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Self-driving Automated Vehicle Using IoT

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ABSTRACT

An autonomous robot that can recognize and avoid obstacles while following a predetermined course is known as a line follower or obstacle detection robot. This robot has sensors and software that allow it to navigate its surroundings and maintain its system despite obstacles. The robot's line-following mechanism makes use of infrared sensors to find the black line on a white background. The sensors, which are positioned underneath the robot, determine how much infrared light is reflected from the surface. The robot can detect its position on the line and make necessary corrections to stay on course by comparing the values from the sensors. The robot can identify impediments along its route using ultrasonic sensors in addition to the line following. The robot will react to obstacles by stopping or changing course to get around them. The robot can navigate around obstacles in the most effective way possible because of its capacity to measure the distance between itself and the object. A microcontroller, which manages the robot, interprets input from sensors and decides how to move around the environment. The robot can be taught to take a predetermined route or to explore a new area while making quick decisions. Overall, the autonomous line follower and obstacle detection robot is a flexible and capable machine that may be employed in a range of contexts, such as manufacturing, logistics, and search and rescue missions. It is the perfect choice for applications that need precise and consistent movement in challenging conditions because of its ability to navigate and avoid obstacles.

1. INTRODUCTION

Since autonomous robots have the potential to change a variety of sectors and applications, they have grown to be a more and more attractive topic for study and development. The line follower and obstacle detection robot is one such robot that is made to follow a predetermined course while spotting and dodging objects in its path. With the help of sensors and programming, the line follower and obstacle detection robot can explore its surroundings and maintain its course even in the face of obstacles. This makes it the perfect choice for use in complicated contexts where accurate and dependable movement is necessary, such as in manufacturing, logistics, and search and rescue operations. The robot's line-following mechanism makes use of infrared sensors to find the black line on a white background. The sensors, which are positioned underneath the robot, determine how much infrared light is reflected from the surface. The robot can detect its position on the line and make necessary corrections to stay on course by comparing the values from the sensors. The robot can identify obstacles along its route using ultrasonic sensors in addition to the line following. The robot will react to obstacles by stopping or changing course to get around them. The robot can also measure the distance between an impediment and itself, enabling it to avoid it in the most efficient way possible. A microcontroller, which manages the robot, interprets input from sensors and decides how to move around the environment. The robot can be taught to take a predetermined route or to explore a new area while making quick decisions. The line follower and obstacle detection robot is an autonomous machine that has the potential to revolutionize a variety of fields and applications. It is the perfect choice for applications that need precise and consistent movement in challenging conditions because of its ability to navigate and avoid obstacles.

2. PARALLEL RESEARCH

Sai Chaya Mounika Mudragada and Devi Venkata Shanmukha Sai Lohith Bondada proposed "Obstacle avoidance and line following 2WD robot". This paper reviews the most modern techniques and algorithms for avoiding obstacles and following a path, including those used by line-following robots. The study emphasises the need for integrating several sensors and algorithms in order to provide reliable and effective navigation in complex settings.[1]

Siddhant Pathak proposed "Line Following Robot". The self-automated line-following robot described in this paper uses computer vision algorithms to locate and follow a black line on a white surface. The robot has a microcontroller, a camera, and a motor control system.[2]

Kumar Rishabh proposed "Design of autonomous line follower robot with obstacle avoidance". The self-operating robot described in this paper may be simply operated without the use of other gadgets like smartphones, remote controls, WiFi, etc. Using an Arduino microcontroller, this will run automatically while adhering to a set line.[3]

Ahmed Bendimrad, Ayoub El Amrani, Bouchta El Amrani proposed "Design and implementation of line follower and obstacle detection robot". Using a method based on the calculation of the line's curvature radius, this study studies the design of a line-following and obstacle-detection robot intended for autonomous navigation along a black line on white ground while avoiding any potential obstacles.[4]

Sourav Sutradhar, Viswanatha V, Siddhant Kumar and Shivam Kumar proposed "Intelligent Line Follower Robot using MSP430G2ET for Industrial Applications". This paper examines the applications of line-following robots now in use as well as the challenges and opportunities facing this sector. The study emphasises the importance of flexibility, precision, and toughness in line-following robots.[5]

Abdul Latif and Hendro Agus Widodo proposed "An Implementation of Line Follower Robot based Microcontroller ATMega32A". This work presents the design and development of a line-following robot with improved performance using PID control. The robot has a line-following sensor array and a microcontroller-based control system.[6]

3. OUR PROPOSAL

We propose a model of a self-driving vehicle which is analogous to an actual self-driving car, but is a simpler and value effective version. This model will help students to understand the working of an actual autonomous car. This model can also help in solving some real world problems. Using the logic and algorithm used in this model , we can make wheel chairs, hospital beds and etc. autonomous and help the user to operate it without anyone else's help.

4. SYSTEM DESIGN

The circuit consists of an Arduino Uno, a servo motor, two stepper motors, a motor driver (for the stepper motor), a 12V or 9V battery, IR sensors, and an ultrasonic sensor. The pins on the Arduino are what ultimately determine whether a component is an input or an output. The robot executes the instructions given by the computer-programmed circuit, which is controlled by the C++ language and its libraries. The Arduino board and C++ are both fairly quick programming languages; therefore, the robot doesn't require much time to execute these commands.

Hardware components:

- Microcontroller (e.g. Arduino, Raspberry Pi)
- Line sensor module (e.g. IR Sensors)
- Ultrasonic sensor module (e.g. HC-SR04)
- Motor driver module (e.g. L298N)
- DC motors
- Chassis or base for the robot
- Battery and power supply components
- Miscellaneous components such as wires, breadboard, etc.

A. WORKING PRINCIPLE

Robots that can identify obstacles and follow lines operate on the feedback control principle. The microprocessor processes the signal from the line sensor, which detects the line on the surface, to maintain the robot on the line. Any obstruction in the robot's route is detected by the obstacle sensor, and the microcontroller interprets the signal to adjust the robot's course in order to avoid it. The control algorithm for the robot is created to reduce the error between its location and the desired path. The robot's path is adjusted by the motor driver after the control algorithm has calculated the inaccuracy.

B. SYSTEM ARCHITECTURE

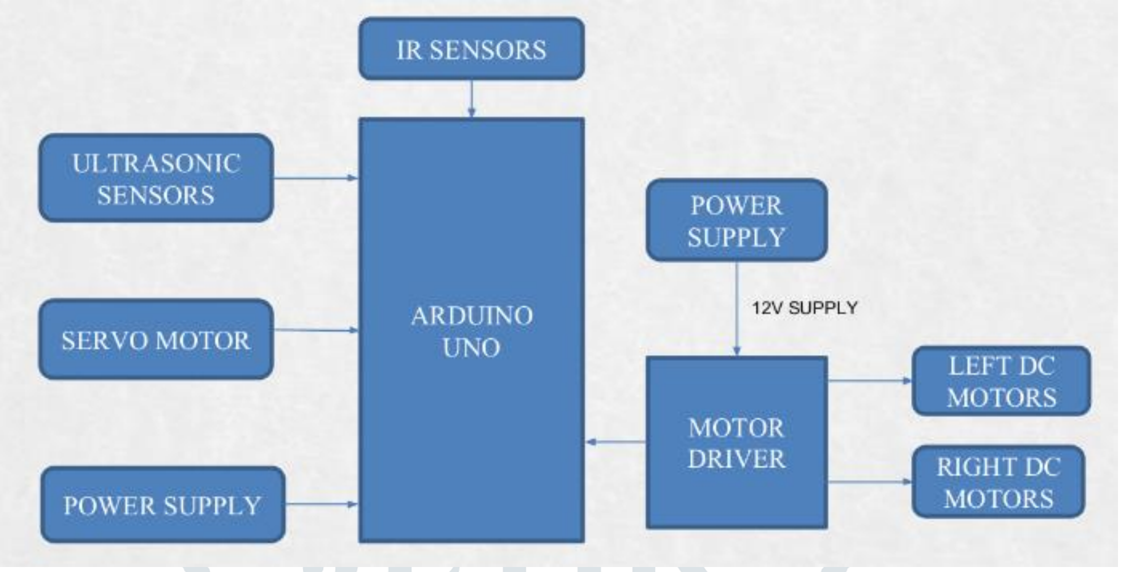

Fig 1. System Architecture

5. CONNECTIONS TABLE

ARDUINO	MOTOR DRIVER	IR SENSORS(IR1,IR2)	ULTRASONIC SENSOR	SERVO MOTOR	BATTERIES
Vin	+12V				-ve
5V		VCC	VCC	Power	
A0		OUT(IR1)			
A1		OUT(IR2)			
A2			Echo		
A3			Trig		
A5				Control Input	
10	ENA				
9	IN1				
8	IN2				
7	IN3				
6	IN4				
5	ENB				
GND	GND	GND	GND	GND	+ve

6. MODULES

A module is a standalone, independent block that executes a single capability or collection of related functions. Modules are made to be easily replaceable and reusable, so developers can combine several modules to build complicated systems.

The codebase is organized using modules, which divide functionality into smaller, easier-to-manage chunks. The program is now simpler to create, test, maintain, and expand. We discussed five modules in our project namely:

Installation module:

The chassis of the robot is often constructed of lightweight materials, such as plastic, and it is built to support numerous parts. The robot's front-mounted line sensor picks up the surface line and transmits a signal to the microcontroller. The sensor signal is processed by the microcontroller, the robot's brain, and the result is sent to the motor driver, which manages the robot's motors. Depending on the robot's design, the obstacle sensor may be installed on the robot's front or sides. It sends a signal to the microcontroller whenever it finds an obstruction in the robot's route. The motor driver then modifies the robot's path to avoid the obstacle after the microcontroller has processed the signal and sent the output to it.

Line follower module:

The line sensor module can be used to detect and follow the black line on the ground. The line sensor module has eight IR sensors that can detect the black line. The output of the line sensor module can be fed to the microcontroller to control the movement of the robot. The microcontroller can be programmed to adjust the speed of the DC motors based on the sensor readings.

Obstacle detection and avoidance module:

The ultrasonic sensor module can be used to detect obstacles in the path of the robot. The ultrasonic sensor can detect objects up to a certain distance (e.g. 2-3 meters). The microcontroller can be programmed to stop the robot when an obstacle is detected. The microcontroller can also be programmed to move the robot in a different direction to avoid obstacles. For example, if the obstacle is detected on the left side of the robot, the robot can be programmed to turn right.

Combination module:

The microcontroller can be programmed to switch between line-following mode and obstacle detection and avoidance mode based on the sensor readings. For example, if the robot is following a line and an obstacle is detected, the microcontroller can switch to obstacle detection and avoidance mode. Once the obstacle is avoided, the microcontroller can switch back to the line following mode.

Testing module:

The robot can be tested on a test track with a black line and obstacles placed in its path. Based on the test results, improvements can be made to the software and hardware components to make the robot more efficient and reliable.

7. RESULTS

The project has been tested and found working smoothly in figure When we turn on the switch , the ultrasonic sensor starts collecting data of the surroundings and sends it to the Arduino. The Arduino collects the data and processes it. After processing it sends signals to the gear motors. The gear motors then help the car to move according to the commands sent by the Arduino.

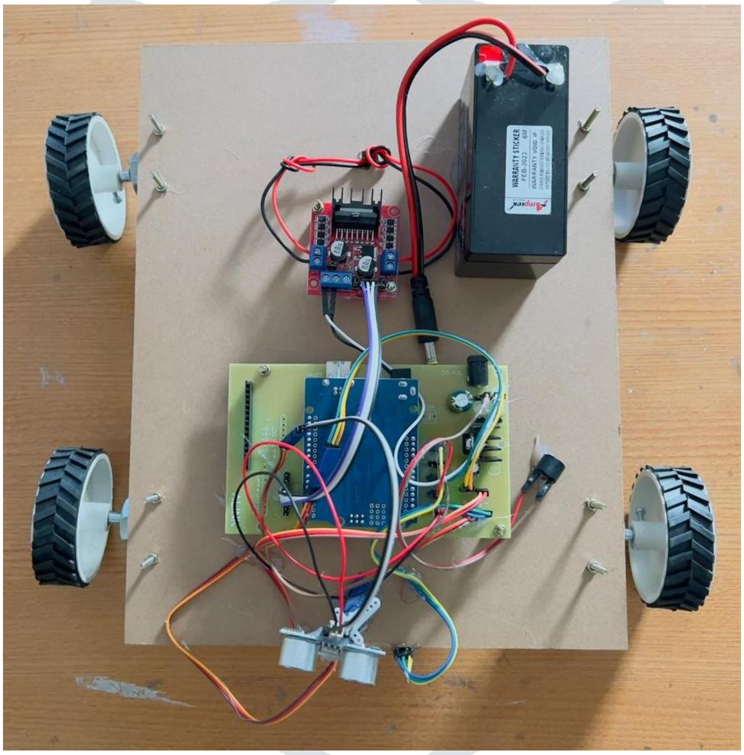

Fig 2. Vehicle top view

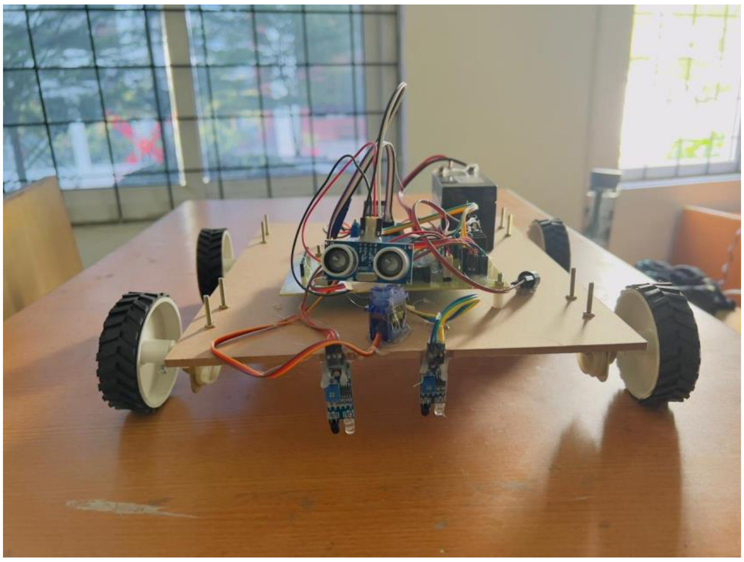

Fig 3. Vehicle front view

Sample video of Vehicle

8. CONCLUSION

Robots that follow path and identify obstacles are crucial to the robotics sector because of the many industries, households, and public spaces where they are used. In comparison to conventional approaches, the design and construction of robots are comparatively simple, cost-effective, accurate, and efficient. Robots that can follow path and identify obstacles have a bright future, and we may anticipate seeing more sophisticated robots with more features and functionalities in the future.

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