VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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MINI PROJECT REPORT

ON

"COLLISION DETECTION SYSTEM"

In partial fulfillment of the requirements for the award of the degree

BACHELOR OF ENGINEERING

IN

ELECTRICAL AND ELECTRONICS

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BANGALORE INSTITUTE OF TECHNOLOGY

(Affiliated to Visvesvaraya Technological University)

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CERTIFICATE

This is to certify that the Mini Project Report titled **“COLLISION DETECTION SYSTEM”,** bonafide work carried out by **ANISH DHIMAN (1BI18EE003), CHITRA BHAT (1BI18EE007), GARIMA GOSWAMI (1BI18EE010), SAMARTH GOYAL (1BI18EE035),** students of **Bangalore Institute of Technology** in fulfillment for the **Mini Project** under **Visvesvaraya Technological University, Belagavi** during the year 2020-2021. The report has been approved as it satisfies the academic requirements in respect of Mini Project Work.

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100

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ABSTRACT

A collision avoidance system (CAS), also known as a pre-crash system, forward-collision warning system, or collision mitigation system, is a driver assistance system designed to prevent or reduce the severity of a collision. In its basic form, a forward-collision warning system monitors a vehicle's speed, the speed of the vehicle in front of it, and the distance between the vehicles, so that it can provide a visual and audio warning to the driver if the vehicles get too close, also self-braking in case vehicles get too close and avoiding an accident. Various sensors are mounted on the vehicle to make this happen. For the scope of this project, Ultrasonic Distance Sensor (UDS) is used to constantly determine the distance between the vehicles or objects and act in 3 zones. When the car is in zone 1, a visual alert is provided - if the driver fails to respond and the car moves into the 2 zone, an audio alert is provided to the driver. If he fails to respond again, the vehicle enters zone 3, and self-braking starts. To further enhance the system, technologies and sensors like RADAR, LIDAR, and cameras (employing image recognition) can be added and made the system more reliable and can enable pedestrian detection as well.

List of abbreviations

Abbreviations	Full Forms
WHO	World Health Organisation
GPS	Global Positioning System
EEE	Electrical and Electronics Engineering
HRL	Hughes Research Laboratory
NHTSA	National Highway Traffic Safety Administration
UNECE	The United Nations Economic Commission for Europe
CAS	Collision Avoidance System
AEBS	Advanced Emergency Braking System
CDS	Collision Detection System
RADAR	Radio Detection and Ranging
LIDAR	Light Detection and Ranging
UDS	Ultrasonic Distance Sensor
IO	Input/Output
LED	Light Emitting Diode
DC	Direct Current
AC	Alternating Current
BIT	Bangalore Institute of Technology

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CHAPTER I: Introduction

1.1 Introduction

Emerging as one of the top causes of death among the most productive age groups, road crashes have developed into a major public health crisis across the world. According to the World Health Organization (WHO), road crashes kill 1.2 million people and permanently disable another 50 million every year. Over the last decade, road crashes have become the tenth leading cause of death in the world and are predicted to rise to the fifth position by 2030. India is the number one contributor to global road crash mortality and morbidity figures. Every hour, 16 lives are lost to road crashes in India. In the last decade alone, India lost 1.3 million people to road crashes and another 5.3 million were disabled for life. Road accidents are caused due to various reasons such as distracted driving, drunk driving, reckless driving, road condition, bad weather. Surprisingly, most accidents were caused because of distracted driving, and The WHO categorizes driver distraction as an important risk factor for road crash injuries. The United States Department of Transportation terms distracted driving as one of the most dangerous driver behaviors and an epidemic that has increased with the proliferation of mobile phones. Distracted driving is defined as any activity that diverts a person's attention from their primary task of driving. These types of activities include the usage of a mobile phone, eating, and drinking, conversation with co-passengers, self-grooming, reading or watching videos, adjusting the radio or music player, and even using a GPS for navigating locations.
Collision avoidance systems respond to situations in two different ways. The first is to alert a driver to the risk through light, a sound, or both.

1.2 Objectives

- As noted from the abstract, most road accidents are caused due to distracted driving; to reduce the number, a visual and audio alert is given to the driver when the car is in the vicinity of foreign objects and is nearing collision.
- If the driver fails to act, and the car is nearing the object which might cause a collision - voltage being a function of the distance between the vehicle and the object, is varied automatically hence reducing the speed of the motors so that the car stops before causing an accident.

- This system actively reduces the chances of an accident and helps the driver in the decision-making.
- The car can be further modified to give warnings for obstacles in the path in any direction of movement.
- This system makes the vehicle safer for senior citizens while driving and for people with infants in the vehicle.

The stakeholders of the project are drivers who are concerned with ease of use and safety and automobile manufacturers are concerned with cost and safety. Potential benefits are reduced human suffering caused by injury and death and reduced financial burden on the healthcare industry. Ideally, the systems will be implemented in all of the automobiles on the road.

Consequently, there is a need for a reliable-real time warning system that can alert drivers of a potential collision. Most collision avoidance systems currently being researched are based on road-vehicle or inter-vehicle communication. Such systems are vehicle-dependent, thus limiting their applicability to vehicles that are equipped with the proper technologies.

CHAPTER II: About the institution

2.1 About the college: Bangalore Institute of Technology

Bangalore Institute of Technology (BIT) was started in the year 1979 to provide quality education in the field of Technology and thereby serve society. It has reached an enviable level of excellence in technical education. This was achieved due to the unconditional support of Rajya Vokkaligara Sangha, committed staff, and students. The environment of BIT motivates the student to quench their thirst for knowledge. The college strives to achieve the all-round development of the students.

BIT has always been at the forefront of modern technology and has the distinction of being the first College to introduce a full-fledged degree in Computer Science and Engineering in Karnataka. The institute has visualized the areas of future growth and incorporated various courses over the years. At present BIT has 10 undergraduate, 10 postgraduate courses, and 13 research centers. BIT has an annual intake of 1300 students. Several centers are carrying out interdisciplinary research and many collaborative programs exist between the college and other professional institutions, like IISc, NAL. The Chemistry department has been recognized as one of the latest research centers in Karnataka. BIT also has the acclaim of being the Study center for IGNOU programs.

BIT is proud to say that it has 289 faculty members with excellent knowledge and teaching caliber. 83 faculty members have Ph.D. degrees and 71 are pursuing Ph.D. Sixty percent of faculty members have served BIT for more than twenty years. The Institution has 294 efficient and committed teams of supporting staff.

Fig 2.1: Bangalore Institute of Technology(BIT)

Fig 2.2: BIT Library

2.2 About the department: Electrical & Electronics

The department of Electrical & Electronics Engineering came into existence along with the establishment of the institution in the year 1979. It is now headed by Dr. Pramila M.E., Ph.D., supported by highly qualified, experienced, and dedicated staff.

In this age of development in technology, it is we the Electrical & Electronics engineers who hold the key to development with our horizon ranging from power generation to microcontrollers. Established in the year 1979, the department boasts well-equipped labs and well-qualified faculty. The department has endeavored in organizing regular field trips to various industries hence giving ample industrial exposure, thus integrating practical & theoretical knowledge.

To develop the overall personality of the students the Electrical Engineering Association (EEA) was formed. EEA holds various seminars, technical talks & personality development programs to keep the students & staff updated with the latest developments. Several technical institutions like CPRI. PRDC etc, have conducted various lectures & workshops. To add to the credibility of the department various project papers have been acknowledged by the industry. The department has a VTU recognized R&D center and 6 faculty members from our department & also from other institutions have registered for Ph.D. at this center. Also, 5 faculty members of our department have been awarded Ph.D. in diversified areas of EEE. Thus the department has a strong sense of responsibility to provide an excellent technological education to the undergraduates and has been successful in providing a platform to carry out R&D work. The students acquire the requisite knowledge for a successful career and the academic strength of the faculty is reflected by the alumni, many of whom are in the top echelons of industry and academia both in India and abroad.
Department has a good placement record of 90% in top companies.

Department also has an appreciable record of topping VTU thrice i.e; 1st rank with 07 Gold medals and secured 02 consecutive ranks (1st and 2nd rank) for the academic year 2013-14, 02 ranks for the academic year 2015-16, 01 rank for the academic year 2016-17, two ranks during the academic year 2017-18, two ranks during the academic year 2018-19 securing first rank (7 gold medals) and 9th rank.

Fig 2.3: Electrical and Electronics Department

Fig 2.3: EEE laboratory

CHAPTER III: Early approaches & concept of working

3.1 Early approaches and forward collision avoidance system

Early warning systems were attempted as early as the late 1950s. An example is Cadillac, which developed a prototype vehicle named the Cadillac Cyclone which used the new radar technology to detect objects in front of the car with the radar sensors mounted inside "nose cones". It was deemed too costly to manufacture.

The first modern forward collision avoidance system was patented in 1990 by William L Kelley. The patent number is 4926171 and the title is Collision Predicting Avoidance Device for Moving Vehicles.

The second modern forward collision avoidance system was demonstrated in 1995 by a team of scientists and engineers at Hughes Research Laboratories (HRL) in Malibu, California. The project was funded by Delco Electronics and was led by HRL physicist Ross D. Olney. The technology was marketed as Forewarn. The system was radar-based – a technology that was readily available at Hughes Electronics, but not commercially elsewhere. A small custom fabricated radar antenna was developed specifically for this automotive application at 77 GHz.

In 1995, Hughes Research Laboratories and Delco Electronics demonstrated a radar-based forward collision avoidance system. Radar technology had progressed from the nose cones of the Cyclone to a small antenna specifically designed for vehicles. Radar has progressed and evolved, hence featured heavily in many automatic collision avoidance systems.

3.2 Commercial product development

The first production laser adaptive cruise control on a Toyota vehicle was introduced on the Celsior model (Japan only) in August 1997.

In the early-2000s, the U.S. The National Highway Traffic Safety Administration (NHTSA) studied whether to make frontal collision warning systems and lane departure warning systems mandatory. In 2011, the European Commission investigated the stimulation of "collision mitigation by braking" systems. Mandatory fitting (extra cost option) of Advanced Emergency Braking Systems in commercial vehicles was scheduled to be implemented on 1 November 2013 for new vehicle types and on 1 November 2015 for all new vehicles in the European Union. According to the "impact assessment", this could prevent around 5,000 fatalities and 50,000 serious injuries per year across the EU.

In March 2016, the National Highway Traffic Safety Administration (NHTSA) and the Insurance Institute for Highway Safety announced the manufacturers of 99% of U.S. automobiles had agreed to include automatic emergency braking systems as standard on virtually all new cars sold in the U.S. by 2022. In Europe, there was a related agreement about an AEBS or AEB in 2012. The United Nations Economic Commission for Europe (UNECE) has announced that this kind of system will become mandatory for new heavy vehicles starting in 2015. AEBS is regulated by UNECE regulation 131. NHTSA projected that the ensuing accelerated rollout of automatic emergency braking would prevent an estimated 28,000 collisions and 12,000 injuries.

In 2016, 40% of US car models have AEB as an option. As of January 2017, in the United Kingdom, an estimated 1,586,103 vehicles had AEB. This makes AEB available in 4.3% of the British vehicle fleet.

3.3 Functioning of the system

A collision avoidance system can be put up by making use of a microcontroller employed with sensors. The components used are listed below:

- Controller: An Arduino UNO which is a board-based microcontroller is used as the controller.
- Distance sensor: An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal.
- Piezo buzzer: A Piezo buzzer is a type of electronic device that's used to produce a tone, alarm, or sound.
- Wires: Jumper wires are required to make hardware connections.
- L293D: A L293D is used as a motor driver in the circuit

- LEDs: LEDs are used to provide a visual warning.
- Bluetooth module: A Bluetooth module is used to connect the whole setup to a controller.
- Software used: TinkerCard

This is an Arduino-based collision detection warning system. This kind of system is the fastest-growing safety feature in automotive industries. Such a system enables vehicles to identify the chances of collision and give visual and audio warnings to the driver, so that the driver can take necessary action to avoid a collision. The working of the collision detection system can be explained in zones; as the precautionary action taken by the system depends solely on the distance between the car and the obstacle itself.

The basic concept of working can be explained taking into consideration the functioning of each module present. The interfacing/connections of the sensors to the car are done in such a way that a forward collision warning can be given to the driver in case of danger. The UDS is present at the front(bonnet) of the car which continuously seeks the distance between the obstacle and the driver, the LED, and piezo buzzer inside the car to alert the driver about the obstacle. As the distance is fed to the controller, the controller uses the motor driver to control the speed if necessary along with warning the driver simultaneously. The functioning of the controller depending on the distance can be explained in terms of zones; as different conditions are imposed depending on the zones.

3.3.1 Concept of working

The functioning of the Collision Detection System can be explained as follows. The operation of the LED and the buzzer depends on which zone the car is present in.

As shown in fig. 3.1., when the car is present in the zone I, i.e. the distance between the obstacle and the driver is considerably more, no warning is provided to the driver.

- Zone I: No warning is provided by the controller. (Refer to fig. 3.2)
- Zone 2: Only visual warning (in this zone, the driver has to respond and reduce speed) (Refer fig 3.2)
- Zone 3: Both visual and audio warnings. (Refer to fig. 3.3)

Fig. 3.1. Visual representation of the system

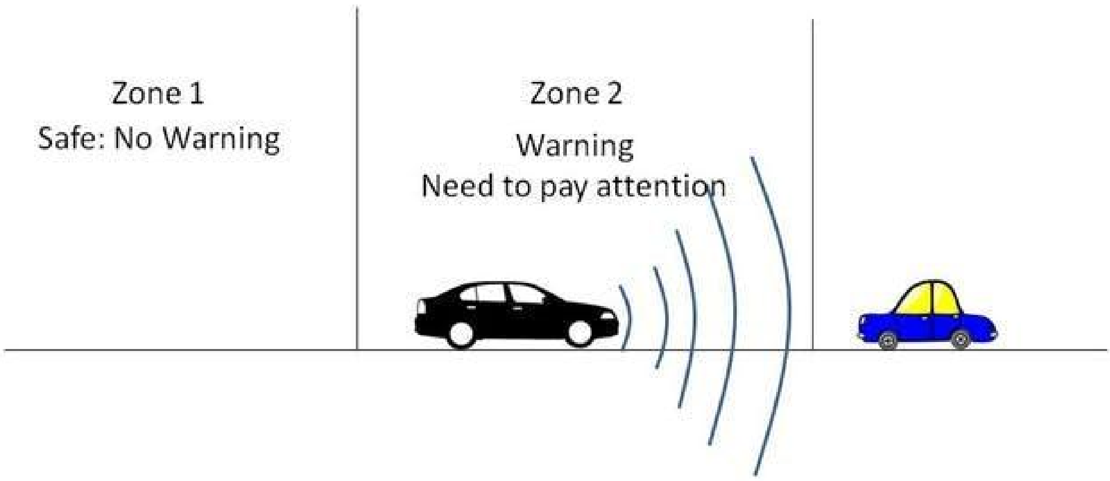


Fig. 3.2. Car is present in zone II

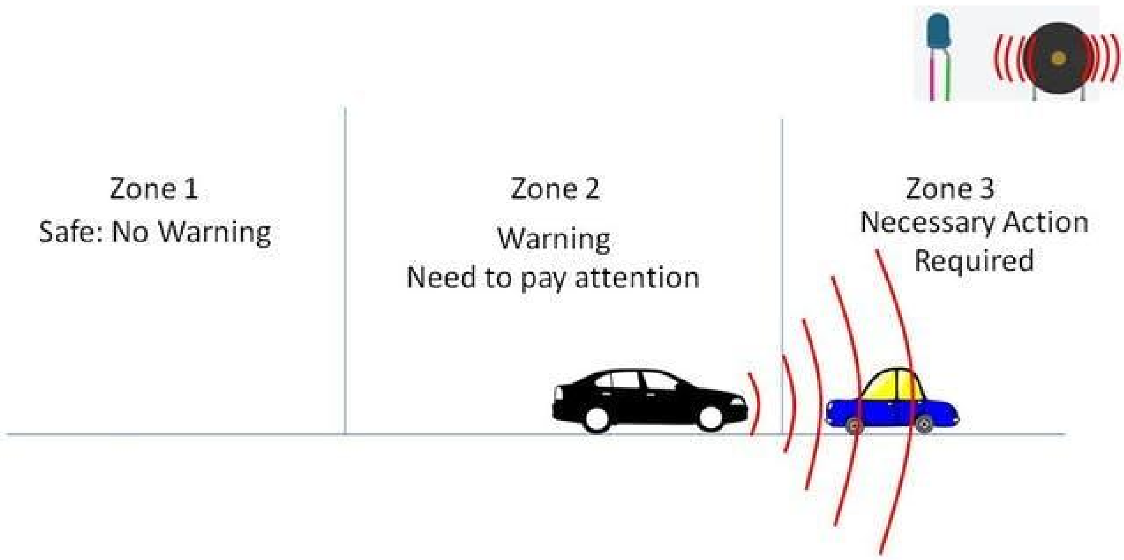


Fig. 3.3. Car heading to zone III

Fig. 3.4. Car in zone III (Black strips indicate the road edges)

3.4 Practical application

The goal is to create an application that will help to eliminate the number of accidents due to distracted drivers. The quickest way to change this would be to change the driver, but this is not a feasible approach. Another way to help with distracted driving is to change the technology surrounding the car design which is what the application will do. This application will create a safer driving environment for its participants. The application will be used to alert drivers of the obstacles that they are sure to encounter if they continue on the same path and speed. The application will alert the driver to the situation allowing them to stop or slow down. The alert will come in the form of the position of the threat, the speed of the vehicle being approached, and the type of the vehicle. The application will alert drivers with a beeping sound. If two vehicles approach a certain distance from each other, a heads-up display will tell the drivers of the danger present.

On the basis of working, it can be seen that this system can be employed in:

1. Quadcopters, Hexacopters, Tricopters, and Octocopters without any major change.
2. It can be used in Self Driving Cars.
3. It can be used in Photographic Drones.
4. It can be used in RC Planes, Boats, and other toys.

CHAPTER IV: Literature Survey

4.1 Collision Avoidance Theory with Application to Automotive Collision Mitigation *by Jonas Jansson*

4.1.1 Problem concept

This thesis discusses the theory for collision avoidance decision-making and its application to automotive collision mitigation by braking. In the introduction, a rough estimation of the effect of a CMbB system, which reduces the collision speed in rear-end collisions, is calculated. For a system with a uniformly distributed collision speed reduction, between 0 and 15 km/h, rear-end collisions are estimated to be reduced by 16%. This corresponds to a reduction of all injuries of approximately 5 %.

4.1.2 Methodologies - Merits & Limitations

Merits -

1. Stops the car before the collision
2. RADAR & LIDAR provides a long-range view of the obstacles ahead.

Limitations -

1. The vehicle does not give a chance for the driver to take action instead directly goes into the braking stage.
2. Understanding the situation by the system is lesser because of direct braking and can cause problems while driving if it turns out to be a false alarm.
3. Very expensive to implement on a mass scale.

4.2 The Collision Avoidance Technology *by Prof. Ahmed Elnakib*

4.2.1 Problem concept

This system tries to avoid collisions by helping the driver drive better and has more vehicle awareness by actively scanning the area around the vehicle and helping the driver to change lanes while driving in traffic. The system is based on a combination of RADAR and Ultrasonic Distance Detector which can detect vehicles in the close vicinity of the vehicle and provide the driver with a live view of vehicles around. This reduces the effort by the driver to sense the traffic around and hence can ensure proper and safe lane changing and not cause accidents.

4.2.2 Methodologies - Merits & Limitations

Merits-

1. Helps the driver in maneuvering through traffic.
2. Provides a birds-eye view of the car in traffic.
3. Cheap and easy to implement.

Limitations-

1. Doesn't provide a solution for a head-on collision.
2. The system is driver dependent and acts as an aid to the driver in safe driving. In case the driver is unable to act, a collision is certain.
3. Very limited to just nearby traffic and functionality is limited to lane changing and driving.

4.3 Vehicle Collision Avoidance System *By Miller Kory Rowe LLP*

4.3.1 Problem concept

A collision avoidance system is an automobile safety system designed to reduce the severity of an accident. Also known as a precrash system, forward-collision warning system, or collision mitigation system, it can use radar (influenced by all-weather) and sometimes laser and camera (both sensor types are ineffective during bad weather) to detect an imminent crash. Once the detection is done, these systems either provide a warning to the driver when there is an imminent collision or take action autonomously without any driver input (by braking or steering or both). Collision avoidance by braking is appropriate at low vehicle speeds (e.g. below 50 km/h), while collision avoidance by steering is appropriate at higher vehicle speeds. Cars with collision avoidance may also be equipped with adaptive cruise control, and use the same forward-looking sensors.

4.3.2 Methodologies - Merits & Limitations

Merits -

1. Avoids the collision by any means.
2. Provides the driver with alerts in time before self-braking starts.
3. RADAR provides a long-range vision to the system.

Limitations -

1. The system fails to compensate for the kinetic energy and provides a buffer region for the vehicle to stop before the collision.
2. Instead of focusing on the buffer, the system takes control of the steering and tries to steer away from the obstacle. This could cause the vehicle to create an anomaly and collide with another approaching obstacle or can derail from the road.
3. Can harm the driver in the process of avoiding the collision.

4.4 Problem concept

The number of collisions at urban and rural intersections has been on the rise despite technological innovations and advancements for vehicle safety. It has been reported that nearly a third of all reported crashes occur in such areas. Consequently, there is a need for a reliable-real time warning system that can alert drivers of a potential collision.

Road accidents are the most unwanted thing to happen to a road user, though they happen quite often. The most unfortunate thing is that we don't learn from our mistakes on the road.

The main cause of accidents and crashes is due to human errors. Our project is an Arduino-based collision detection warning system. This kind of system is the fastest-growing safety feature in automotive industries. Such a system enables vehicles to identify the chances of collision and give visual and audio warnings to the driver so that the driver can take necessary action to avoid a collision.

4.5 Methods to overcome the limitations

There were plenty of limitations in the systems overviewed above, tackling them would result in a collision-avoidance system that can not only be practically applicable to current EV's and also would be cheaper to implement.

In the first system overview, the vehicle does not give a chance for the driver to take action, instead directly goes into the braking stage. This causes major problems in case of a false alarm and can panic the driver. Hence, a multi-level system can be deployed to tackle this situation. The operation can be categorized into zones of operation. These zones can be made up depending upon the distance between the obstacle and the vehicle. As the vehicle enters zone 1, a visual warning is provided to the driver and time for the driver to act, in case the driver fails to respond and the vehicle enters zone 2, the driver is provided with an audio warning. If the driver fails to respond, the vehicle enters zone 3 where self-braking starts in order to reduce the speed of the vehicle slowly and halt the vehicle well before the collision. A buffer distance region is maintained to compensate for the kinetic energy possessed by the car and hence avoiding the collision completely by also keeping the driver along with the obstacle safe.

4.6 Formulation of project title

The initial idea was to make a car whose speed can be altered with and changed by the driver without putting much action, but then the idea felt very naive and overused, so on researching how the thought could be made useful for the society even and make the project such that it can serve in a more impactful manner, after brainstorming all the idea, the conclusion was to make a system that can reduce the number of car accidents and help the people in even the greatest way possible.

The idea of a system that can help detect obstacles is old and overused, but the thought of applying some brain to make the car automated such that it stops itself after detecting the obstacles and prevent any accidents whatsoever by reducing the speed without depending on the action by the driver.

CHAPTER V: Hardware & Software Specifications

5.1 Hardware Information

5.1.1 Arduino UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins, 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

5.1.2 L293D - Motor driver circuit

An L293D consists of an H-Bridge. An H-bridge is an electronic circuit that switches the polarity of a voltage applied to a load. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.

Most DC-to-AC converters (power inverters), most AC/AC converters, the DC-to-DC push-pull converter, isolated DC-to-DC converter, most motor controllers, and many other kinds of power electronics use H bridges. In particular, a bipolar stepper motor is almost always driven by a motor controller containing two H bridges.

5.1.3 Ultrasonic Distance Sensor UDS

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.

Ultrasonic sensors are a great solution for the detection of clear objects. For presence detection, ultrasonic sensors detect objects regardless of the color, surface, or material (unless the material is very soft like wool, as it would absorb sound) To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.

5.1.4 Piezo Buzzer

A "piezo buzzer" is a tiny speaker that you can connect directly to an Arduino. "Piezoelectricity" is an effect where certain crystals will change shape when you apply electricity to them. By applying an electric signal at the right frequency, the crystal can make a sound. If your buzzer has a sticker on top of it, pull the sticker off. Connect one pin (it doesn't matter which one) to the Arduino's ground (GND) and the other end to the digital pin. From the Arduino, you can make sounds with a buzzer by using tone. You have to tell it which pin the buzzer is on, what frequency (in Hertz, Hz) you want, and how long (in milliseconds) you want it to keep making the tone.

5.2 Pin information

Controller to computer connection: A USB cable available with Arduino UNO is used to connect the Arduino to the computer. This is used to power the microcontroller to make use of the system.

Connections of the pins of the microcontroller to the components are as follows:

- Pin 12: Enable L293D
- LED Connections: Connect one end of the terminal to the GND. Connect the other to Pin 11 of the controller
- Piezo Buzzer connections: Connect one end to the GND and the other to Pin 10 of the microcontroller.
- Pin 9 and pin 8 are used as inputs 3 and 4 for the microcontroller
- UltraSonicDistance sensor: Pin 7 is connected to the trigger pin of the UDS. Pin 6 is connected to the echo terminal of the UDS.
- Pins 4 and 5 are inputs 1 and 2 respectively
- Pin 2 is the enable pin.

These connections constitute the entire circuit connections. After the connections are made, the system can be implemented. (Refer fig. 6.1.)

5.3 Block diagram

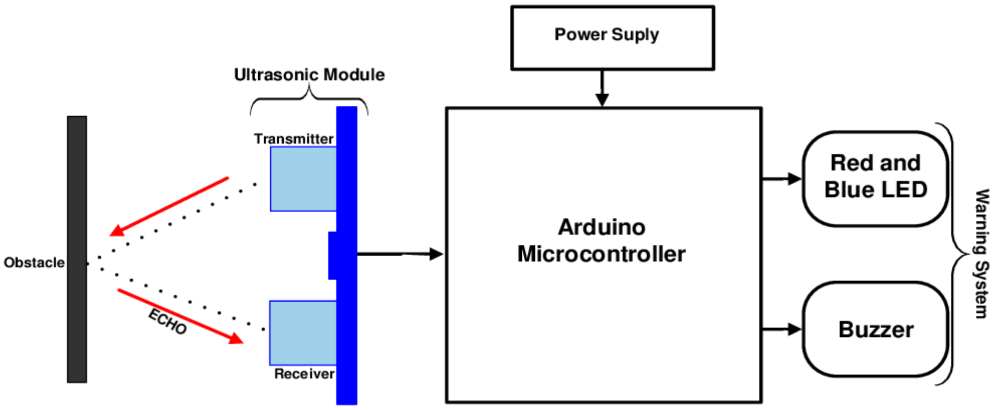


Fig 5.1: Block diagram

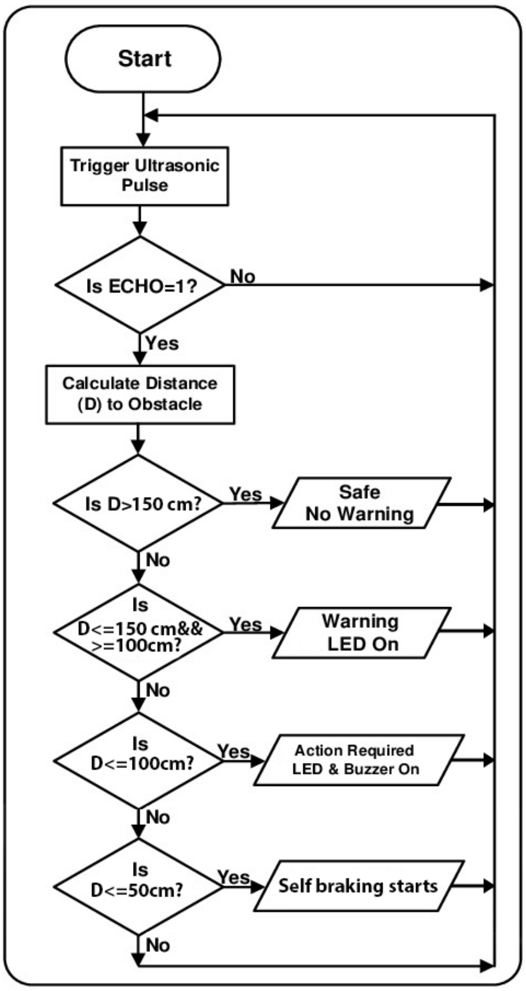


Fig 5.2. Flowchart

Input is given to Arduino from the UDS and the Driver (direction), then the Input value is given to L293D by the Arduino after running through the conditions applied. The L293D controls the DC Motors depending on the input given and conditions applied, value of the distance between the car and the obstacle is obtained (from UDS), and fed to the Arduino for comparison. If the car is in the safe zone, nothing happens, if the distance becomes considerably small, the LED lights up. If the car still does not come to halt, and the distance keeps decreasing, the buzzer alerts the driver. Finally, if the obstacle is very close, the Arduino instructs the L293D to make the speed a function of distance, and eventually stop the car, to prevent any accident, keeping the buffer distance in mind to make sure the car loses all of its kinetic energy too and no accidents occurs because of it.

5.4 Project Cost Estimation

S.No.	Component Name	Amount	Cost /Piece	Final Cost
1.	Arduino UNO	1	500/-	500/-
2.	DC Motor	2	50/-	100/-
3.	L293D	1	30/-	30/-
4.	UDS Module	1	100/-	100/-
5.	LED	2	10/-	20/-
6.	Buzzer	1	35/-	35/-
7.	Jumper Wires	20	5/-	100/-
8.	Resistors	2(100ohm)	5/-	10/-
9.	Battery	1 (12V)	100/-	100/-
10.	Arduino Connector	1	70/-	70/-
11.	Bread Board	1	20/-	20/-
Grand Total				**1085/-**

The components procured are not very high on the economical scale; however, the components used are required for the following reasons:

- Two DC motors on either side of the car

- An Arduino UNO is the microcontroller used for interfacing the sensors
- A UDS to obtain the distance between the obstacle and the car
- L.E.D lights and a Piezo buzzer to alert the driver according to the working
- L293D is the D.C. motor driver for the mentioned project.
- 2 - 12V batteries to power up the circuit as the input to L293D

5.5 Implementation Methodology

The following project has been implemented in a simulator, the name of which is Tinkercad. Tinkercad is an open-source, online simulator that runs in a web browser. Since it became available in 2011 it has become a popular platform for all sorts of basic electrical and electronics simulations.

The following project has been implemented in the latest version (i.e. 2021), wherein all sorts of apparatus about the project were available, also the options to code and test (at least the static working) the project were available too.

One of the drawbacks of the simulator at present is that it only supports the Arduino UNO microprocessor, and still has some parts not available for interfacing.

One of the drawbacks of simulating this project was that it could only be simulated in a static environment whereas its real working could only be understood in a dynamic environment, despite the fact, Tinkercad server the purpose and it was possible to compile the code and debug it, making sure there are no discrepancies in the code which may later lead to any sorts of discomforts or any problems in the proper working of the project when implemented in real life/practical environment instead of a simulator.

Since it was not possible to implement the project in practical (due to covid) we made sure to find the costings of all the apparatus used in the project, and make sure the most reasonable costs are listed, making the project very economic and makes it easy for the person's pocket whoever tries to implement it.

Since an Arduino has been used, the code has been written in C/C++ which makes it easy to understand and implement and customize it even further for more innovation. The code has been written in an easy-to-understand format with all the comments to make the reader understand and debug the code without much of a problem or without stressing on the coding language a lot, a person with average logical skills can understand and debug the code with ease.

The link to the project ready in the simulator has been shared too, so anyone can try hands on the project without any downloads, all the wires and apparatus are connected with very understandable logic so anyone can understand the interfacing too, and can further evolve the project according to their own needs and demands.

The snippets of code for the project have been explained below, along with how they make the project work as a whole.

5.6 Code:

```
#include<stdio.h>
#define led 11
#define echoPin 6
#define trigPin 7
#define buzzer 10
int duration;
int distance;
int FirstDistance=0;
int SecondDistance=0;
```

Fig. 5.3 Code snippet 1

#include<stdio.h> imports the standard I/O files that are necessary to communicate with the microcontroller.

#define assigns a specific PIN to a certain work/certain pin on the sensor which helps to communicate with the sensor. **int** is used to initialize a variable.

```
//Left Motor Pins
int Enable1 = 2;
int Motor1_Pin1 = 4;
int Motor1_Pin2 = 5;

//Right Motor Pins
int Motor2_Pin1 = 9;
int Motor2_Pin2 = 8;
int Enable2 = 12;
```

Fig. 5.4 Code snippet 2

The PINs of the motors are initialized and defined to specific pins on the Arduino to interface with when it is required.

```
char direction; //variable to store the data
int speed; //Variable to control the speed of motor
int velo;

int getdistance()
{
    digitalWrite(trigPin, LOW);
    delayMicroseconds(2);
    digitalWrite(trigPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(trigPin, LOW);
    duration = pulseIn(echoPin, HIGH);
    distance = duration * 0.034 / 2; // Speed of sound wave divided by 2
    Serial.println(distance);
    return distance;
}
```

A function **getDistance()** to read the distance of the car from the obstacle is declared and coded, which uses the UDS to calculate the distance and return the same when the function is called.

Fig. 5.5 Code snippet 3

```
int carspeed()
{
    FirstDistance = getdistance(); //get the first distance
    delay(1000);
    SecondDistance = getdistance(); //gets the second distance
    speed = (FirstDistance - SecondDistance)/1;
    return speed;
}
```

A function **carspeed()** is declared to calculate the speed when called and return the same, which is done using the instantaneous distances obtained by calling **getdistance()**.

Fig. 5.6 Code snippet 4

```
void check(){
    //conditions based on distance from obstacle
    if(getdistance() < 150)
        digitalWrite(led, HIGH);
    else if(getdistance() < 100){
      tone(buzzer, 300);
        delay(1000);
        noTone(buzzer);
        delay(1000);
    }
    //decreasing speed as a function of distance
    else if(getdistance() < 50){
        map(velo, 1, getdistance(), 0, carspeed());
        analogWrite(Enable1, velo);
        analogWrite(Enable2, velo);
    }
}
```

A function **check()** is declared to check the distance of the car from the obstacle and depending on the distance perform specific tasks. The **map** function is an inbuilt function that makes the speed of the car a linear function of its distance from the obstacle.

Fig. 5.7 Code snippet 5

```
void setup()
{
  //Set the baud rate of serial communication.
    Serial.begin(9600);
  //Setting the L293D, LED, Buzzer, UDS pins as output and input pins.
    pinMode(Motor1_Pin1, OUTPUT);
    pinMode(Motor1_Pin2, OUTPUT);
    pinMode(Enable1, OUTPUT);
    pinMode(Motor2_Pin1, OUTPUT);
    pinMode(Motor2_Pin2, OUTPUT);
    pinMode(Enable2, OUTPUT);
    pinMode(buzzer, OUTPUT);
    pinMode(led, OUTPUT);
    pinMode(trigPin, OUTPUT);
    pinMode(echoPin, INPUT);

  //Setting the enable pins as HIGH.
    digitalWrite(Enable1, HIGH);
    digitalWrite(Enable2, HIGH);
}
```

setup() is where the initial conditions are declared of the microcontroller pins, and the setup of all the pins is done.

It is also the place where pins are differentiated as **INPUT** and **OUTPUT** so that all pins would know their function and work.

Fig. 5.8 Code snippet 6

```
void loop(){
    direction = Serial.read();   //Storing the data in the 'direction' variable
    Serial.println(direction);      //Printing it on the serial monitor
    switch(direction){
    case 'w':  //Moving the Car Forward
        digitalWrite(Motor2_Pin1, HIGH);
        digitalWrite(Motor2_Pin2, LOW);
        digitalWrite(Motor1_Pin1, HIGH);
        digitalWrite(Motor1_Pin2, LOW);
        check();
        break;
    case 's':  //Moving the Car Backward
        digitalWrite(Motor2_Pin1, LOW);
        digitalWrite(Motor2_Pin2, HIGH);
        digitalWrite(Motor1_Pin1, LOW);
        digitalWrite(Motor1_Pin2, HIGH);
        check();
        break;
    case 'a':  //Moving the Car Left
        digitalWrite(Motor1_Pin1, LOW);
        digitalWrite(Motor1_Pin2, LOW);
        digitalWrite(Motor2_Pin1, HIGH);
        digitalWrite(Motor2_Pin2, LOW);
        check();
        break;
```

loop() is the part that runs continuously, this is the part that keeps implementing, again and again, to keep the microcontroller running.

Fig. 5.9 Code snippet 7

```
    case 'd':   //Moving the Car Right
        digitalWrite(Motor1_Pin2, LOW);
        digitalWrite(Motor1_Pin1, HIGH);
        digitalWrite(Motor2_Pin1, LOW);
        digitalWrite(Motor2_Pin2, LOW);
        check();
        break;
    case 'q':   //Stop
        digitalWrite(Motor2_Pin2, LOW);
        digitalWrite(Motor2_Pin1, LOW);
        digitalWrite(Motor1_Pin2, LOW);
        digitalWrite(Motor1_Pin1, LOW);
        break;
    }
}
```

Fig. 5.10 Code snippet 8

Here the input from the user is read and depending on the input, the different output is obtained. Using a switch case it was possible to separate the 4 direction motion of the car, the Arduino checks for distance every time an input is given and since the input is continuous, the checking part is also done continuously.

CHAPTER VI: Simulation & Output

6.1 Result

6.1.1 Simulation

The below image shows the screenshot of how the whole project looks like in the simulator, the interfacing of the project was not a tedious task as the simulator has all the options to make the interfacing part as easy as possible and anyone can interface it in real life if they have the given below circuit diagram and basic knowledge of the electronic parts used. The wires have been colored separately to avoid any confusion in connections, if a UDS is not present, any alternative that serves the same purpose can be used too. Note that a resistor is necessary to be connected along with the LED and BUZZER to make sure that they do not end up short-circuited.

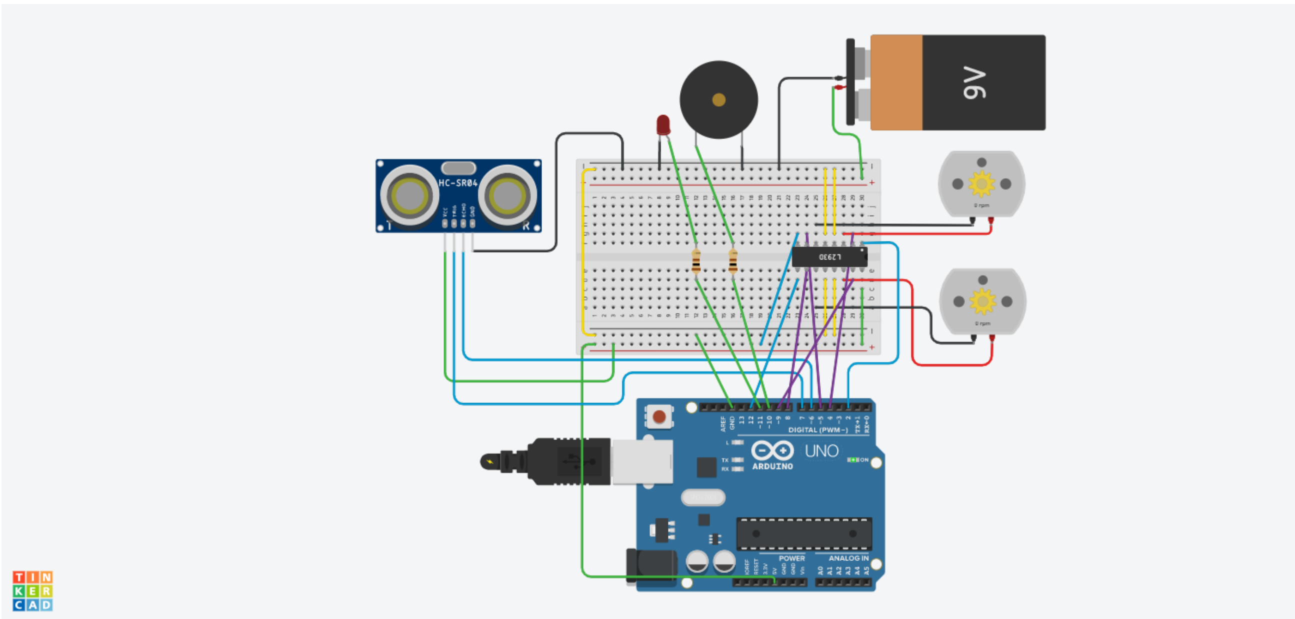


Fig. 6.1 Simulated connections

6.1.2 Output

Depending on the key pressed, distance is calculated every second, and accordingly, velocity is varied. Hence it is seen that the RC car works in the way wherein ‘w’ drives the car in the forward direction as both the motors rotate clockwise. Similarly, on pressing ‘s’ motors rotate anti-clockwise. Two other keys, ‘a’ and ‘d’ respectively are pressed to turn the car left and right. This is done by the provision of torque by one motor which drives the motor in the required direction. As noted in the serial monitor below, the distance of the obstacle is continuously monitored. When the distance between the obstacle and the car:

- Distance between the obstacle and car < 150 cm: L.E.D. glows up
- 150 cm < distance between the obstacle and car < 100 cm: L.E.D. and buzzer starts to alarm the driver
- Below that: The car comes to a rest on its own.

Case I: Distance is greater than 150 cm

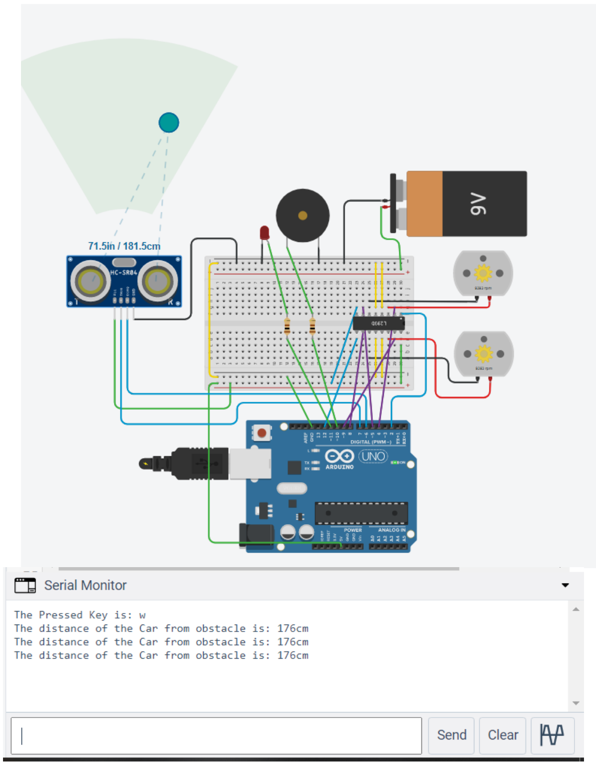


Fig 6.2 shows the system in zone I wherein the car is at a distance greater than 150cm. In such a situation, there is no warning extended to the driver.

Fig 6.2.: Car in zone I

Case II: Distance is less than 150 cm:

As shown in fig. 6.3, the car is now in zone II indicating to the driver that the distance is less than 150 cm by turning on the LED.

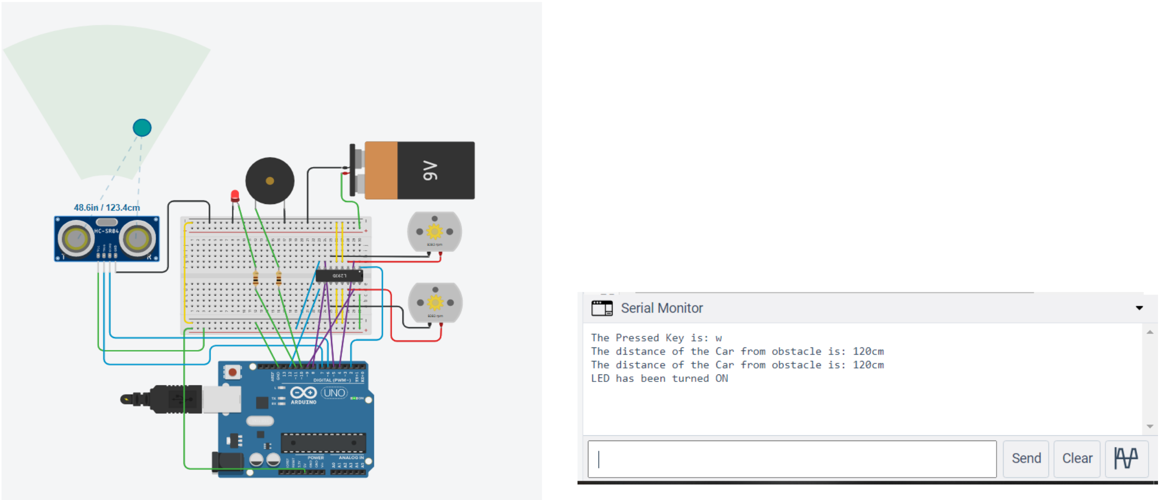
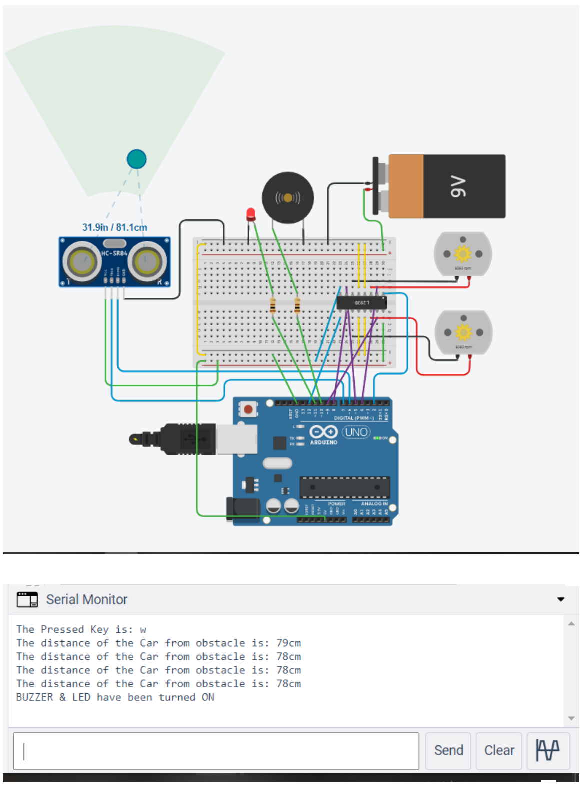


Fig. 6.3.: Car in zone II

Case III: Distance is less than 100 cm:



As indicated in fig. 6.4., the distance between the car and the obstacle is further decreased. The system prompts the driver to take action, the buzzer goes off along with the LED

Fig 6.3.: Car in zone III

Case IV: Distance is less than 50 cm

If no action is taken by the driver despite the repeated warnings, the car comes to a stop. The controller does this by checking the distance between the obstacle and the car.

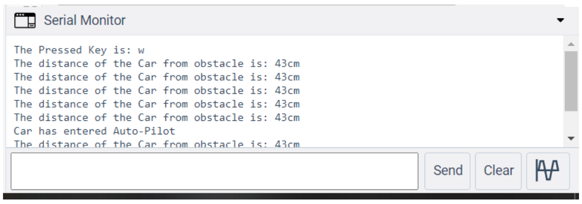


Fig 6.5. Final output

6.2 Future scope

- Employment of sensors such that along with forward collision warning, the system can provide:
    - Blind-spot warning
    - Lane departure warning
    - Tailgate warning
    - Cross obstacle warning
- Depending on the specifications of the motor; the speed and hence time to reduce the speed can vary.
- As the blind-spot warning is to be achieved, a further implementation during times of parking or in driveways could be employed.
- Depending on the obstacle presented to the system, misreading of the same by the sensor can be reduced.

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