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INVENTORY MANAGEMENT ROBOT USING LANE DETECTION MECHANISM

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Abstract: Lane Detection is one of the most important aspects of robotics. A Line Following Robot is an autonomous robot that can follow a black line that is drawn on the surface consisting of a contrasting color. It is designed to move automatically and follow the line. The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on track. The array of four sensors makes its movement precise and flexible. The robot is driven by DC gear motors to control the movement of the wheels. The Arduino Uno interface is used to perform and implement algorithms to control the speed of the motors, steering the robot to travel along the line smoothly. This project aims to implement the algorithm and control the movement of the robot by proper tuning of the control parameters and thus achieve better performance. Arduino now must make decisions based on the data received from the sensor, until the sensor detects no black line it will go forward. If the left sensor detects a black line, the robot turns right, and if the right sensor detects a black line, it turns left. The robot will stop when both sensors detect a black line at the same time. It can be used for industrial automated equipment carriers, small household applications, tour guides in museums, and other similar applications, etc.

Index Terms **– Sensors, Arduino, Motors, Robot, Lane Detection, Contrast Colors, Inventory Management, Parameters**

I. INTRODUCTION

An autonomous mobile robot that can efficiently manage inventory while navigating through a warehouse or a store is known as an inventory management robot. It has a few sensors and cameras that can detect and identify objects, shelves, and their surroundings. An inventory management robot may find it difficult to correctly navigate the aisles and avoid running into obstructions, though.

A lane detection system used by an inventory management robot can be a good answer to this problem. The robot can proceed following the predetermined course and prevent deviance thanks to lane detection technology, which uses cameras to detect the aisle lines or limits. The robot's place in the aisle is maintained by the mechanism, which continuously scans the markings and modifies its movement as necessary.

A very effective method of controlling inventory in warehouses and retail establishments is to deploy an inventory management robot with a lane detection system. Automating the inventory management process can result in time savings and lower labour expenses. By giving real-time updates on the stock levels of various products, it can also increase the accuracy of inventory data. To enable the robot's effective functioning, though, significant issues with accurate lane detection, obstacle avoidance, product recognition, real-time inventory tracking, and cost-effectiveness must be resolved. By addressing these issues, an accurate and effective inventory management system can be created, increasing the efficiency and security of the warehouse or retail space. Line following and lane detection robot integration also offers improved path planning. Robots can determine the quickest and most productive routes to gather or replenish product inventories. The robots can intelligently explore the warehouse by considering elements like product popularity, urgency, and closeness to other products that need replenishing.
In conclusion, organizations have an automated and effective option for inventory management with lane detection and line-following robots. It improves data integrity, lowers mistake rates, decreases manual labour, and generally makes operations more efficient. Businesses can streamline inventory management procedures and improve supply chain management by utilizing automation and computer vision technology.

II. PROBLEM STATEMENT

The manual, labor-intensive, and error-prone nature of the traditional inventory management procedure used in warehouses and retail establishments results in erroneous inventory data and stock shortages. Due to the heavy lifting and repetitive duties involved, the procedure can be dangerous for the workers. These issues can be solved by an inventory management robot with a lane-detecting system. To enable the robot's effective functioning, though, significant issues with accurate lane detection, obstacle avoidance, product recognition, real-time inventory tracking, and cost-effectiveness must be resolved. To increase the overall efficiency and safety of the warehouse or retail space, the inventory management robot must be affordable and offer

real-time updates on the stock levels of various products. An effective inventory management system can be achieved by addressing these issues.

III. OBJECTIVES

- To manage objects more accurately and quickly in Industries.
- To place the object in its designated place.
- To ensure the proper delivery of objects in Industries.
- To work smoothly without any errors.
- To optimize and decrease the human intervention of working all day.

IV. PROPOSED WORK

The IR Proximity Sensors: The concept of working with a line follower robot is based on the phenomenon of light. We know that white color reflects almost all the light that falls on it, whereas black color absorbs most of the light. In the case of a line follower robot, we use IR transmitters and receivers also called photodiodes. They are used for sending and receiving light. IR transmits infrared light. When infrared rays fall on a white surface, they're reflected and caught by photodiodes which generate some voltage changes. When IR light falls on a black surface, light is absorbed by the black surface and no rays are reflected, thus photodiode does not receive any light or rays. Here in this Arduino line follower robot when the sensor senses a white surface then Arduino gets 1, i.e., HIGH as input, and when senses a black line Arduino gets 0, i.e., LOW as input.
L298N Motor Drive H-Shield: The Motor Driver is a module for motors that allows you to control the working speed and direction of two motors simultaneously. This Motor Driver is designed and developed based on L298N IC. L298N is a 16 Pin Motor Driver IC. This is designed to provide bidirectional drive currents at voltages from 5 V to 36 V. Rotation of the motor depends on Enable Pins. When Enable 1/2 is HIGH, the motor connected to the left part of the IC will rotate according to the following manner: Input 1 Input 2 Result 0 0 Stop 0 1 Anti-clockwise 1 0 Clockwise.

V. WORKING

In this project, we have designed an Inventory management using Lane detection which is an Arduino-based Line Follower Robot. The working of the project is simple: detect the black line on the surface and move along that line. The detailed work is explained here. As mentioned in the block diagram, we need sensors to detect the line. For line detection logic, we used two IR Sensors, which consist of an IR LED and a Photodiode. They are placed in a reflective way i.e., side–by–side so that whenever they come into proximity of a reflective surface, the light emitted by IR LED will be detected by Photodiode. The following image shows the working of a typical IR Sensor (IR LED – Photodiode pair) in front of a light-colored surface and a black surface. As the reflectance of the light-colored surface is high, the infrared light emitted by IR LED will be maximum reflected and will be detected by the Photodiode. In the case of a black surface, which has a low reflectance, the light gets completely absorbed by the black surface and doesn't reach the photodiode. Using the same principle, we will set up the IR Sensors on the Line Follower Robot such that the two IR Sensors are on either side of the black line on the floor. Depending on the input the robot follows the line and stops at that node.

VI. IMPLEMENTATION

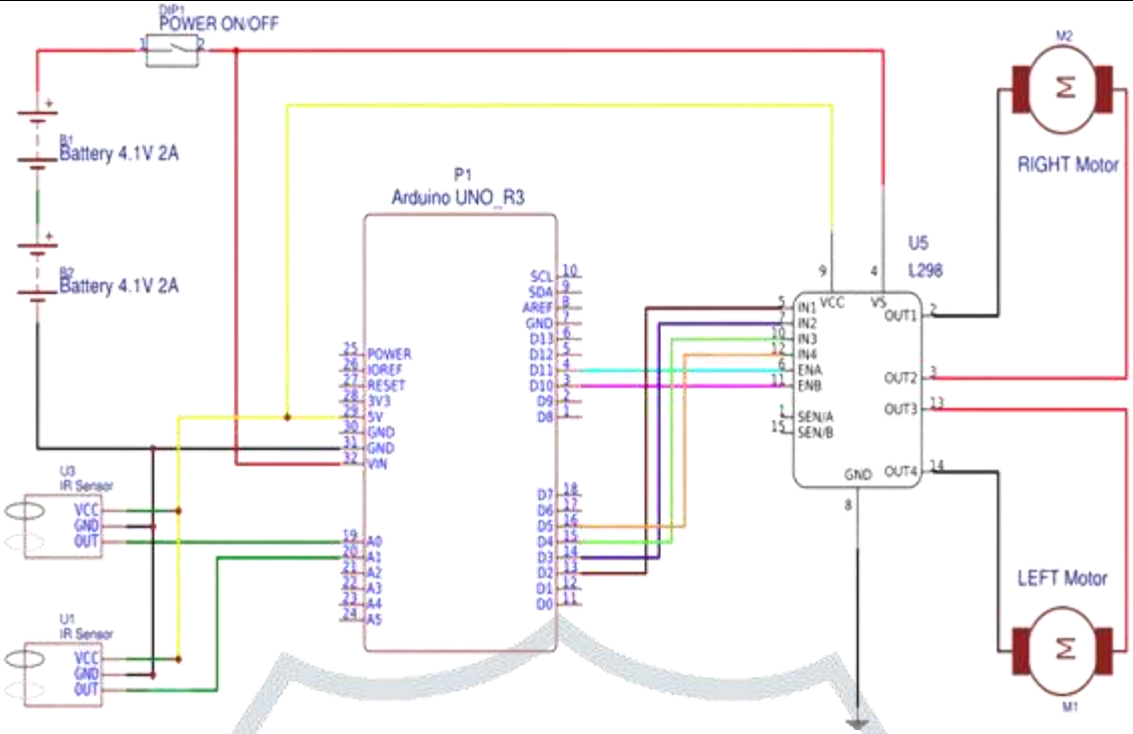
Step 1:
Connections are made between Arduino and Infrared Sensors. The same connections are made to 2 IR sensors to their respective ports.

Step 2:
After connecting the Arduino board to 2 IR sensors, connections are made between the motor driver and the IR sensors.
Connections are made between Arduino and the motor driver.

Step 3:
The TT geared motors are connected to the motor driver.
The batteries are also connected to the driver as a power supply.

Step 4:

- Assemble all the parts and mount them on a plate.
- Place the IR sensors in such a way that they are very close to the ground but should not touch the ground.
- A switch is used between the motor driver and the batteries.

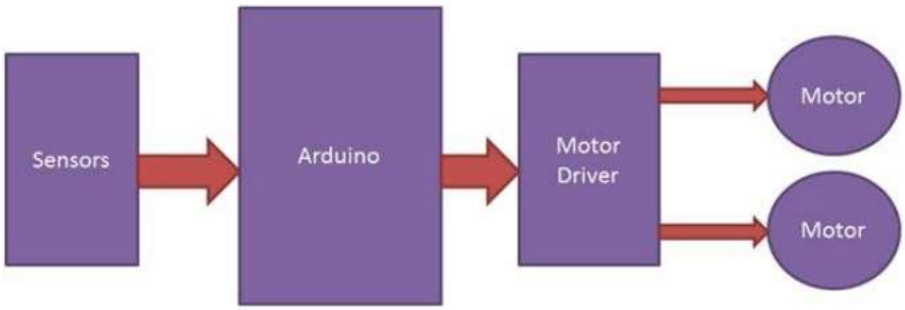


circuit diagram

VII. SYSTEM ARCHITECTURE

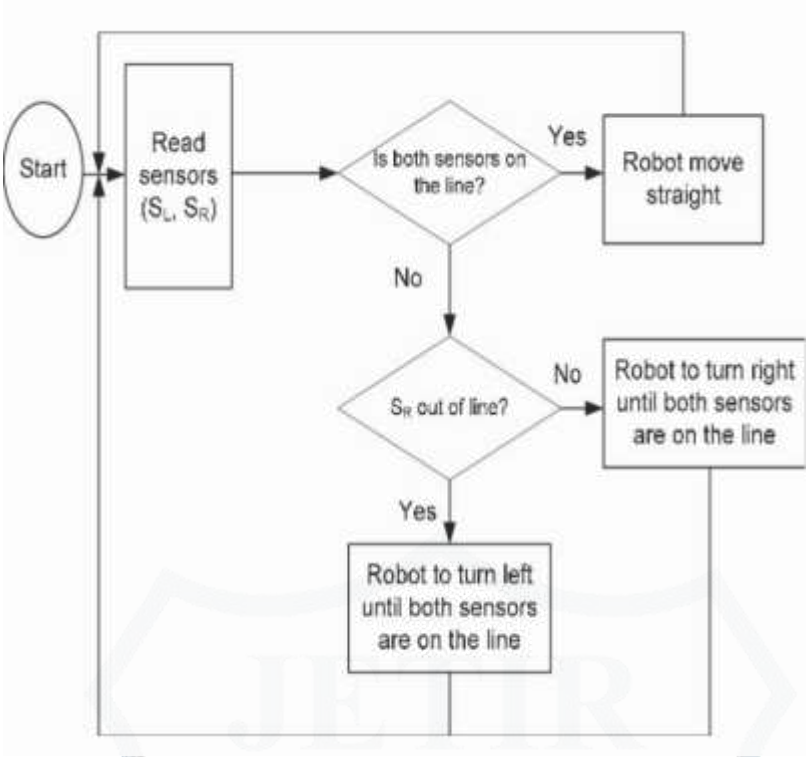
The system architecture can be analyzed by following steps:

- If we want the left motor to rotate in one direction, we apply a high pulse to IN1 and a low pulse to IN2. To reverse the direction, reverse the pulses to IN1 and IN2. The same applies to the right motor.
- If we want the right motor to rotate in one direction, we apply a high pulse to IN3 and a low pulse to IN4. To reverse the direction, reverse the pulses to IN3 and IN4.
- Motor A wires are connected to motor terminals 1 and 2 of L298N, whereas Motor B wires are connected to motor terminals 3 and 4. IN1, IN2, IN3, and IN4 are connected to pins 2, 3, 4, and 7 respectively.



block diagram

VIII. SYSTEM FLOW



flowchart

The direction of the robot will be determined by the status of the sensors mentioned earlier. Based upon which sensors did not detect the line, a corresponding corrective action signal is sent to the motor. This corrective action will continue until both sensors detect the line again. The corresponding corrective action signals are shown in the figure. If both sensors did not detect a line, the robot will stop and reverse until either one of the sensors detects a line after which the line-following algorithm is activated again. The phenomena of light serve as the basis for the idea. We are aware that black absorbs most of the light, but white reflects practically all of the light that strikes it. We use infrared transmitters and receivers, also known as photodiodes, in the instance of a line-following robot. Light is transmitted and received through them. Infrared light is transmitted through IR. When infrared light strikes a white surface, it bounces back and is captured by photodiodes, causing voltage changes. The photodiode does not receive any light or rays when infrared light strikes a black surface because the light is absorbed by the black surface and no rays are reflected.

IX. RESULT AND DISCUSSIONS

There are several possible advantages to using lane detection systems in inventory management. Certain portions of inventory management can be automated by using computer vision algorithms to find and monitor lanes inside a warehouse or storage facility.

1. When the input is given as NODE 1, the robot follows the line taking the shortest path to NODE 1, and reaches the destination.
2. Similarly, depending on the input (NODE) given, the robot will follow the line taking the shortest path to that NODE.
3. The NODES depict the tables of a restaurant or a house in a layout or vacant places in industries.

It's crucial to remember that putting into practice a lane detection system for inventory management calls for careful design, suitable sensor or camera installation, and robust algorithm development. To ensure precise lane detection, environmental factors like lighting and building barriers must also be considered. For the system to function at its best, regular calibration and maintenance are also required.

X. CONCLUSION

Robotics is an emerging technology that will be used in the future. In this project, we introduced an inventory management robot that is used for multipurpose. Traditionally, the operator does most industrial tasks manually. However, in our experiment, we used lane detection using Line Follower Robot. By doing this, the process of categorizing distance and path is quicker and more precise. The productivity of an industry is generally optimized, which is the most significant factor. This robot is capable of remarkably human-like actions. Although robots have made great progress, their application is still constrained by the scarcity of resources and the high cost of production. More advantages from robotics can be realized if we can get beyond these obstacles.

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