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Line Following Robot with Obstacle Avoidance

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ABSTRACT

In order to survey, examine, and improve the movement of vital commodities inside healthcare facilities and other businesses, this paper discusses the line-following robot utilizing Arduino. The suggested system will detect the black trail and move along the ground in its direction. This technology reduces the need for people while also making material transfer easier. This technology focuses on the safe, timely, and efficient delivery of cargo. By adjusting control settings, the paper intends to create controlled robot movement and improve performance. This robot is mostly made to follow a predetermined path. Two IR sensors are utilized in order to find this path and ultrasonic sensor is used to detect the obstacle. These kinds of robots are typically utilized in manufacturing operations with pick-and-place equipment. By following a pre-determined course, this robot transports materials from the intended source to the intended destination. Numerous studies have recently been conducted to enable automation in both industry and healthcare. This robot is designed to deliver necessities like injections and medications. Software and hardware modules make up this essay.

Keywords: Arduino, IR sensors, Ultrasonic sensor pre-determined path.

INTRODUCTION

Our nation's population is growing quickly. A facility like a hospital requires constant watchfulness. The lives of patients can be seriously endangered by inadequate staff members. Additionally, there is the issue of moving products like food, medication, and other equipment from one location to another. In the event of an emergency, a line-following robot can serve as a temporary nurse and help the hospital staff. Additionally, a robot of this type will serve as a delivery robot in the operating room, where doctors may require additional supplies in an emergency. In the modern, technological world, robotics is currently one of the most significant sectors for the creation, manufacture, use, and application of robots. Prior to the 20th century, this industry did not prosper in its development. The usage of robots in many residential, commercial, and military sectors is currently expanding the applications of robotics on a daily basis. A robot is often an electrically powered, electronically controlled piece of machinery with computer programming that can carry out activities automatically in response to sensors. This project's goal is to create a robotic vehicle that follows the light while also avoiding obstacles. It does this by using an LDR module to determine the path to take based on the amount of light hitting it and an ultrasonic sensor to control its movement. In order to carry out the requested action, an Arduino Uno R3 is used. Any obstruction in front of it is detected by an ultrasonic sensor, which then sends an instruction to the Arduino. This robot reaches the destination by avoiding collisions and detecting collisions with obstacle sensors. Any commercial, industrial, medical, or educational lab can use the suggested system.

METHODOLOGY

There are two main portions to the complete circuit diagram. One uses an LDR module to follow a light source, and the other uses an ultrasonic sensor to identify obstacles. The robot first receives 5 volts of power. The robot then got to work after obtaining the light source. The robot will begin to follow the path where the LDR sensor detects the most light.

Any impediment that an ultrasonic sensor runs into will cause it to stop the robot in that spot and begin to echo the pulses. At the specified distance, the triggering pins time is monitored.

The robot will check its left and right tracks, rotate the ultrasonic sensor 180 degrees with the aid of a servo motor, and then proceed along the long-distance path. A stepper motor simultaneously creates the pulse and rotates the web camera with the aid of light; the camera when takes the pictures and movies of the pulse transmits the information to the user through Bluetooth or Wi-fi.

We employed infrared (IR) transmitters and receivers also known as photo diodes in this Arduino based line follower robot. They function as light transmitters and receivers. Infrared radiation is transmitted through IR. Infrared photons strike the white surface, are reflected back, and then gathered by photo diodes, which causes some voltage changes.

The majority of automated robotic applications call for the robot to travel along a predetermined path. If an obstacle is encountered in its path, it avoids it before returning to the designated track once more. An ultrasonic sensor is used to detect obstacles, and an infrared sensor is used to track a path.

SYSTEM REQUIREMENTS

A. Arduino Uno:

A microcontroller board called the Arduino UNO is based on the ATmega328P. It contains 6 analogue inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB cable, an AC-to-DC adapter, or a battery to power it.

Fig 1: Arduino UNO

B. IR Sensor:

The infrared (IR) sensors are made up of infrared (IR) photodiodes and LEDs. The IR photodiode is referred to as a receiver, while the IR LED is referred to as a photo emitter. The surface is hit by the IR light the LED emits, which is then reflected back to the photodiode. The output voltage from the photodiode is then proportional to the surface reflectance and will be high for a light surface and low for a dark surface. Darker objects reflect less IR light, and lighter ones reflect more IR light.

Fig 2: IR Sensor

C. Ultrasonic Sensor:

HC-SR04 A device that uses sound waves to detect a distance to an object is called an ultrasonic sensor. By emitting a sound wave at a specific frequency and listening for the return of that wave, it will be able to determine the distance.

Fig 3: Ultrasonic sensor

D. ESP 32 Wi-fi Camera:

With a footprint of just 40 x 27 mm, a deep sleep current of up to 6 mA, and a wide range of IoT applications, the ESP32 CAM WiFi Module Bluetooth with OV2640 Camera Module 2MP for Face Recognition is a highly competitive small-size camera module.

Fig. 4: ESP 32 Wi-fi Camera

E. L298N Motor Driver:

The twin H-Bridge motor driver L298N enables simultaneous speed and direction control of two DC motors. With a peak current of up to 2 A, the module is capable of driving DC motors with voltages between 5 and 35 volts.

F. Servo Motor:

A servo motor is a kind of motor that has extremely precise rotational capabilities. This sort of motor typically includes a control circuit that offers feedback on the motor shaft's present position. The servo motors can rotate with high precision thanks to this feedback.

Fig. 5: Servo Motor

G. Servo Motor:

An electrical device that transforms electrical energy into mechanical energy is a DC motor. Direct current is used as the electrical energy source in a DC motor, which converts it into mechanical rotation.

CIRCUIT DESCRIPTION

Connected to the Arduino A0 pin is the left IR sensor. Both of the IR sensors' ground pins are connected to the junction board and the right IR sensor's Vcc (power supply) pin is connected to Arduino A1 pin. (Also called a "bread board"). The Arduino's 13th pin is used to connect the buzzer. Pins for the ultrasonic sensor are connected to the junction board via Vcc and ground. The Arduino's 7th pin is used for trigger, and its sixth pin is used for echo.

The junction board is wired up with the servo motor's VCC and ground pins. Additionally, the control pin is linked to the Arduino's eighth pin.

The L298 N module is wired to accommodate DC motors. The Arduino's pins 2, 3, and 4 are used to connect the L298 N module. The Arduino pin '1' is used to connect the ESP 32 Wi-Fi camera (the Arduino pin 1 is only used for transmitting data). All of the components share a common ground and Vcc (power supply) via the junction board. (Bread board, also referred to as a junction board)

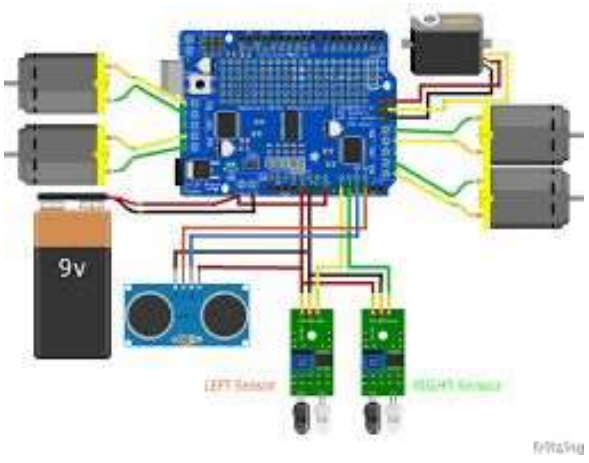

Fig. 3: Circuit

EXPERIMENTATION RESULTS AND ANALYSIS

The way the system is designed, the robot will move in that direction automatically if any one of the IR sensors detects the black path. The ultrasonic sensor has also been positioned so that it can determine whether or not there are any obstacles in the way. The servo motor rotates to the right to check if there is an obstacle if one is detected. It moves from the right side, avoids the obstacle, and returns to the original path if there is no obstruction on the right side.

If the obstacle is present on both the right and left sides, the ultrasonic sensor rotates through the servo motor to check the left side once more before returning to the original path. By dodging the obstacles, the robot is able to follow the line. Here, we installed an ESP 32 Wi-Fi camera so that, in the event of an obstruction in the path, it will immediately capture an image of the obstruction and send it to the associated device. Additionally, the camera has a buzzer that notifies the immediate vicinity of the obstacle's detection.

Through the code that is loaded into Arduino, all the components are controlled. DC motors are also used to propel the robot forward. Additionally, the DC motors are driven by the L298N motor driver module, which produces the high-current signal for the DC motors after converting the low-current signal to it.

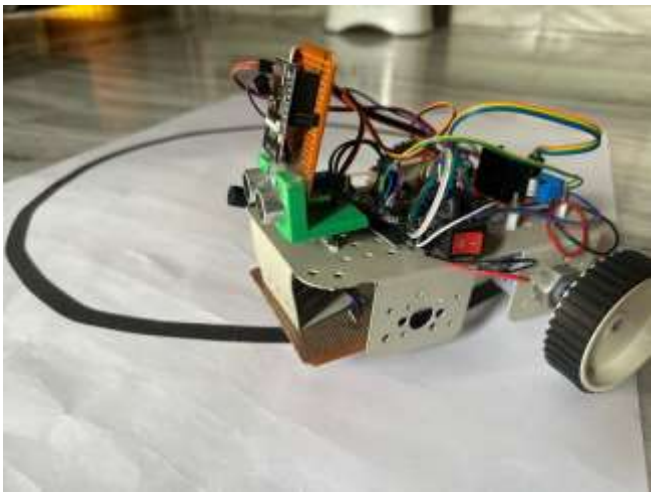

Fig. 4: Prototype

APPLICATIONS

- The line follower robot can be used to deliver food to customers tables in dining establishments or lodging facilities. Therefore, the waiters are no longer required to carry the food. The robot will carry the item to the customer by simply entering the table number and following the path.
- It is never safe to contact infected patients directly, particularly virus-infected patients. However, it's also crucial to give them their medications on time at the same time. In these kinds of circumstances, a line-follower robot can be useful. because it can administer treatments to specific patients without the oversight or control of a human. It can easily navigate the cabins by following the lines, get to the infected patients' medications, and then safely make its way back to its own cabin.
- This line-following robot can be used in factories or industries to automate the movement of packages or other items using a crane system.

It is possible to retrieve materials from the mine using this line-following robot. It is the position where the robot's edge mechanism engages. The mine is littered with obstructions and holes.

CONCLUSION

Robotics technology is becoming more and more prevalent in a wide range of human endeavours and applications, particularly in the manufacturing, medical, utility, defence, and consumer sectors. The prototype for industrial robots is this line-following, obstacle-detecting robot. Because it uses little power, this clever and intelligent robot has more advantages. The goal of our project is to build an autonomous robot that can navigate by sensing obstacles in its path.

The line follower robot has thus been successfully created and put into use. These robots' more sophisticated iterations can be used in transit systems and other modes of public transportation.

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