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Autonomous Obstacle Avoidance Robot using IR Sensors Programmed in Arduino UNO

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***Abstract*--- Obstacle avoidance robot have several advantages. These robots can be used to detect and avoid obstacles. In autonomous vehicles obstacle avoidance can perceive their surroundings with the assistance of sensors and cameras to support in navigation systems. Obstacle avoidance can be used in dangerous environments which restricts the presence of human beings. Moreover, drivers suffering from slight disabilities are completely assisted with high automated vehicles to amend their needs. In this research work the autonomous obstacle avoider robot is build using Infrared Sensors (IR). IR sensors can measure and detect infrared radiation in its surroundings. IR sensors have an advantage of operating on low power consumption and applicable for darker condition. Two IR sensors are used one is placed in the right and other left. When the intensity is low in both the sensors, then the robot detects and object and moves backward. If it detects low intensity in the right sensor, the robot moves backwards and then take a right turn and vice versa. If there is no object detected, then the robot moves forward until it detects any obstacle.**

***Index Terms*— Obstacle avoidance, Autonomous vehicles, Mobile robots, IR sensors, Vehicle safety**

I. INTRODUCTION

Obstacle detection is the method of detecting objects or terrain types that obstruct motion using sensors, data structures, and algorithms. Obstacle avoidance robots are designed to manoeuvre in unfamiliar environments while preventing collisions.[1] Obstacle-avoiding robot detects obstacles in its direction, avoids them, and continues on its way. Since IR sensors are commonly used to measure distances, they can be used in robotics to avoid obstacles. Infrared sensors are also quicker than ultrasonic sensors in terms of response time. Almost all mobile robot navigation systems will benefit from obstacle avoidance robots. They can be used for tasks around the home, such as vacuuming. They can also be used in risky situations where human penetration is a concern. [2,3]

Avoiding stumbling blocks the robot is designed to manoeuvre in an unfamiliar environment while avoiding collisions. Obstacle-avoiding robot detects obstacles in its direction, avoids them, and continues on its way. In order to achieve this goal, we used sensors. We used two D.C. MOTORS, which are battery-powered motors.[4]

The relationship between the robot's software (the 'task'), its physical hardware (the way its sensors and motors work), and the terrain determines how a mobile robot behaves (environment).[5] The aim of this paper's creation is to illustrate the hardware and software implementation in order to create an autonomous platform It's used in fields like designing software modules for obstacle avoidance and looking into the relationship between the robot mission and the terrain. This platform is used for educational purposes, revealing the most up-to-date technologies for various sensors and actuators used in mobile robot design.[6]

To sense its surroundings, an infrared sensor emits and/or detects infrared radiation. The basic idea of an infrared sensor used as an obstacle detector is to send out an infrared signal, which bounces off the surface of an object and is received by the infrared receiver.

II. METHODS AND MATERIALS

The components used for building an obstacle avoider robot involve 2 pieces of thin wood, which acts as a chassis, 2 DC motors, 2 wheels, Arduino Uno, 2 IR sensors, breadboard, L239D Motor driver, male to male pins, female to female pins, double sided tapes, bolts and nuts. Here the justification for the materials and equipment used in building this robot.

2.1 DC Motors

DC motor works as any regular motor by converting the electrical energy to mechanical energy. In this work, the DC motor acts as an output device. The 2 wheels used for motion of the robot are attached closely to the spindle of the motor. When the motor is made to run, the wheels rotate. Moreover, they can work without much noise & vibrations. DC motor was chosen for the following reasons

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such as high torque, quick starting and stopping operation, speed variations, low power requirement and minimal maintenance.

Fig 1: Image illustrating the DC Motors used.

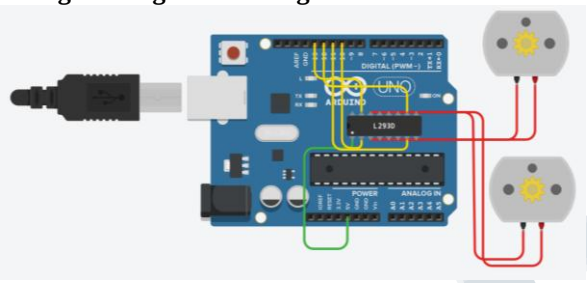

Fig 2: Circuit connection of DC motors to Arduino UNO

2.2 L239D Motor Driver

The L293D IC receives signals from the microprocessor and transmits the relative signal to the motors. It has two voltage pins, one of which is used to draw current for the working of the L293D and the other is used to apply voltage to the motors. The feature of L239D motor drivers are user friendly. It can be used to run Two DC motors with the same IC. Speed and Direction control is possible. Motor voltage varies from 4.5V to 36V, maximum peak motor current is 1.2A, maximum continuous motor current is 600mA, supply voltage ranges from 4.5V to 7V and automatic thermal shutdown is available. Motor driver is used in this project as Microcontrollers cannot provide enough power supply (current or voltage) required for motors. With the use of motor drivers, it can interface between the microcontroller and motor.

Fig 3: Image depicting L239D Motor Driver

The motor driver acts as an interface between the motors and the Arduino UNO. The power source from the 9V is connected to the motor driver which in turns make the DC motors rotate. The rotation of the spindle of the DC motors makes the wheels rotate. With the help of Arduino UNO, we can program the robot in such a way that we can control the power to the right and left motors as per our needs and requirements. The following table 1, depicts the connections of the L239D motor driver to Arduino UNO.

Table 1: Connection of Motor Driver to Arduino UNO

Component 1	Terminal 1	Terminal 2	Component 2
Motor Driver	EN A	5V	Arduino UNO
Motor Driver	INP A1	Pin 10	Arduino UNO
Motor Driver	INP A2	Pin 11	Arduino UNO
Motor Driver	EN B	5V	Arduino UNO
Motor Driver	INP B1	Pin 12	Arduino UNO
Motor Driver	INP B2	Pin 13	Arduino UNO

2.3 IR Sensors

Infrared sensors are used to sense characteristics in its surroundings by detecting infrared radiation and are capable of measuring the heat being emitted by an object and detecting motion. The use of IR sensors have several advantages and also varies depending on the application. IR sensors can work on low power requirements make them suitable for Arduino UNO. IR sensors can identify motion in presence or in the absence of light almost with same reliability. They do not require contact with object to for detection.

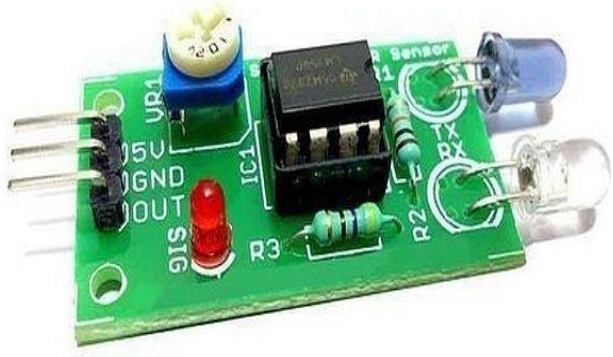

Fig 4: Illustration of IR sensor

In this robot, there are two IR sensors used. Each IR sensor is place 5 cm from the centre of the wooden chassis. The left IR sensor detects the obstacles on the left side and the right IR sensor detects the obstacle on the left side. The operating power source for these two IR sensors are transferred from the 9V battery to the Arduino UNO. These IR sensors are operated on 5Volts. The following

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table 2, shows the schematic connection of the IR sensors to the Arduino UNO board.

Table 2: Connection for IR Sensor

Component 1	Terminal 1	Terminal 2	Component 2
Left Digital IR Sensor	A_{OUT}	A0	Arduino UNO
Left Digital IR Sensor	5V	5V	Arduino UNO
Left Digital IR Sensor	GND	GND	Arduino UNO
Right Digital IR Sensor	A_{OUT}	A0	Arduino UNO
Right Digital IR Sensor	5V	5V	Arduino UNO
Right Digital IR Sensor	GND	GND	Arduino UNO

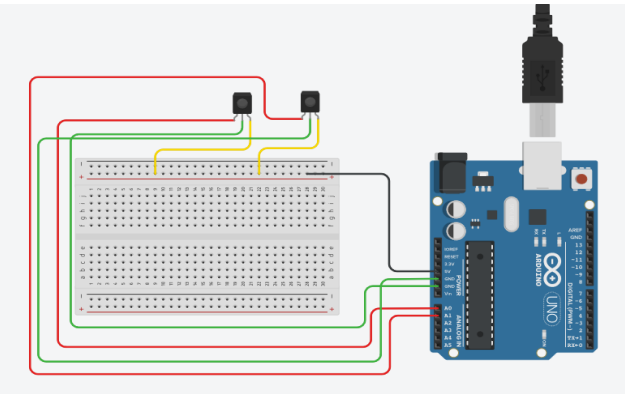

Fig 5: Circuit connection of IR sensors and Arduino UNO

2.4 Arduino Uno

It is an open-source microcontroller. This microcontroller is equipped with 6 analog and 14 digital pins. These pins can be used as input or output modules. Moreover, Arduino uno can supply voltage from 3.3 volts to 5 volts. This amount of voltage is sufficient to run the DC motors. Using Arduino Uno has several advantages. It is an open source in hardware, inexpensive, simple to code and compact to place it over mobile robots.

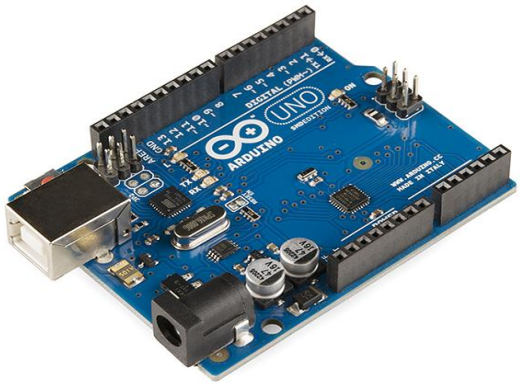

Fig 6: Arduino UNO Microcontroller board

The important components of Arduino UNO board are the USB connector, power port, microcontroller, Analog input pins, Digital pins, Reset switch, Crystal oscillator, USB interface chip and TX RX LEDs. The USB port used to upload programs from the Arduino IDE onto the Arduino board. The board can also be powered through this port. The analog pins can read the signal from an analog sensor like a temperature sensor and convert it into a digital value so that the system understands. These pins just measure voltage and not the current because they have very high internal resistance. Hence, only a small number of current flows through these pins. The digital pins can be used as either input or output pins.[7] When used as output, these pins act as a power supply source for the components connected to them. When used as input pins, they read the signals from the component connected to them.

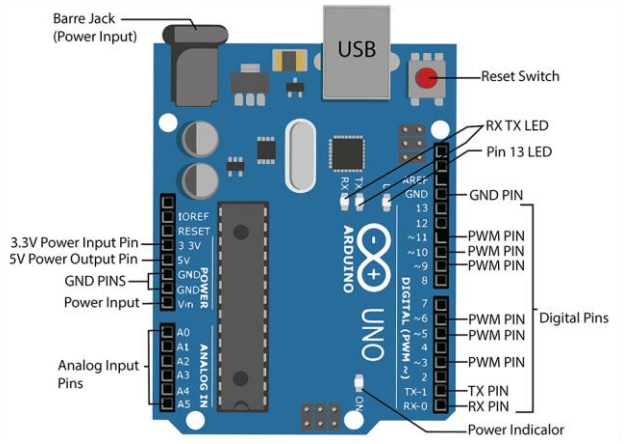

Fig 7: Parts of Arduino UNO

III. RESULTS AND DISCUSSION

An obstacle-avoiding robot was constructed using readily accessible components such as DC motors, L239D motor drivers, IR sensors, and cables. This robot is designed in

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such a way that it can prevent crashes when navigating an unfamiliar world and a fulgent backdrop.[8] The designed robot detects obstacles in its way, avoids them, and resuscitate its run. While there is no obstacle in the way, the robot goes forward; when there is an obstacle in the way, it moves backwards and makes a left turn, and the other way round. Finally, the aim is to develop and construct an obstacle-avoiding robot using IR sensors and an L239D motor pilot.

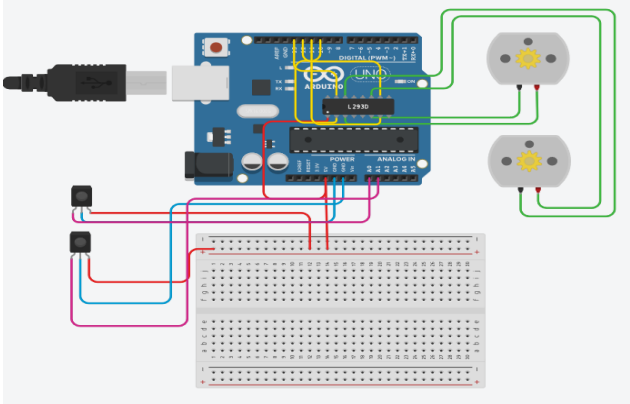

Fig 8: Final connection of DC motors and IR sensors

When the robot is does not detect any obstacle then it is desired to move in the forward direction, then both the left and the right motor are made to rotate in clockwise direction moving the robot in forward direction. If the robot detects an obstacle, then it should navigate in the backward direction this case is the vice-versa of the forward movement. When the robot detects an obstacle in the right side, it moves towards its right then the right motor moves in the reverse direction and the left motor moves in the forwards direction. When the robot detects an obstacle in the left side then it should take a left turn right motor moves in the forward direction and the left motor moves in the reverse direction. The following Table 3 shows the movement of the robot with respect to the movement of left and right motors.

Table 3: Robot movement and Motor Motion

Robot Movement	Right Motor Movement	Left Motor Movement
Forward	Forward	Forward
Backward	Reverse	Reverse
Right	Reverse	Forwards
Left	Forward	Reverse
Stop	Stop	Stop

The created robot platform was not intended to perform a particular role, but rather to serve as a general wheeled autonomous platform. As a result, it may be used for educational, scientific, or industrial purposes. Research on obstacle avoidance robots will help students improve coordination, technological skills, and teamwork.[9] The architecture of such a robot is extremely adaptable, and multiple approaches may be modified for different implementations.[10]

IV. CONCLUSION

This robot can also be built using Ultrasonic sensors. These sensors work in the principle of ultrasound. It can work better in dull environment too. The robot was level - headed in avoiding obstacles, but it still has certain curbs. Adding sensors to the robot's left and right sides will help it advance even further. In addition, machine vision with camera capabilities can be used to track application. To advance more, well-suited sensors can be used to collect precise knowledge about the terrain and hazards while implementing obstacle avoidance in aerospace. The laser-based (LIDAR) sensor system is extremely durable, especially in off-road outdoor environments.LIDAR-based mapping is the most precise method for cognitive knowledge about the structure and surface characteristics of any object. Because of recent advances in LIDAR technology, researchers and professionals will now analyse the world with greater precision, exactness, and versatility than ever before. The use of a LIDAR camera is thought to be an important approach to the issue of obstacle detection and identification. However, obstacle avoidance creates difficulties for image analysis using a LIDAR sensor.

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