Construction of a Device for Obstacle Detection

Reetu Malhotra, Vanshika, Neha

Abstract:-Road accidents are pervasive and prove to be fatal. The presented paper deals with the construction and working of a device for obstacle detection. Obstacle detection is a mechanism used for the identification of any obstruction that may hinder the way of the vehicle. It can improve mobility as well as the safety of people who drive on roads. The proposed system automatically turns left or right on detecting obstacles using ultrasonic sensors & an Arduino. The primary focus is to make the vehicle secure and to ensure the safety of the driver. The project initiated based on a case study done by gathering information from community partners and bus drivers of Chitkara University, Punjab, India.

Keywords: Automobile safety, Ultrasonic sensor, Obstacles, Accidents, Micro-controller, embedded system.

I. INTRODUCTION

An obstacle detection safety system [2] helps the driver to know the nearby obstacles and avoid them (example Bicycle, guard rail, children, and walls). It is basically to slow down the vehicle or reverse when parking. The front and rear bumpers are attached to ultrasonic sensors in this system. These sensors calculate the distance between the driving vehicle and obstacle around the front and rear bumpers, and when it beeps continuously, it means that the vehicle is about to collide with the obstacle. The system differs in different car models. We should know how the system of the vehicle works beforehand, especially if you have rented a car. We should also make sure that the sensor has not covered with unwanted material like scrap or stickers. The device "Cadillac Cyclone" was invented at Hughes laboratory. After then, it discussed to make this device installed in the vehicles necessary, and almost all the vehicles [1] used the technology in their systems. The driver should know how the internal system is working in his vehicle. To have an idea about your vehicle, you can walk around your car before driving. We use an ultrasonic sensor for obstacle detection, and then the sensor attracts the waves and bounces them back for detection — the system used in alarms, pre-programmed door openers .

II. PROBLEM STATEMENT

In recent years, the two-second rule has given way in some circles the three-second rule.

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The same rule has used but with a bit suffer to ensure adequate space is left. After figure outthe problem statement, our team decided to go for a community survey. We met the drivers at this survey and asked them about the problems they face on the road while driving a vehicle. In this survey, we found that drivers need a device for their vehicles to help them drive safely on the parking lot and the road. To solve their problems, we made a device that also fulfills our aim. The device is accurate and also portable.

III. DESCRIPTION OF APPARATUS

Various components used for constructing the device given in Table I and described as follow:

A. *Motor*

In today's world, all mechanical development that we see accomplished by an electric motor. The first electric motor invented by Andrew Gordon in 1740. After further research in years, motor 1820, then in 1832, in 1871, and then finally Frank Julian Sprague first discover available DC motor in 1886, which maintains the constant speed under different loads. The motor is a device that takes electric energy from the primary source and creates mechanical energy. So a machine that transmutes the electrical energy into mechanical energy is mainly called motor. It usually categorized into two types: Direct current motor and alternating current motor. In our project, the authors use 150 r.p.m. dc.

B. *Sensor*

The sensor is a device that observes and answers to some input from its surroundings. Sensors [6] are of different types like color, gas, ultrasonic, touch, PIR, IR, humidity, heartbeat. Among these, the authors use an ultrasonic sensor [3] shown in Fig.1 because it is cost-effective and reliable. Usually, this sensor is used to recognize the barrier. It estimates distance by forwarding ultrasonic waves to an obstacle. These waves emitted by the sensor head and also get the wave mirrored by the target. Sensor determines the distance sonar waves used, and then the trigger sends high-frequency waves. Thus, echo pin receives the signal reflected by the transmitter. The maximum angle an object place is detected by the ultrasonic sensor is 30 degrees. There are many ranges at which the ultrasonic sensor can detect. The distance at which an obstacle recognized depends on the magnitude, configuration, and position of an object.

Table I: Apparatus used in Designing the Device

Component	*Number*
Chassis	1
DC motors	2
Ultrasonic sensor HC-SR04	1
12V battery	1

Motor driver module L298N	1
Arduino Board	1
Tyres	4
Connecting Wires (Male to Female, Male to Male)	n

The maximum range of the sensor that the authors used in our project is 110-150cm.

Fig. 1: Ultrasonic Sensor

Name and description of pins used in this sensor is given in Table II.

Table II: Description of Various Pins in Sensor

Pin no.	*Name of Pin*	*Explanation*
1.	VCC: +5VDC	It gives supply to the sensor
2.	Trig: Trigger(INPUT)	This pin allows it to use the standard three-wire connector. It generates 40kHz ultrasonic waves when setting at high.
3.	Echo: Echo(OUTPUT)	When the trigger pin is set high, this pin also becomes high, and it remains high until the reflected sound reached back to the sensor.
4.	GND: Ground	The ground of the system connected to GND.

C. *Battery*

Batteries are one of the most reliable ways to produce energy. Batteries are used in our daily life in houses, in medical, in military use, in health devices. Benjamin Franklin, in 1749, first used the term to represent a succession of capacitors he had associated together for his experiment. VOLTA invented the first modern-day battery in 1800. There are three main components of battery - anode, cathode, and electrolyte. The primary purpose of the battery is to supply electrical energy. As the authors implemented a small toy car, they use a 12-volt battery (Fig. 2) to give power supply to Arduino. It is a rechargeable called secondary battery. Some batteries are not rechargeable, called primary batteries. The life of a battery can increase by keeping it at a low temperature.

Fig. 2: 12-Volt Battery

D. *Motor Driver Module*

It is used to manage the direction and speed of two DC motors. Frank Julian Sprague invented it in 1886. L298 H-bridge used with the motor and has a voltage lie between 5 and 35V DC. It is a mini current amplifier. Its primary purpose is to take a low current signal and convert it into a higher-current signal so that the motor can drive.

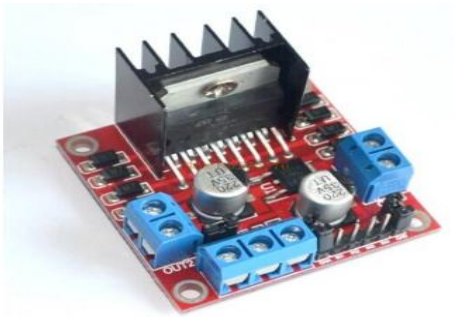

Fig. 3: Motor Driver Module

If the authors join the motor directly to Arduino, it does not work and thus destroying microcontroller due to high currents. Drivers are not used only for motors. They used for any device that usually draws more than 50-100 mA. The pin no. and pin name is shown in Table III.

Table III: Pin Number and Names in Motor Driver Module

Pin No.	*Pin Name*
1.	motor 1 "+"
2.	motor 1 "-"
3.	12V jumper
4.	GND
5.	5V
6.	IN1(first input)
7.	IN2(second input)
8.	IN3(third input)
9.	IN4(fourth input)
10.	motor 2 "+"
11.	motor 2 "-"

E. *Arduino board*

A diversity of microprocessors and controllers used for designing Arduino. There is a set of digital and analog pins provided on board. The project of Arduino [5] began in 2003.

It is a program for students at Interaction Design Institute Ivrea [9].

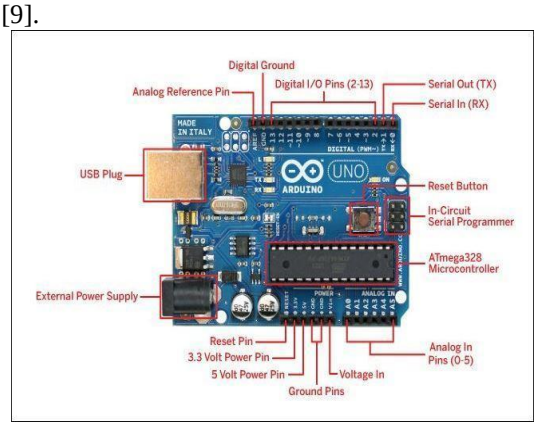

Fig. 4: Arduino Board

The main aim of this is to give a reasonable and easy way of creating a device for novices. Powerboards (USB/Barrel Jack) require a way that connected to a power source. The USB cable is used to give supply to Arduino (Fig. 4). The code is loaded to Arduino using this USB cable. Supply more than 20 Volts cannot use, as it overpowers an Arduino. The recommended voltage for other Arduinos varies between 6 and 12 Volts.

IV. METHODOLOGY

After further discussions in the team, we finalize a Pair-wise comparison chart (PCC). PCC is the process of comparing entities in pairs to judge which entity is preferred. It also compares whether or not the two entities are identical. Priorities of the objectives set through pair-wise comparison chart shown in Table IV. Here, the safety factor [4] and accuracy has maximum points, i.e., 9 means safety is the most prior objective than other elements of design. 8 means accuracy is second main objective.

Table- IV: Pairwise Comparison Chart

Goals	*Accuracy*	*Portable*	*Safer for everyone*	*Cost*	*Score*
Accuracy	****	1+1+1+1	0+1+2+0	0+0+1+0	8
Portable	0+1+0+0	****	0+0+1+0	1+0+1+0	4
Safety	0+0+1+1	1+1+1+1	****	1+1+0+1	9
Cost	0+0+1+1	1+1+1+1	0+0+0+0	****	6

V. CONCEPT GENERATION

As different members of the team have different 2 concepts, and the authors decided to make a chart generally called a pugh chart to choose the best idea.

Table V: Pugh Chart

Objectives	*Weight*	*Concepts*			
		1	**2**	**3**	**4**
Accuracy	8	Reference	-	0	-
Safety	9	Reference	+	-	0
Cost	6	Reference	+	0	0
Portable	4	Reference	-	+	+
+score		0	+13	-7	-8
-score		0	-18	+5	+5
Total score		0	-5	-2	-3

As the authors made a decision matrix by taking the concept of one team member as a reference and concept of other team members are compared to it. So concept taken as a reference is chosen.

VI. WORKING OF DEVICE FOR OBSTACLE DETECTION

Obstacle detection [7]-[9] and collision sensors become more critical in consumer sectors. With the growing technologies, the need of the people is also arising. People want more and more and useful things for a better quality of life. People want a quality of life and quick solutions to their daily life problems.

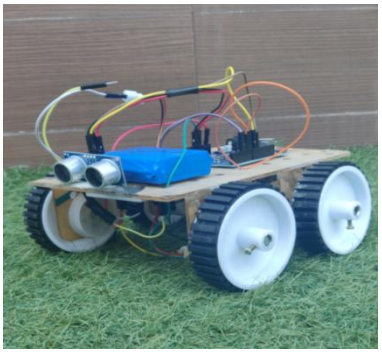

Fig. 5: Device for Obstacle Detection

Many times while driving, the drivers are not able to identify the object in front of the car. Sometimes, it leads to severe accidents and may cause serious casualties. For this problem, the authors have made a device that detects the obstacle in front of the car. Obstacle detection is the full detailed process of using various types of sensors, data structures, and algorithms to detect the objects. The driver is made aware of the beeps or digital display. The craft of obstacle avoidance device requires the moderation of many sensors according to their task. We used a CHASSI, which would work as the framework and help to provide support to the other parts. Initially, the authors started by making code for the working and detecting of the obstacle. After the code was ready, the code uploaded in Arduino. Further connections made with the help of connectors. Arduino, motor driver module, sensor finally connected with the help of connectors. All the connections were ready and had fitted to the Chassis. Further, the 4tyres were attached and made to work with the help of the motors and the motor driver module. So the whole of the working model was ready to work. As soon as the battery source connected to the Arduino, the car starts moving. It detects the object in front of it at a certain distance, and the car would take a slight reverse and would keep moving either to the left or to the right direction. Whenever an obstacle comes ahead of it, the ultrasonic waves reflected from an object, and that information passed further. The instant action the car does is to detect the object and take a quick reverse. The sensor can identify how far the object from the vehicle and warn the driver and take an automatic quick reaction. So the leading role is of the sensors.

VII. CONCLUSION

In this paper, the authors constructed a device for obstacle detection to avoid accidents. This device is easy to implement, along with the current systems in vehicles. It is very suitable to avoid regular tough situations. The ultrasonic sensor emits radiations, which move through the ecosystem at the velocity of sound. If it strikes an object, then the sensors sense them as echo signals, and itself calculate the distance to the target object based using natural echo properties of time. An attempt made in this project to understand and comprehend the aspects of ultrasonic distance sensors. This device helps us to detect obstacles and prevent road accidents. It is cost-effective and durable. It also ensures the maximum safety of passengers. Bus drivers of Chitkara University, Punjab satisfies with the project, soon they take benefit of this device.

VIII. SCHEMATIC REPRESENTATION OF PROBLEM STATEMENT

Fig. 6 indicates the schematic diagram of problem statement.

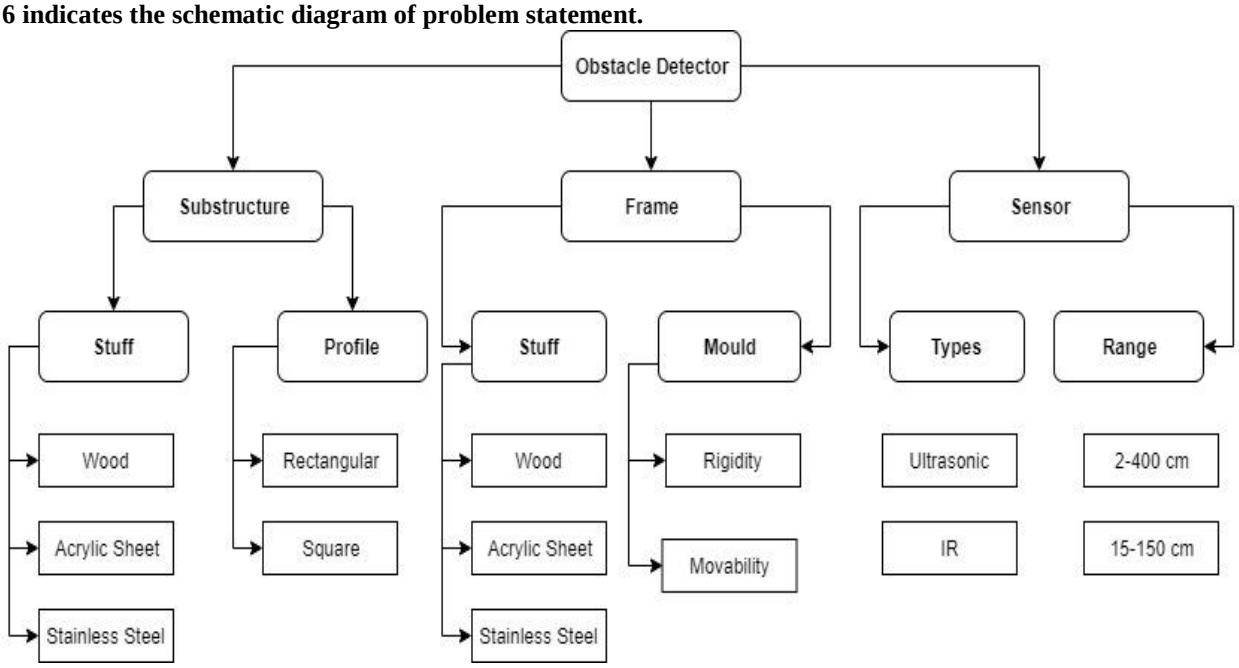

Fig. 6: Schematic Diagram of Problem Statement

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REFERENCES

1. Kunsoo H., Park J., Hwang, J. and Hong, D. (2008) A stereo vision-based obstacle detection system in vehicles, Optics, and Lasers in Engineering 46(2), 168-178.
2. Bovcon, Borja, Janez Perš, and Matej Kristan (2018) Stereo obstacle detection for unmanned surface vehicles by IMU-assisted semantic segmentation, Robotics and Autonomous Systems 104, 1-13
3. Simone D., Marco, C., Rivera, Z. and Guida D. (2018) Obstacle avoidance system for unmanned ground vehicles by using ultrasonic sensors, Machines 6(2), 18
4. Abraham, S., Tana L. J. and Yuvaraj D. (2018) Enhancing vehicle safety with drowsiness detection and collision avoidance, International Journal of Pure and Applied Mathematics 120(6), 2295- 2310.
5. De Simone, Marco C., and Domenico Guida (2018) Identification and control of an unmanned ground vehicle by using Arduino, UPB Sci. Bull. Ser. 80, 141-154.
6. Jihun K., Han D. S., and Senouci B. (2018) Radar and vision sensor fusion for object detection in autonomous vehicle surroundings, In 2018 Tenth International Conference on Ubiquitous and Future Networks (ICUFN),76-78.
7. Borenstein, J., and Koren, Y. (1991) The vector field histogram – fast obstacle avoidance for mobile robots," IEEE Journal of Robotics and Automation, 7(3), 278-288.
8. Broggi, A., Caraffi, C., Fedriga, R. I., and amp; Grisleri, P. (2005) Obstacle detection with stereo vision for off-road vehicle navigation, IEEE Computer Society Conference on Computer Vision and Pattern Recognition 65.
9. Moore, K. and Torrie, M. John Deere Final Report: Obstacle Detection and Avoidance for an Automated Tractor," Tech. Rep., Center for Self-Organizing and Intelligent Systems, Utah State University, Aug. 1999.Links:

AUTHORS PROFILE

Dr Reetu Malhotra is working as an Associate Professor in the Department of Applied Sciences, Chitkara University, Rajpura, Punjab, India. She is MSc. (Mathematics), MPhil(Mathematics), Ph.D. (Mathematics) and qualified CSIR UGC Test. Her areas of interest include "Reliability Modeling", "Queuing Theory" and "Optimization". Having teaching experience of about 16 years, she has co-authored three books of Mathematics and has published various Research Papers in Journals of National and International repute. She is Reviewer of many National/International journals. She has organized/participated in various National/International workshops/conferences.

Vanshika Mehta,is student of second year B.E. studying at Chitkara University, Punjab created a model of a Vehicle obstacle beeper during my second semester. She found this topic very informative and thus decided to do more research on this topic. She has completed her middle school education from Holy Angels School, Rajpura and her high school education from Mukat Public School,Rajpura.

Neha, the second year student of B.E in Computer Science studying at Chitkara University, Punjab and I have completed my senior secondary education from Govt. Girl Senior Secondary School, Nangal. In my second semester I created a model of a Vehicle Obstacle beeper. I do more research on this topic and found that this topic is very informative.