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Distance Based Accident Avoidance System

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Abstract

In this paper we introduce a new technique in automobile technology how to mechanically avoid accidents and control speed through sensors. Traffic accidents are increasing day by day in South Asian countries due to drivers not obeying traffic laws. In our proposed system we have determined a balanced movement by determining the distance from one vehicle to another using ultrasonic sensors and Arduino UNO. If the distance from one vehicle to another vehicle is more than 9 meter then the vehicle will have maximum speed. Our proposed technology will halve the vehicle speed from 9 meter to 3 meter. The vehicle will remain stable at a distance of less than 3 meters. We hope our proposed system will play an effective role in populated areas.

Keywords: Arduino uno, ultrasonic sensor, obstacle avoidance, accident avoidance etc.

Introduction

The automobile industry experienced significant growth in the 20th century, leading to a significant increase in the number of cars on the road. Unfortunately, this initially resulted in an increase in the number of accidents. Day by day the death toll in road accidents is increasing due to driving at irregular speed limits. According to the Global Status Report on Road Safety 2023, the number of annual deaths due to road accidents is 1. 19 million [1]. According to the report of World Population Review, in 2019 there were 1949000 car accidents in USA, 300143 in Germany, 174896 in Turkey, 172183 in Italy, 123212 in UK, 105791 in Canada [2]. In our proposed system we set the speed limit by measuring the distance using ultrasonic sensors to avoid accidents. In the future we will improve the system using other sensors. Later we will develop another system to avoid accidents using temperature sensor, speed sensor, GPS, fire sensor and other necessary sensors. We expect that our currently proposed system will be able to handle most road accidents.

System circuit diagram and components

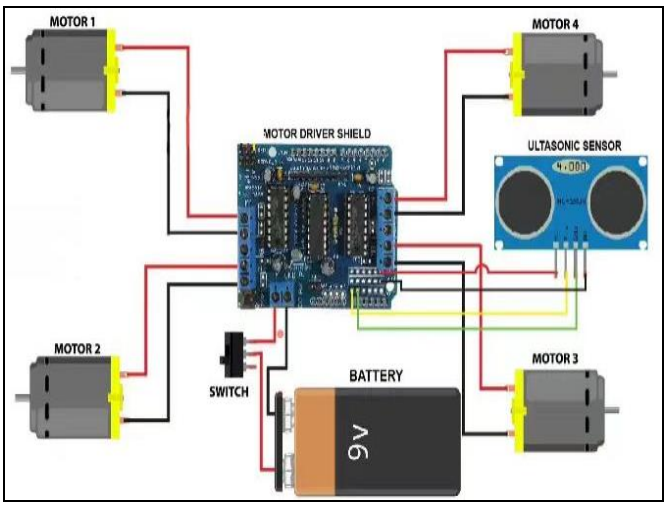


Fig 1: Circuit diagram

Components

Arduino Uno

Arduino Uno is an open source microcontroller board which is the brain of the robot. It has the ATmega 328 microprocessor which is a single chip microcontroller. It has specification of 2 kB of RAM,1 KB of ROM,32 KB of flash memory. Programming in the Arduino Uno carried out in the integrated development environment which called(IDE). The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Inte grated Development Environment), via a USB B cable. It can be powered by the USB cable or by an external battery [3].

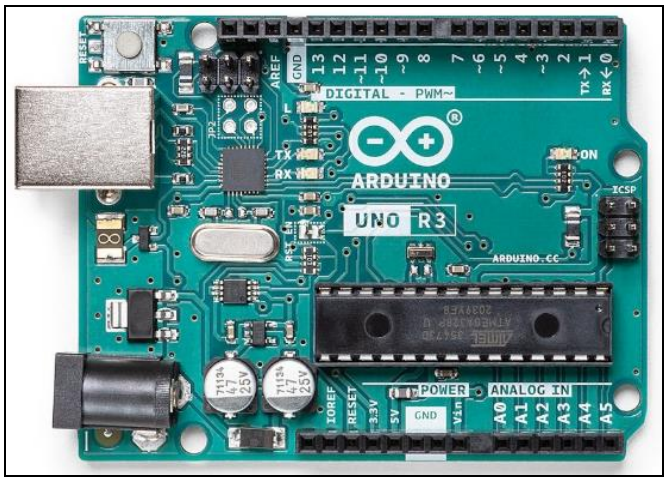


Fig 2: Arduino Uno

Arduino L298D Motor Driver Shield

L298D Motor Driver Shield is a motor driver shield which is designed to Work with L293D IC. The L298D motor driver Shield features a built-in micro stepping driver that allows for precise control of the motor's speed and direction [4].

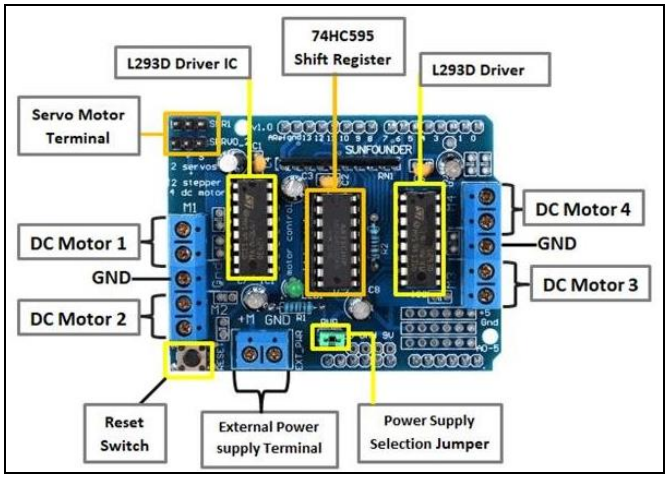


Fig 3: Arduino L298D Motor Driver Shield

TT Dc Motor

TT Dc motor is an electrical machine that's converts electric energy into mechanical energy. The motor is usually the important component in building a robot since it imparts motion to the robot. In this project we used 4 dc motor to drive the car [5].

Fig 4: TT Dc Motor

Ultrasonic Sensor HCSR04

An ultrasonic sensor is an electronic device that measures the distance to an object using ultrasonic sound. The working principle of this module is simple, it sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated [6].

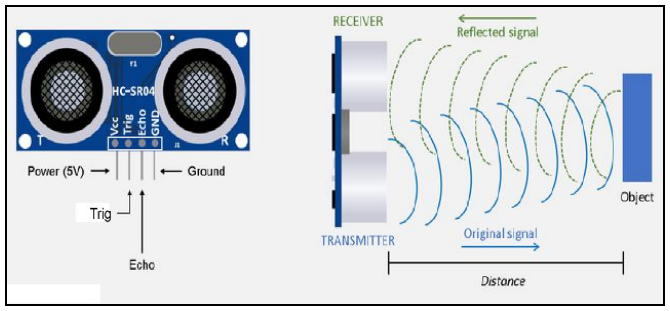


Fig 5: Ultrasonic Sensor HCSR04

Male and female jumper wire

These male-to-female jumper cables are used to join any development board with a female header pin to other development boards with a male connection. These are straightforward cables with connection pins on both ends that enable you to link two locations together.

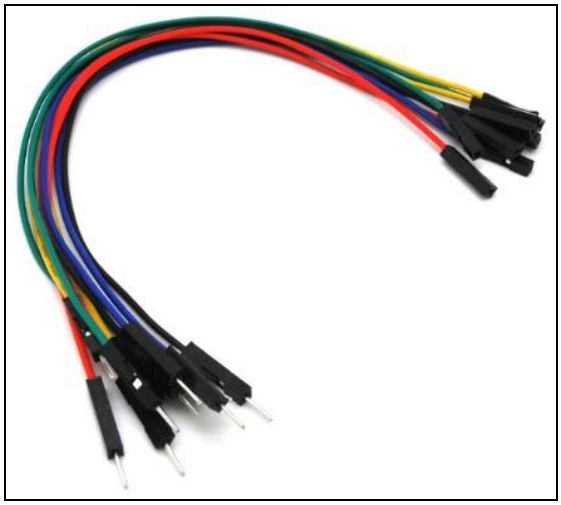


Fig 6: Male and female jumper wire

Battery Holder

To house and connect one or more 18650 Lithium-ion battery cells, a special compartment known as the 18650 Li-ion battery holder is needed. The circuit is established when spring-loaded or flexible contacts in these holders come into contact with the positive and negative poles of the batteries. The capacity outputs are achieved through connection of multiple cells in parallel or series whereas single cells can also be accommodated. A well-built holder should enable easy installation and removal of a battery, but must also secure against possible short circuits, reversing polarities, or leakage. Proper selection of a holder depends on several factors such as application field, battery chemistry, temperature exposure and safety rules.

Fig 7: Battery Holder

18650 Li-on battery

18650 Li-on battery is a cylindrical rechargeable cells which is very common in many electronic devices and applications. They take 18mm of diameter and 65mm of length hence their name "18650". These batteries usually have a nominal voltage of 3.6-3.7V and capacities that range from 1200mAh to 3350mAh being common with between 2200-2600mAh. Lithium-ion chemistry has a high energy density making it possible for the use of 18650 cells as power tools, laptops, electric vehicles, energy storage systems etc. Though its theoretical cycle life is about 1000 charges, parameters like aging and discharge rate affect their actual lifespan. Proper battery management systems are essential for safe operation in packs of high capacity [7].

Fig 8: 18650 Li-on Battery

Ultrasonic sensor working principle

Ultrasonic sensors function through echo location, similar to how bats navigate. It emits ultrasound sound waves and measures the time it takes for them to bounce back off an object as a way of calculating distance.

Sound Waves Emission: In principle, ultrasonic sensors are made up of two important parts; transmitter and receiver. The environment is filled with high frequency sound waves (typically around 40 kHz) by the transmitter.

Reflected Sound Waves: These sound waves from the transmitter hit an object and get reflected back towards the sensor.

Receiving Echoes: The receiving unit picks up the echoes generated.

Calculating Time Interval: Through internal circuitry of the sensor it is possible to measure how long it takes for sound to travel from emitter to object and back.

Calculating Distance: Applying this formula, one can find out what length separates him or her from a target.

Example Calculation

Measuring Time of Flight

Suppose the time of flight measured by the sensor is 0.03 second.

Speed of sound: Assume the speed of sound in air is 343m/s.

Apply the Formula

$$\text{Distance} = \frac{(0.03 * 343 m/s)}{2}$$

$$= 5.145 \text{ m}$$

So, the distance to the object is approximately 5.145 meters.

Hardware

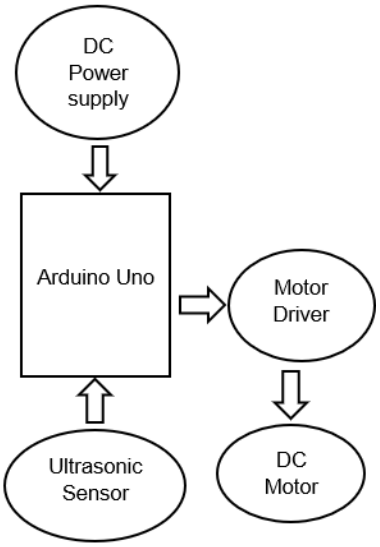
First, we have to build a frame or chassis as per the requirement. We use acrylic sheet for build this frame. We should carefully arrange the components in the chassis as per the circuit diagram. The L293D Motor Shield has been used to control DC motors. It's a kind of interface between Arduino and DC motors. It is capable of handling 4 DC motors. 4 Motors are connected to the M1, M2, M3, M4 slots of the motor shield. Then, the trig pin of the Ultrasonic Sensor is connected to A1, and the echo pin is connected to A0. All the ground and VCC pins of the ultrasonic sensor are attached to the ground and 5V pins of the motor shield respectively. The whole unit is powered through a 3.7V Lithium Polymer battery which is connected to the external power supply terminal of the motor shield. The motor shield requires an external power supply and thus for Arduino itself no additional power is needed.

Software

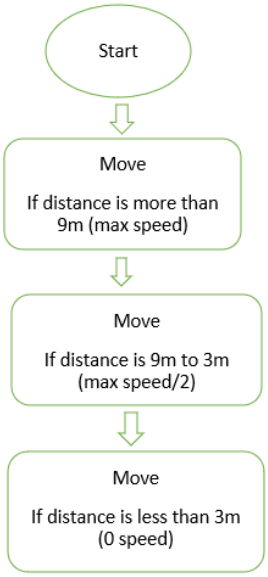
In order to make sure that hardware components work well and achieve their intended purposes, they should be programmed using software such as Arduino IDE. To begin with, this microcontroller is not pre-programmed which

means that you need to use software for uploading the required program. The data exchange process has three main sections so as to enable them perform a desired task. One involves the collection of data by the sensor module and then it sends it so that it can be treated by the microcontroller. On the other hand, controller looks at incoming sensors' information in terms of what action should come next and where to keep this information. The microcontroller receive processed data for actuating or controlling motor operation within motor control section. Because we prefer Arduino UNO board, it also determines our choice of Arduino IDE which writes programs into microcontrollers. This ensures that these hardwares interact smoothly resulting into accomplishment of their objectives in a more effective manner.

Block Diagram



Flow Diagram

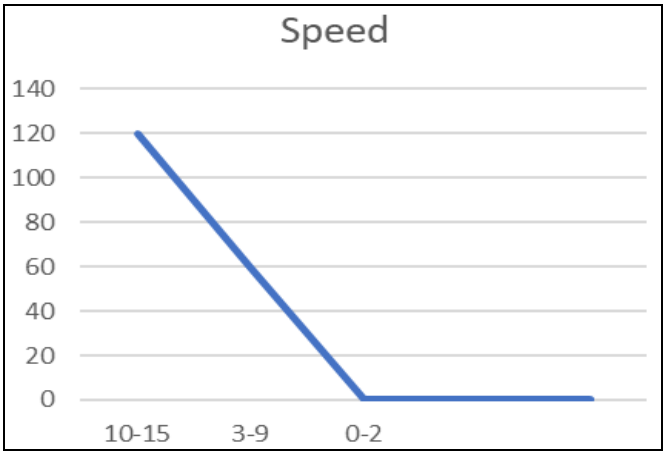


Results and Discussion

We have been able to implement distance based accident avoidance systems. We replaced our recommended system in our model car. Through various experiments, we have seen that the car detects the distance through the ultrasonic sensor and sets its speed limit according to the distance from the car in front and the car stops its speed at a close distance. Below are the key figures of our findings:

Table 1: Distance and Speed

Distance	Speed
10-15	120
3-9	60
0-2	0



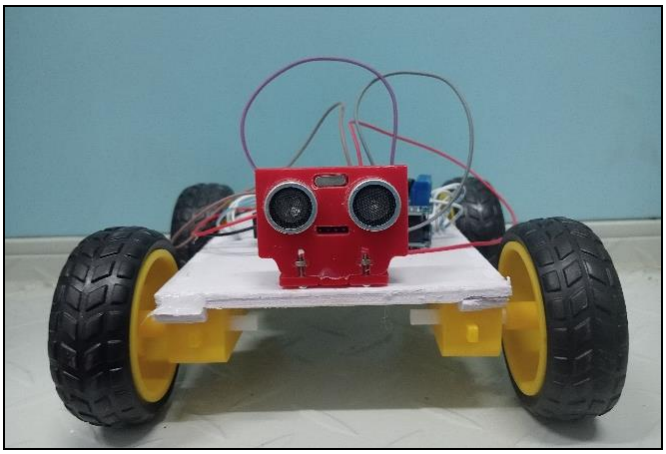


Fig 9: Distance based accident avoidance car

Conclusion and future work

In this paper we proposed and implement the accident avoidance system. Using this system we may avoid many accidents happened due to the following systems. The system comprises very low cost components such as ultrasonic sensor, Arduino uno etc. In the future we will improve the system by adding GPS, temperature sensor, fire sensor and many other sensors to the system. We hope, by using this system, we will be able to save many lives by avoiding road accidents.

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