Line Following Robot with Object Avoidance using Arduino

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***Abstract* - One of the most significant functions of robots is tracing. Robot with a Linear Motion A self-contained robot that may be followed, or a black line painted at the top that blends two colors. It is configured to move in a straight line and automatically. The robot uses observable signals to recognize the line, which helps it stay afloat. Because of the four-sensory system, its movements are precise and varied. DC gear motors are used to control the movement of the robot's wheels. To develop and test algorithms for controlling motor speeds and moving the robot along the line, the Arduino Uno interface is employed. The purpose of this project is to use an algorithm to adjust the control parameters to control the robot's movement.**

Keywords - Arduino UNO; DC motor; Sensors.

I. INTRODUCTION

The line following robot is capable of controlling a machine that follows a line drawn on the ground, which appears black in white or white in a dark environment.

It's a self-contained robot that points and traces a black and white line on the upper surface or a white line in the dark. The next robot must be able to view the given line again, maintain track of it, and do the tasks that have been assigned to it. The supplied path line should be followed by the design as well as a robot built in certain conditions when using the do function. It is made up of input, process, and output components in a better system. After reading the book and drawing a black / white or white / black path in an imagined world, send the input signal to an Arduino UNO microcontroller via a process that can be questioned and decisions taken. The microcontroller has determined the robot's directions and speed based on possible input detection modifications (if needed). Changes the outcome to any line follower speed direction that is possible. Following the robot's speed and naked directions, the programme delivers the initial or pre-configured control signals for the line.

II. OBJECTIVE

- The robot must be able to follow a line and turn in various degrees.
- it must be unaffected by external components such as light and sound.
- it must allow for the calibration of the line's darkness threshold.
- Scalability must be prioritized in the design.
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III. LITRETURE SURVEY

Zaman, Hasan U., et al. “A novel design of line following robot with multifarious function ability”. This paper describes the design and development of a Line Following Robot that follows a line, specifically a black line on a white surface. This line following robot has two unique modes: line following and obstacle detection. It's comparable to a self-driving car that follows a set itinerary. This robot can detect barriers to the right, left, and in front of it while following its predefined path on its pathway. As a result, the robot can move along a black line while detecting obstacles in all three directions. [1]

Colak, Ilknur, and Deniz Yildirim. “Evolving a Line Following Robot to use in shopping centers for entertainment”. In this project, the Linear Robot design,

The most significant parts of developing mobile robots are obstacle detection and avoidance. Robots with this technology have senses that allow them to navigate in unfamiliar environments without damaging themselves. The purpose of this research is to develop an Obstacle Avoiding Robot that can detect obstacles in its route and avoid colliding with them. It's a robot automobile that detects obstacles using ultrasonic distance sensors and is controlled by an Arduino microcontroller. [2]

Punetha, Deepak, Neeraj Kumar, and Vartika Mehta. "Development and applications of line following robot based health care management system”. The methodologies for assessing, planning, administering, and enhancing the health care management system are outlined in this paper report. The line that follows the drug-carrying robot is designed to provide the patient medication as needed. A linear robot is an electronic system that can recognize and follow a line painted on the ground. A line is typically defined by a pre-determined course that appears as a black line in a white region of a

different hue. A robot is connected to a light-based resistor sensor, whose resistance varies depending on the amount of light. When LDR receives a big amount of light, it has a resistance to its lowest value, which is close to zero, and it has a resistance to its highest value, which is close to infinite, when there is no light falling on it. A robot is attached to an IR sensor switch located near the patient. [3]

Román Osorio, C., et al. "Intelligent line follower mini-robot system." This study shows the prototype development of a smart robot fan tracking system, with the goal of detecting, understanding, and transforming a robot's actual movement throughout its course using real-time data from the numerous magnetic sensors used. V2X digital compass, microcontroller, and odometric readings are used in this system. The V2X (digital compass) sensor rating, as well as the cost-effectiveness of prototype implementation and performance, are also shown in the article. [4]

Tabassum, Faiza, et al. "Obstacle avoiding robot." which is commonly used to transport children to the mall, is considered a new commercial product in the industry. The robot can follow a 4.8-cm-wide black line with a 400-kg load and has five different speed levels. There are two ways to control the robot: line tracking and service mode. With the remote control in Line Tracking mode, it can be manually pushed forward, backward, left, and right on the blackline route, while in Manual Process mode, it can be manually moved forward, backward, left, and right on the blackline route. Two permanent left and right DC magnetic engines power the robot. The ability to move forward and backward, Two H-Bridge circuits control forward and backward movement, as well as the left and right side motors. [5]

Surya, M. Sri Venkata Sai, et al. “Smart and Intelligent Line Follower Robot with Obstacle Detection”. A smart robot that detects and follows a visible line on the floor is known as a line follower. The path is predetermined and can be as basic as a black line on a white background with a high contrasted color or as complex as magnetic or laser guide markers. These lines can be detected using a variety of sensors. The most frequent method for detecting the line that the robot must follow is to use infrared sensors. The robot is self-moving and capable of working across long distances. It is possible to customize a line follower's obstacle detection feature. [6]

Rodríguez Arechabala, Olatz. "Path planning robot with obstacle avoidance." The goal of this project is to get a wheel robot to successfully reach a location while avoiding any impediments it may encounter. The robot has an ultrasonic sensor to identify obstacles and an Inertial Measurement Unit (IMU) to estimate its position by measuring velocity and acceleration. To accomplish this, a control system was created and implemented that builds a path from the starting point to the destination and can avoid and return to the path if it encounters an impediment.[7]

IV. WORKING METHODOLOGY

BLOCK DIAGRAM

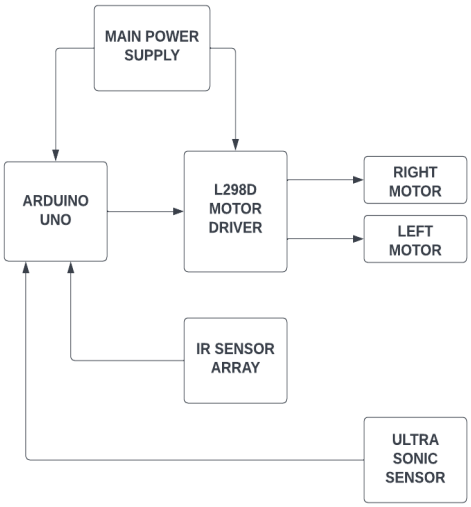

Fig1: Block diagram of line following robot

These robots are inexpensive and simple to construct. The infrared sensor is also utilised to locate the path's black line. Obstacles are detected using an ultrasonic sensor along the way. The robot reacts to sensory input by doing something. This robot can entirely follow a line that is at least 1 inch wide, as well as a sophisticated approach that includes obtuse / acute angled twists and turns of those black lines. [1]

Two motors rotate clockwise and the robot advances when two infrared sensors on both sides of the robot detect a white route. Two motors rotate clockwise and the robot advances when both infrared sensors detect a black line (for example, cross-black lines).

The robot will turn to the right if one of the Infrared sensors (say, the one on the right) discovers a dark path while the other (on the left) identifies a white path. The right engine remains upright to keep the robot running smoothly, while the left engine spins in time with the clock, causing the robot to turn right.

If one of the infrared sensors (on the left) identifies a dark path while the other (on the right) detects a white path, the robot will also turn left. The robot turns left because the left engine remains upright while the right engine spins according to the clock.

Generate the left engine rotate clockwise while the right engine rotates counterclockwise to make a steep right bend.

To make a sharp left turn, rotate the right engine clockwise while rotating the left engine counterclockwise.

When the ultrasonic sensor in front of the robot detects any interruption (at a predetermined distance), the motors stop rotating and the robot comes to a halt. As soon as the block is removed, the robot starts moving. [2]

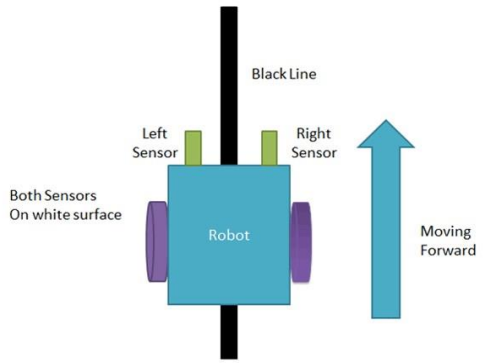

Fig 2: Forward movement

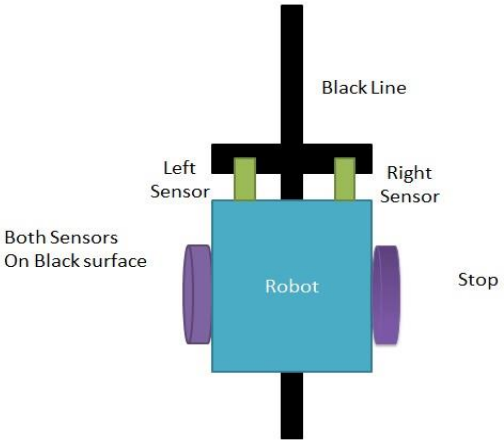

Fig 3: Stop the robot

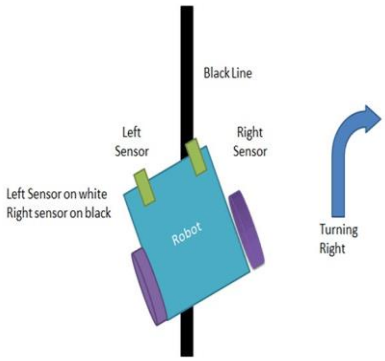

Fig 4: Turning right

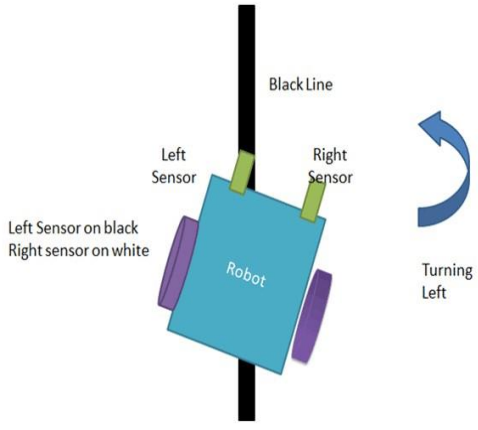

Fig 5: Turning left

FLOW CHART

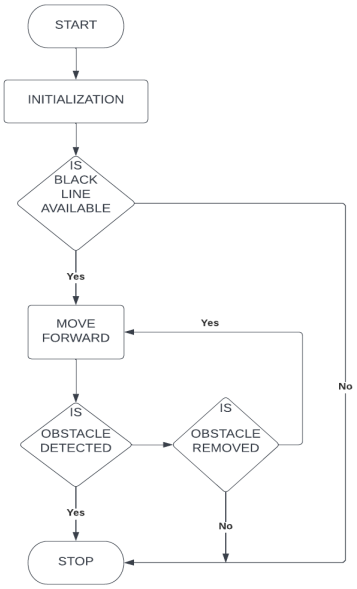

Fig 6: Flow chart

V. HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENTS

Arduino Uno R3

The ATmega 328P microprocessor is used in the Arduino UNO microcontroller board. On the board, there are 14 digital input/output pins (six of which are PWM outputs), six analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header, and a reset button. Everything you'll need to get started with the microcontroller is included.

ESP 32 cam module

The ESP32-CAM is a low-power, compact module based on the ESP32 protocol. It has an OV2640 camera and a TF card slot on the inside. Wireless video monitoring, WiFi picture uploading, QR detection, and other smart IoT systems can all benefit from the ESP32-CAM.

L298D motor driver

The L298 Driver is a full dual current bridge high voltage driver designed to operate flexible loads such as relays, solenoids, DC and stepping motors using common TTL standards. Without input signals, two enable inputs are provided to enable or disable the device. The transistors of each bridge's low emitters are coupled together. An external sensor can be connected using a compatible external terminal.

IR sensor

To perceive the line, the robot employs photodiode sensors, which are comprised of a two IR-LEDs (TX) and Photodiode (Rx) sensors. An analogue signal is created at the output based on the amount of light entering from the back, which is provided to the component to make 0s and 1s, and then fed to Arduino.

Ultra sonic sensor

The operation of this module is simple. It sends out a 40kHz ultrasonic pulse that travels through the air and returns to the

sensor if it hits something. By multiplying the travel time by the sound speed, the distance may be calculated.

DC Motor

An electric motor that converts electrical energy into mechanical energy is known as a DC motor. The essential concept of operation of a DC motor is that it meets the mechanical strength whenever the current conductor is placed in a magnetic field.

Servo Motor

A servo motor is an electromechanical device that generates torque and speed based on current and voltage input. The servo motor is part of a closed loop system that provides torque and speed as directed by a servo controller, which closes the loop with the help of a response device. The response device sends information to the servo control, which adjusts the vehicle's activity based on the required parameters, such as current, speed, or position.

SOFTWARE REQUIREMENTS

ARDUINO IDE

The Arduino Software (IDE) is free and open-source, making it simple to create code and upload it to the board. Any Arduino board can be used with this software. Arduino is a hardware and software platform for computers. UART TTL-serial communication is provided by the Arduino UNO ATmega328, and digital pins such as TX (1) and RX (1) are available (0). The Arduino software includes a serial monitor for convenient data entry. When data is transmitted over USB, two LEDs on board, such as a receiver and a transmitter, will flash. To download programmes from personal computers, boards include a range of communication interfaces, including Universal Serial Bus (USB) on some models. Microcontrollers are generally configured utilising regional language features from C and C++ programming languages. The Arduino project includes an integrated development environment (IDE) based on the Processing Language project, in addition to entire compiler tool chains.

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Robot movement is automatic.
- It is capable of taking various degrees of turns.
- Used for long distance applications.
- Cost effective.

DISADVANTAGES

- LFR have to move on a fixed track or path.
- Lack of speed control makes the robot unstable at times.
- IR sensor may sometimes absorb IR rays from surroundings. As a result, robot may affect the movement.

VI. RESULT

This line follower robot with several modes compatibility performs admirably as intended. While recognizing obstacles, the robot was able to feel the line and follow the blueprint. [1] For the obstacle detecting section, an obstruction was placed ahead of the line follower's path, allowing the robot to make better decisions when determining its course [2]. The line follower robot's defined tasks with numerous modes are successfully examined.

Fig 7: implementation

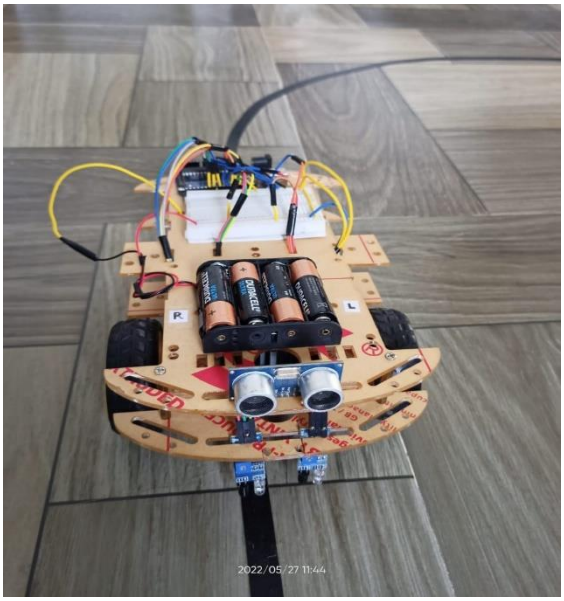

Fig 8: Robot following line

VII. CONCLUSION

Robots play a vital role in the global economy and in everyday life. Also of concern for robotic research is the competitiveness and design of patents in the world's industries according to their type of applications. The need for robotic technology is growing in a wide variety of human applications and applications, especially in the manufacturing, medical, service, defence and consumer industries. This linear robot is an example of an industrial robot. By studying this one can create a linear robot for use in industry. Performance can be improved by using good materials and hearing aids. improves motor movement. The cost of setting up a linear robot depends largely on the costly machinery, land, construction and watchmaking equipment to maintain and operate such equipment.

Another way to improve the current system is to replace trained workers with robotic robots. This robot will be able to manage a large number of assets in a manufacturing system in a shorter amount of time, with higher precision and cheaper cost per unit.

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