up to 3m
5	Buzzer	Sound Output: 80dB
6	Motor Driver	Maximum Current: 2A
7	ESP32 Microcontroller	Operating Voltage: 3.3V
8	Chassis	Dimensions: 300mm x 200mm x 100mm
9	Wheels	Diameter: 50mm
10	Basket	Capacity: 2kg

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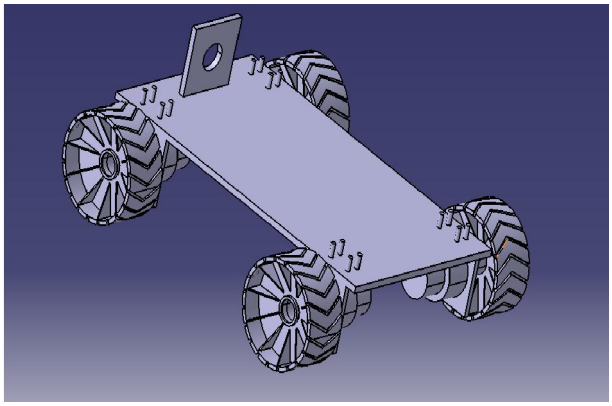
V. SYSTEM DEVELOPMENT

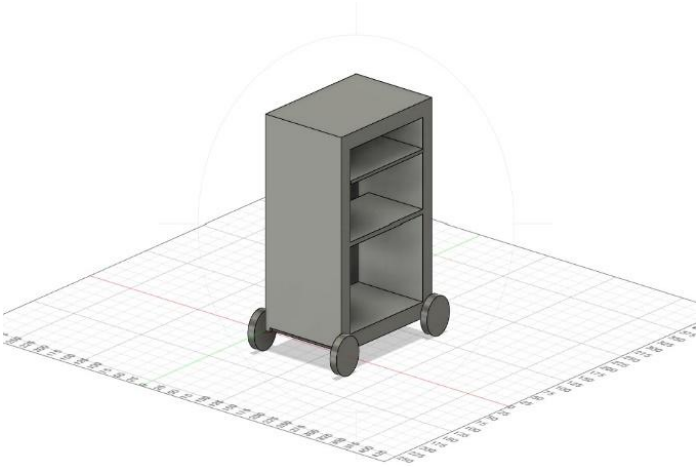
A. CAD Model of Rover:

The chassis consists of a flat rectangular base with four wheels attached to it. The wheels are distributed evenly, with two on each side, likely for stability and balance. There are protrusions on the sides of the chassis, possibly for mounting additional components or sensors. Overall, this chassis seems well-suited for building a mobile robot platform, where additional components such as motors, microcontrollers, sensors, and a power source could be mounted to create a functional robot capable of various tasks like navigation, exploration, or transportation.



B. CAD Model of AGV

We have designed the two compartments on the rover to carry products. The design of therover is successfully developed by the help of Fusion 360 software.



Considering the situations and demand of contact less delivery the design has been made. Unlike regular humanoid hospitality robot this design is unique and serves better for the purpose. It has more space for the medicine and food also can accommodate well and is handy. Industrial cast iron is chosen for the chassis because it has the strength to carry the load and the finish of it will be an added advantage. To bear the weight, it has 30 cm x 21 cm dimension base with a height of 89 cm.

The base has 4 wheels connected to the motor and wheels to assist the movement. IR sensor is placed in front of the front base. The batteries and electronic components are placed at the bottom of a 11 cm height base.Keeping the patient bed height in mind the robot was designed to be around 2.5 ft height so that the patient can access the medicine box easily and without getting up from his place. T robot has 1 tray and 2 racks for medicine which is covered by MDF (Medium Density Fiberboard) sheets, dust, etc. while it's travelling from inventory to patient. At the bottom the robot can accommodate medical equipment'sin a special tray and also has separate compartments.

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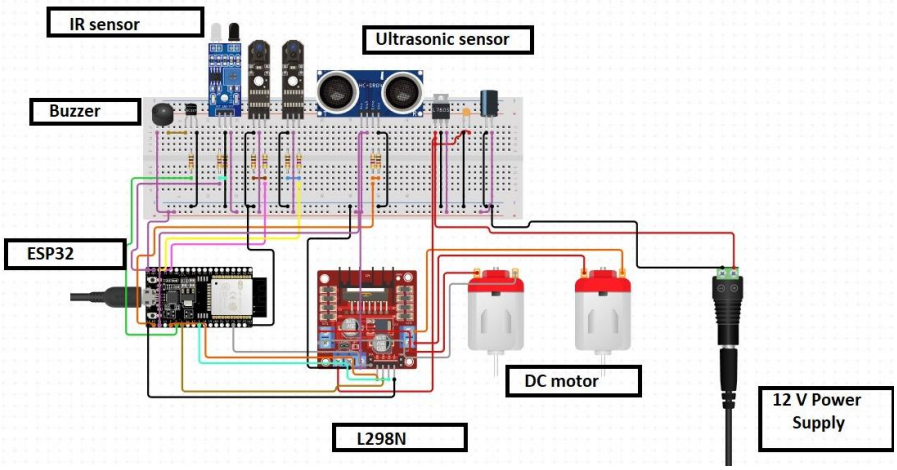
VI. CIRCUIT DIAGRAM

We Select Microcontroller as a ESP32Microcontroller, the board is connected to the Microcontroller,Motor driver, IR senors , Ultrasonic sensor, buzzer and DC motorswith the help of jumper wires.



This circuit diagram shows a breadboard configuration with different electronic parts connected to form a working circuit. An ESP32 microcontroller board, acting as the central control unit, is at the center of the configuration. It is surrounded by a variety of sensors and actuators, such as an L298N motor driver module-powered DC motor, an IR sensor, an ultrasonic sensor for measuring distance, and a buzzer for auditory notifications. Vibrant cables are used to connect the many parts, each of which stands for a different connection or functionality. The circuit receives energy from the 12V power supply. This setup points to the development of a complex project that probably involves robotics, automation, or sensing applications. The ESP32 board is used to control the actions of multiple sensors and actuators in response to input data or predetermined criteria

Description of components:-

- **ESP32:** This is a microcontroller board, serving as the brain of the project. It's connected to various sensors and actuators to control and monitor them.
- **IR Sensor**: An infrared sensor used for detecting objects or obstacles. It sends signals to the ESP32 for processing.
- **Ultrasonic Sensor:** Another type of sensor for distance measurement. It emits ultrasonic waves and measures the time taken for the waves to bounce back from objects. This data is sent to the ESP32 for processing.
- **Buzzer:** The buzzer generates audible alerts or tones based on signals received from the ESP32. It can be used for indicating certain conditions or events.
- **DC Motors:** Two DC motors are present in the setup. They are controlled by the L298N motor driver, which receives signals from the ESP32 to regulate motor speed and direction.
- **L298N Motor Driver**: This module serves as an interface between the ESP32 and the DC motors. It provides the necessary circuitry to control the motors effectively.
- **12V Power Supply:** This power source provides the necessary voltage for the DC motors and other components in the circuit

VII. RESULTS

We have successfully design and developed the prototype of Hospitality robot controlled by Microcontroller interface with increased height and Upgraded compartments for Delivery of major& minor products in hospitals or hotels./.

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IX. CONCLUSION

An ESP32-based line follower robot with built-in motor driver, buzzer, ultrasonic sensor, and infrared sensors was created. With painstaking design, rigorous testing, and repeated refining, it demonstrated remarkable material movement and obstacle detecting skills. The exceptional precision of line following, which is essential for medical navigation, was guaranteed by the advanced PID controller tuning. The prompt obstacle identification and collision avoidance actions made possible by the seamless integration of sensors improved safety. Remote monitoring was made possible by better situational awareness thanks to instantaneous feedback methods like buzzers. It carried medical supplies throughout hospitals with efficiency thanks to its sturdy build and thoughtfully constructed storage racks. Its effectiveness and usefulness are highlighted by its user-friendly interface, efficient power management, and flexibility to adapt to different conditions. All in all, the project is a good example of originality, innovation, and teamworkway to improve hospital logistics automation and productivity.

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