FABRICATION OF AUTOMATIC BRAKING SYSTEM USING ULTRASONIC SENSOR

M. JE SRI KRISHNA [1], P. HEMANTH[1], MD.USMAN KHAN[1], K.REVANTH[1], T.PRABHU SRINIVAS[1], Dr. K.PRASADA RAO[2]

[1]UG Students, Department of Mechanical Engineering, NRI Institute of Technology, Agiripalli, Eluru District, A. P, India, Pin: 521212
[2] Professor, Department of Mechanical Engineering, NRI Institute of Technology, Agiripalli, Eluru District, A. P, India, Pin: 521212

---***---

Abstract - *According to data from the Ministry of Transport, 426 people are killed in traffic accidents each year, with 18 occurring every hour in our country. The majority of accidents occur as a result of poor infrastructure, a lack of road protocols, the near absence of measures to enforce traffic laws, and the driver's failure to hit the brakes. Vehicle speed control can play a critical role in reducing the number of accidents, which an automatic system can achieve. The braking system is an intelligent mechatronic system that includes an Ultrasonic wave emitter on the front portion of a car that produces and emits Ultrasonic waves. An Ultrasonic receiver is also installed on the front of the vehicle to receive a reflective Ultrasonic wave. The reflected wave (detected pulse) gives the distance between the obstacle and the vehicle. Then a microcontroller is used to control the speed of the vehicle based on the detection pulse information to push the brake pedal and apply brake to the car stupendously for safety purpose.*

***Key Words*: Ultrasonic sensor[1], Aurduino[2], Motor drive[3], DC gear motor[4].**

1. INTRODUCTION TO BRAKING SYSTEM

As we all know, an automobile is made up of various systems such as the lighting system, the ignition system, the air-conditioning system, and so on. The braking system is one of the most important of these systems.

One of the most critical car controls is the brake. This is a mix of interactive and non-interactive elements. It absorbs energy from the moving part and, through friction, slows down the vehicle.

Every vehicle has its own braking system to help it stop. Below are the most commonly used braking systems in automobiles.

1.1 Functions of Brake System

The function of the brake system is to stop the vehicle within the smallest possible distance and hence this is done by converting the kinetic energy of the vehicle into the heat energy which is dissipated into the atmosphere

1.2 TYPES OF BRAKING SYSTEM

1. Manual braking system.

- Mechanical Brake
- Disc Brake
- Hydraulic Brake
- Power-assisted Brake
- Air Brake
- Electric and
- Hand brake System

2. Automatic braking system

An automated braking system is an important component of car safety technology. It is a sophisticated system that is especially designed to either prevent or limit the speed of a moving vehicle prior to a collision with another vehicle, a pedestrian, or a barrier of some kind. These systems employ sensors such as radar, video, infrared, or ultrasonic to identify potential objects in front of the vehicle and then use brake control to avoid a collision if the object is identified. Automatic braking is one of several automotive safety technologies that are frequently combined with other technology, such as pre-collision systems and adaptive cruise control. Despite the fact that each automobile manufacturer has its own unique technology for automated braking systems, they all use them.

1.3 ADVANTAGES OF AUTOMATIC BRAKING SYSTEM

As mentioned, an IBS prevents lock-ups and skidding, even in slippery conditions.

- An IBS shares some of the infrastructure of a traction control system, where new technology helps ensure that each Wheel has traction on the road.

- It is easy for manufacturers to install both of these features at the factory.

- Intelligent braking systems coordinate wheel activity with a sensor on each wheel that regulates brake pressure as necessary, so that all wheels can operate in a similar speed range, and help drivers to have better control of a vehicle in any road conditions (where hard braking may be necessary).

2. LITERATURE REVIEW

Hemant Suryawanshi et.al [1] In this article, the automated braking system is described as an effective mechatronic system that includes an ultrasonic wave emitter on the front section of an automobile that produces and emits ultrasonic waves. To push the brake pedal, a microprocessor is employed to regulate the vehicle's speed depending on the detected pulse information.

J.V. Sai Ram et.al [2] According to him, an ultrasonic braking system automobile offers a look into the future of automotive safety. An ultrasonic system, consisting of an emitter and a receiver, is put in front of the vehicle. Solenoid valves are used to activate brakes, and pneumatics are used to do so.

Manju Kumari et.al [3] The mechatronic braking system in this work is designed and built in such a way that, when activated, it can automatically apply breaks when contacted by any object detected by the ultrasonic sensor. The approaches and findings we give are fairly preliminary and require more serious investigation.

Shailendra Singh et.al [4] If implemented, the braking system can reduce the frequency of accidents and preserve precious human lives and property. The entire system is very adaptable and can function with a broad range of brakes, sensors, and actuator options. It should be noted that some subsystems, such as sensors and actuators, have found additional applications since they were created. This system is now being built as a project at the minor level, but it may be used at the industry level to avoid many accidents and human lives. The future of vehicle safety is more than merely inventing new accident-prevention technologies.

Mr. Tushar Kavatkat et.al [5] According to this journal, "intelligent braking" is one of the clever solutions that may be used in a variety of applications to stop a moving body without abrupt motion. To detect the distance between the vehicle and the barrier, an ultrasonic sensor is employed, which is less expensive and requires less hardware than other types of sensors now in use. For this system, we created an intelligent control approach. The approaches and findings we give are rather preliminary and require additional exploration. It would be beneficial to execute steady, trouble-free braking while also assisting in the evaluation of this safety-critical automobile braking system.

G.V. Sairam et.al [6] In this article, an ultrasonic sensor, which is less expensive and requires less hardware than other types of sensors currently in use, is utilised to estimate the distance between a vehicle and an obstacle. Using sequential samples of the determined distance, the relative speed of the vehicle with regard to the obstruction is estimated. A control system uses these values to determine the actions on both the accelerator and the brake.

P. Bhaskara et al. [7] According to this publication, the braking distance is shorter when the vehicle speed is lower and vice versa. Higher speeds are not tested because it is assumed that the rider will slow down in low or poor light conditions. Because the sensor detects obstacles and stops the car, it will be extremely useful when the driver is stressed and fatigued as a result of a lengthy trip.

Sumeet Bhardwaj ey.al [8] This publication describes how an autonomous emergency braking system minimises or reduces the severity of several types of crashes such as head-on collisions and pedestrian collisions. Ultrasonic sensors combined with stereo cameras aid in determining the distance between the vehicle and the object. These sensors are considerably less expensive than other types of sensors on the market.

Naveen Navudu et.al [9] The world's population is growing by the day, and as a result, so is the use of vehicles. Thousands of people are killed each year as a result of factors such as brake failure, drunk driving, late application of brakes, and so on. A sophisticated ultrasonic braking system is developed to mitigate these risks.

M. Rajyalakshmi et.al [10]. It explains how intelligent braking system has a high potential for preventing accidents and reducing the severity of those that do occur. People have increasing expectations of automobiles, which must be safer, smarter, and more pleasant. Implementation of such an advanced technology may be made mandatory, akin to wearing a seat belt, to reduce the likelihood of an accident.

Amol D. Jadhav et al. [11] In this journal, an ultrasonic sensor, which is less expensive and requires less hardware than other types of sensors currently in use, is utilized to estimate the distance between a vehicle and an obstacle. Using sequential samples of the determined distance, the relative speed of the vehicle with regard to the obstruction is estimated. A control system uses these values to determine the actions on both the accelerator and the brake.

G. Muthu Brindha et.al [12] A vehicle prototype is being built, which will be incorporated into an application for future vehicle installation. This technology will monitor and pinpoint the wounded person's geographical position and send an SMS alert to the nearest hospital. It is a completely automated system that locates the accident site and assists injured people in getting to the nearest hospital as soon as possible.

Dhivya P. et.al [13] To prevent wheel locking, the old approach employed a Bang-Bang or PID controller in the car's electronic control unit. Because the suggested system uses fuzzy logic to create the controller, the automobile will not experience jerks during heavy braking.

Eung Soo Kim et.al [14] To avoid an accident, the auto-braking system was designed in VHDL and built in FPGA. The technology was tested by mounting it on a tiny automobile. As part of the future generation of vehicle technology, we will replace an ultrasonic sensor with a radar sensor.

Vinod Handi et.al [15] The goal of this work was to create a low-cost automatic braking system. The proposed method could be used to avoid collisions in heavy-duty vehicles, automobiles used in city traffic, pedestrian crossings, and other situations. The system reacts accurately to a wide range of distance measurement values and may be expanded for long-distance distance measurement applications.

S. N. Sidek et.al [16] He stated that it is an efficient processor for regulating the intelligent braking system. The architecture allows for real-time control, and the on-board peripherals reduce the cost of additional components. The processor's performance can be increased if the software kernel has a certain fuzzy logic instruction set.

Niveditha P.R et.al [17] The suggested system's architecture is designed for a safe automobile braking system that uses ultrasonic sensors and a vehicle that requires less human attention. It uses radar, distance sensors, and a stereo multiple camera to enhance the system's ability to identify slowly moving objects in a disrupted environment. Experiments have shown that a combination method outperforms a feature-based technique.

Cirovic et.al [18] The proposed strategy for intelligent braking system control entails establishing appropriate deceleration levels for driving conditions and other influencing factors, selecting appropriate control input, and using a continuously learning mechanism to compare realised braking system performances with a model of brake operation.

Luciano Alonso et.al [19] An ultrasonic adaptive cruise control prototype for low speeds and short distances is designed, built, and tested, with an ultrasonic sensor measuring the distance between vehicles and estimating the relative speed. This technology can decrease injuries and collisions with pedestrians.

Dr. R. Naveen et.al [20] He presented a model for a collision avoidance system and a breakdown detection system in this paper. These interactive models are built into each vehicle system in order to eliminate the possibility of major accidents. These findings suggest several future research directions for developing more detailed models that take into account.

3. METHODOLOGY

We are employing an ultrasonic sensor with a range of 2 m to 4 m in this system. This sensor is attached to the front of the body and produces waves to analyse the vehicle's speed and distance from the impediment (vehicle) in front of them. These sensors provide real-time data to the microcontroller. In the system, a Hall sensor will be utilised to analyse the vehicle's speed with the microcontroller. Relay switches are used to trigger the actuator, which pulls the drag wire to operate the brakes. Relay switches are electromechanical switches that activate when an electric current flows through them. Sensors cause an electric current to flow. When the sensor detects an obstruction, it sends a signal to the MCU unit, which then transmits current to the switch.

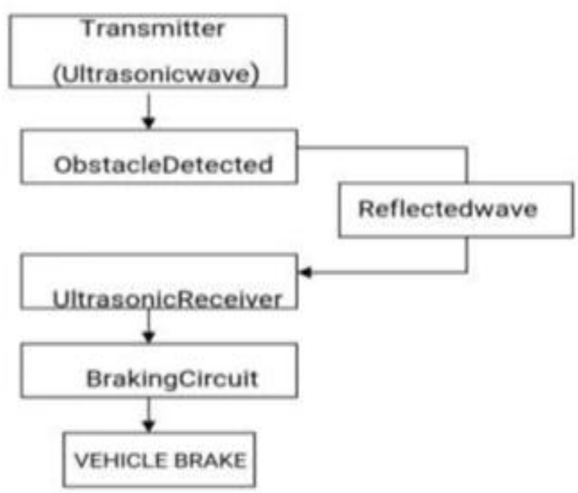

Fig 3.1 Methodology

4. DESIGN AND FRABRICATION

4.1 COMPONENTS:-

- Ultrasonic Sensor (transmitter and receiver)
- Motor drive
- Electric motor (DC gear motor)
- Servomotor

- Battery
- Aurduino
- Wheels

4.1.1 Ultrasonic Transmitter: Before the ultrasonic transmitting wave, there is a part which is an ultrasonic wave generator that functions to create the ultrasonic wave. In that part, there is a timing instruction means for generating an instruction signal for intermittently providing ultrasonic waves. This signal will send to an ultrasonic wave generator for generating ultrasonic waves based on the instruction signal from said timing instruction means (transform electrical energy into a sound wave). After an ultrasonic wave was produced, the ultrasonic transmitter transmits the ultrasonic waves toward a road surface to find out the obstacle. The range that obstacle detected is depends on the range of ultrasonic sensors used. It is shown in fig 4.1

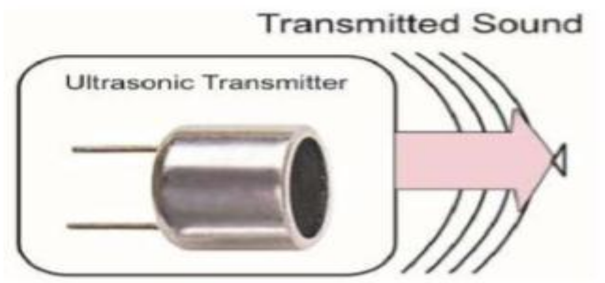

Fig 4.1 Ultrasonic transmitter

4.1.2 Ultrasonic receiver: Whenever the ultrasonic wave detects the obstacle, it produces a reflected wave. An ultrasonic receiver is employed for receiving the ultrasonic waves reflected from the paved surface obstacle to get a reception signal. There is an ultrasonic transducer that will transform back the sound wave into electrical energy. This signal amplified by an amplifier. The amplified signal is compared with a reference signal to detect components within the amplified signal thanks to obstacles on the paved surface. The magnitude of the reference signal or the amplification factor of the amplifier is controlled to take care of a continuing ratio between the types of the reference signal and therefore the average of the amplified signal. It is shown in fig 4.2

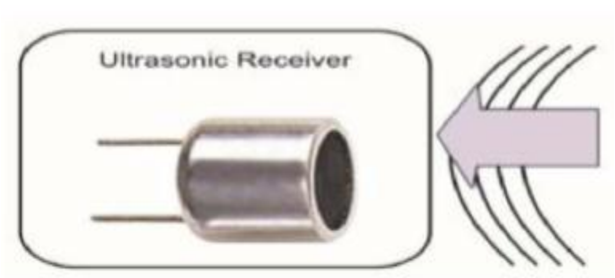

Fig 4.2 Ultrasonic receiver

4.1.3 DC GEAR MOTOR: A DC gear motor may be a fairly simple electric gear motor that uses electricity, gearbox, and magnetic flux to supply torque, which turns the motor. At its most simple, the DC gear motor requires two magnets of opposite polarity and an electric coil, which acts as an electric magnet. The repellent and attractive electromagnetic forces of the magnets provide the torque and cause the DC gear motor to turn. A gearbox is present just after the DC motor and a rotary shaft are connected to it, with the help of this DC gear motor setup the vehicle wheels can be rotated in this project. It is shown in fig 4.3

Fig 4.3 D C Gear motor

4.1.4 SERVOMOTOR: The output shaft of the servo motor is capable of traveling somewhere around 180 degrees. A normal servo motor is employed to regulate an angular motion between 0 and 180 degrees, and it's mechanically unable of turning any farther thanks to a mechanical stop built onto the most output gear. The angle through which the output shaft of the servo motor needs to travel is determined according to the nature of the signal given to the motor as input from the PIC. Because of the rotation of the servomotor in 180 degrees, the brakes can be applied and released through the given brake's mechanism. It is shown in fig 4.4

Fig 4.4Servomotor

4.1.5 Ardiuino: The Arduino Uno is a microcontroller board based on the atmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHZ ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions. It is shown in fig 4.5

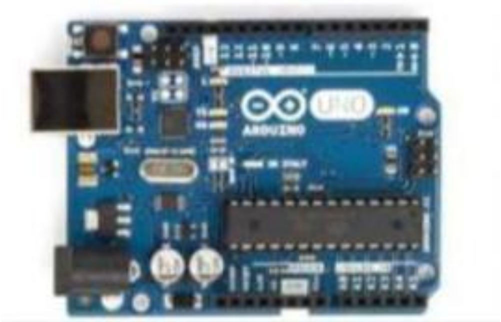

Fig 4.5 Ardiuino

4.2 FRABRICATION:

The fabrication of an automatic braking system using an ultrasonic sensor involves a series of steps, starting with the design of the circuit. The circuit design involves selecting the appropriate components such as an ultrasonic sensor, microcontroller, power supply, relay and resistors. Once the components have been selected, they are assembled together according to the circuit diagram. The power supply is connected to the circuit, followed by programming the microcontroller to control the automatic braking system. The system is then tested to verify its functionality, and finally, it can be installed in a vehicle and tested further to ensure proper operation in real-world conditions. It is shown in fig 4.6

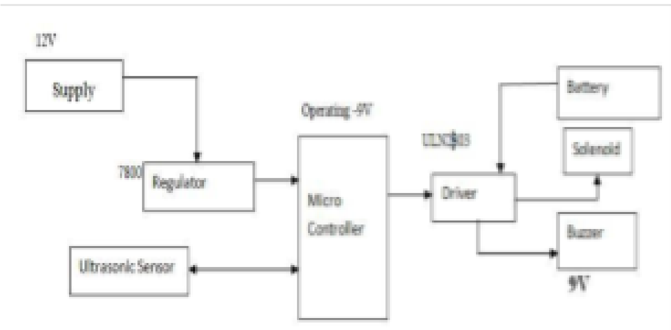

Fig 4.6 Circuit diagram

4.3 PROGRAM USED FOR AUTOMATIC BRAKING SYSTEM:

```
//ARDUINO OBSTACLE AVOIDING CAR//
// Before uploading the code you have to install the necessary library//
//AFMotor Library https://learn.adafruit.com/adafruit-motor-shield/library-install //
//NewPing Library https://github.com/livetronic/Arduino-NewPing//
//Servo Library https://github.com/arduino-libraries/Servo.git //
// To Install the libraries go to sketch >> Include Library >> Add .ZIP File >> Select the Downloaded ZIP files From the Above links //


#include <AFMotor.h>
#include <NewPing.h>
#include <Servo.h>

#define TRIG_PIN A0
#define ECHO_PIN A1
#define MAX_DISTANCE 200
#define MAX_SPEED 190 // sets speed of DC  motors
#define MAX_SPEED_OFFSET 20

NewPing sonar(TRIG_PIN, ECHO_PIN, MAX_DISTANCE);

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);
Servo myservo;

boolean goesForward=false;
int distance = 100;
int speedSet = 0;

void setup() {

  myservo.attach(10);
  myservo.write(115);
  delay(2000);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
}

void loop() {
 int distanceR = 0;
 int distanceL =  0;
```

```
 delay(40);

 if(distance<=15)
 {
  moveStop();
  delay(100);
  moveBackward();
  delay(300);
  moveStop();
  delay(200);
  distanceR = lookRight();
  delay(200);
  distanceL = lookLeft();
  delay(200);

  if(distanceR>=distanceL)
  {
   turnRight();
   moveStop();
  }else
  {
   turnLeft();
   moveStop();
  }
 }else
 {
  moveForward();
 }
 distance = readPing();
}

int lookRight()
{
   myservo.write(50);
   delay(500);
   int distance = readPing();
   delay(100);
   myservo.write(115);
   return distance;
}

int lookLeft()
{
   myservo.write(170);
   delay(500);
   int distance = readPing();
   delay(100);
   myservo.write(115);
   return distance;
   delay(100);
}

int readPing() {
  delay(70);
  int cm = sonar.ping_cm();
  if(cm==0)
  {
   cm = 250;
  }
  return cm;
}

void moveStop() {
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
  }

void moveForward() {

 if(!goesForward)
  {
   goesForward=true;
   motor1.run(FORWARD);
   motor2.run(FORWARD);
   motor3.run(FORWARD);
   motor4.run(FORWARD);
  for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2)
// slowly bring the speed up to avoid loading down the
batteries too quickly
   {
   motor1.setSpeed(speedSet);
   motor2.setSpeed(speedSet);
   motor3.setSpeed(speedSet);
   motor4.setSpeed(speedSet);
   delay(5);
   }
  }
}

void moveBackward() {
   goesForward=false;
   motor1.run(BACKWARD);
   motor2.run(BACKWARD);
   motor3.run(BACKWARD);
   motor4.run(BACKWARD);
  for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2) //
slowly bring the speed up to avoid loading down the
batteries too quickly
  {
   motor1.setSpeed(speedSet);
   motor2.setSpeed(speedSet);
   motor3.setSpeed(speedSet);
   motor4.setSpeed(speedSet);
   delay(5);
  }
}

void turnRight() {
  motor1.run(FORWARD);
  motor2.run(FORWARD);
```

```
 motor3.run(BACKWARD);
 motor4.run(BACKWARD);
 delay(500);
 motor1.run(FORWARD);
 motor2.run(FORWARD);
 motor3.run(FORWARD);
 motor4.run(FORWARD);
}
void turnLeft() {
 motor1.run(BACKWARD);
 motor2.run(BACKWARD);
 motor3.run(FORWARD);
 motor4.run(FORWARD);
 delay(500);
 motor1.run(FORWARD);
 motor2.run(FORWARD);
 motor3.run(FORWARD);
 motor4.run(FORWARD);
}
```

5. RESULT AND DISCUSSION

Automatic braking is one of the smart options which can be implemented in various applications for stopping a moving body without jerky motion. The previous research study clearly explains that Ultrasonic sensor and microcontroller action plays vital role in determining intelligent braking torque generated by brake actuation assembly. An ultrasonic sensor, cheaper and less demanding of hardware than other types of sensors presently used, such as the sensors based on computer vision or radar , is used to measure the distance between vehicle and the obstacle. The speed of the vehicle is estimated using RPM counter. These two quantities are used by the control system to calculate the actions of the brake, thus to adjust the speed in order to maintain a safe distance to prevent accidents. As ultrasonic sensors can detect any kind of obstacle, this system can also prevent collision of the vehicle with pedestrians, or can at least reduce the injuries occurring. Since the control system does not use the absolute speed to calculate the safety distance as done by the currently existing systems, the interaction with automotive electronics is limited to actions on the accelerator and brake. This matter, coupled with the fact of lower cost of ultrasonic sensors compared with other kinds of sensors, could facilitate the application and mounting of the system in many low-end vehicles, helping to improve comfort and safety and offer a hassle free driving experience at a reduced cost.

Braking system and use that to define the basic braking control problem and have developed automatic control method for this system. It would be useful to perform stable, hastle free braking and also help to evaluate this safety-critical automotive braking system. While the model that we have developed has proven to be quite adequate for the development of microcontroller system that has been evaluated on a vehicle, it would be valuable to evaluate the developed controllers in the field. This would force us to take a very careful look at the requirements for real-time implementations of the automatic braking system. Our present work realized us that implementation of this smart system can feasible and of real time use.

The proposed system is based on microcontroller technology for collecting data related to speed and transmitting it through a transceiver to a base station that analyzes the transmitted data and takes appropriate decisions related to speed limit and control requirements. This experience has encouraged us to learn more about upcoming trends and technologies and thereby adding our bumble knowledge and experience about the vast ocean of electronic.

A revolutionary invention is made in the field of brakes. The Electromagnetic brakes are excellent replacement for conventional automobile brakes. The use of Electromagnetic brakes can be done for lighter vehicles also. With some modification, a regenerative braking system can be equipped with the Electromagnetic brakes. The Electromagnetic brakes are the future of automobile brakes. The intelligent braking system provides a total safety in the negligence of the driver in the emergency thus saving reduction in loss of precious human lives and properties. Thus, there is no doubt that this system becomes the future braking system for the automobiles.

The relative speed of the vehicle as per the impediment is assessed utilizing back to back obstacle of the separation computed, these two amounts are utilized by the control framework to ascertain the activities on both the quickening agent and furthermore the brake, in this manner to alter the speed so as to keep up a protected separation to anticipate mischance. As ultrasonic sensors can identify any sort of snag, this framework can likewise anticipate impact of the vehicle with walkers, or can in any event diminish the wounds happening. Since the control framework does not utilize the total speed to ascertain the security separate as done by the present existing frameworks, the collaboration with car gadgets is constrained to activities on the quickening agent and brake. This issue, combined with the reality of lower cost of ultrasonic sensors contrasted and different sorts of sensors, could encourage the application and mounting of the framework in some low-end vehicles, enhancing solace and wellbeing and offer a bother free driving background at a lessened cost.

6. CONCLUSION

The automatic braking system using ultrasonic sensors is a highly effective and efficient solution for preventing accidents and improving road safety. This system works by continuously monitoring the distance between the vehicle and obstacles using ultrasonic sensors, and if the distance is below a certain threshold, the brakes are automatically applied to prevent a collision. The use of ultrasonic sensors allows for a fast and accurate measurement of the distance between the vehicle and obstacles, ensuring that the brakes are applied in time to prevent accidents. Additionally, the automatic braking system is relatively simple and cost-effective to implement, making it accessible to a wide range of vehicles. Overall, the automatic braking system using ultrasonic sensors has the potential to significantly reduce the number of road accidents and improve the safety of drivers, passengers, and other road users.

One of the clever solutions that may be used in many applications to stop a moving body without abrupt motion is automatic braking. According to the results of a prior study, a microcontroller's and an ultrasonic sensor's actions are crucial in deciding the intelligent braking torque produced by the brake actuation assembly. The distance between the vehicle and the barrier is measured using an ultrasonic sensor, which is less expensive and less hardware-intensive than other types of sensors already in use, such as those based on computer vision or radar. The RPM counter is used to assess the vehicle's speed. The control system uses these two values to determine how to use the brakes and modify the speed to maintain a safe distance from obstacles.

REFERENCES

[1] Hemant Suryawanshi and Rohan Sarode are proposed "AUTOMATIC BRAKING SYSTEM" International Research Journal of Engineering and Technology .IRJET, Volume: 08 Issue: 04. e-ISSN Online: 2395-0056 .page no: 2047-2050, Apr 2021

[2] J.V.Sai Ram,K.M.S.V.Manikanta, G.Pavanth, B.Jagadeep and Dr. B.Raghu Kumar "Automatic Braking System Using Ultrasonic Sensor" International Journal of Innovative Science and Research Technology. IJISRT, Volume 2, Issue 4, ISSN No: - 2456 - 2165,page no: 398-404.April– 2017

[3] Manju Kumari, Shambhu Kumar, Anand Kumar and Nikita Kumari "Intelligent Braking System Using Ultrasonic Sensor" International Journal of Science and Research, IJSR. Volume 9, Issue 11, ISSN: 2319-7064,page no: 823-827 November 2020

[4] Shailendra Singh, Yogesh Jangid, Sahil Gupta and Virendra Solanki "Smart Braking System Using Ultrasonic Sensor and Actuator" International Research Journal of Engineering and Technology, IRJET, Volume: 06, Issue: 06, e-ISSN: 2395-0056,page no: 90-92, June 2019

[5] Mr. Tushar Kavatkar, Mr. Harshal Salvi and Mrs. Minal Rahate "Design and Analysis of Intelligent Braking System"International Journal of Engineering Development and Research,IJEDR, Volume 5, Issue 1 ,ISSN: 2321-9939 ,page no: 119-131,2017

[6] G.V. Sairam, B. Suresh, CH. Sai Hemanth and K. Krishna sai "Intelligent Mechatronic Braking System" International Journal of Emerging Technology and Advanced Engineering,IJETAE, , Volume 3, Issue 4, ISSN 2250-2459,page no: 100-105, April 2013

[7] Bhaskara. P, Eriki Ananda. K and Venkataramana. V "Arduino Based Automated Braking Control System to Enhance the Safety at Low Light and Long Stressed Drive Conditions" International Journal of Modern Studies in Mechanical Engineering,IJMSME, Volume 4, Issue 2, ISSN 2454-9711,page no:1-6, 2018

[8] Sumeet Bhardwaj, Ashwani Gulati, Kashish Goyal and Vivek Vij "AUTOMATIC EMERGENCY BRAKING SYSTEM (A SYSTEM FOR DECREASED HUMAN EFFORT)" Conference Paper, Research gate, ISSN 357569615,page no: 1-5, January 2022

[9] Naveen Navudu, Aravind Ramapatruni, Jagadeesh Polaki, Jaya Surya Navagana and Srihari Palli "Automatic Breaking System Using Ultrasonic Sensor" ICONIC RESEARCH AND ENGINEERING JOURNALS, IRE, Volume 5, Issue 2 , ISSN: 2456-8880,page no: 30-35,AUG 2021

[10] M. Rajyalakshmi, B. Kranthi Kumar, A. Krishna Vaibhav and Md Arief Khan "Design and Fabrication of Intelligent Mechatronic Braking System" International Journal of Science Technology & Engineering, Volume 4 ,Issue 10,ISSN (online): 2349-784X,page no: 102-107, April 2018

[11] Jadhav Amol D., Chavhan Tushar V., Sonawane Ravindra F., Thombre Amol V.and Aher Sandip S "INTELLIGENT REVERSE BRAKING SYSTEM "International Research Journal of Engineering and Technology,IRJET, ,Volume: 05 Issue: 02, e-ISSN: 2395-0056,page no: 148-152, Feb-2018

[12] G.Muthu Brindha, K.K.Karishma, A. Mukhesh, K.K.Nilesh Veeramani, M.Mohamed Faizal, Dr.B.Maruthi Shankar and B.Vidhya "Accident Prevention By Automatic Braking System And Multisensors" International Journal of Advanced Science and Technology , IJAST, Vol. 29, No. 8s, ISSN: 2005-4238 ,page no: 873-897,2020

[13] Dhivya P and Murugesan A. "Intelligent Car Braking System with Collision Avoidance and ABS" International Journal of Computer Applications, IJCA, ISSN: 0975 – 8887.page no 16-20,2015

[14] Eung Soo Kim "Fabrication of Auto-Braking System for Pre-Crash Safety Using Sensor" International Journal of Control and Automation ,IJCA, Vol. 2, No. 1,page no: 41-48 March, 2009

[15] Vinod Handia, S. Jeyanthib and A. Giridharan "Development of Automated Braking System for Collision Avoidance of Vehicles" International Journal of Vehicle Structures & Systems, IJVSS, ISSN: 0975-3060,page no: 93-97,2018

[16] S. N. Sidek and M. J. E. Salami "HARDWARE IMPLEMENTATION OF INTELLIGENT BRAKING SYSTEM" First International Conference on Mechatronics,ICOM,Page no:600-604

[17] Niveditha.P.R and S.Gowri "Collision Warning System using Ultrasonic Sensors and Automatic Brake System" Association of Computer Electronics and Electrical Engineers,ACEEE, DOI: 02.ITC.2014.5.106,page no: 419-424.2014

[18] Cirovic, Velimir and Aleksendric, Dragan "INTELLIGENT CONTROL OF AUTOMOTIVE BRAKING SYSTEM",Research gate, F2008-SC-046 , 03 January 2016

[19] Luciano Alonso, Vicente Milanés , Carlos Torre-Ferrero, Jorge Godoy, Juan P. Oria and Teresa de Pedro "Ultrasonic Sensors in Urban Traffic Driving-Aid Systems" Sensors, doi:10.3390/s110100661,page no: 661-673, 11 January 2011

[20] Dr. R. Naveen, S. A. Sivakumar, D. Loganathan, V. Anushya, V. Devi, Glady A, Joy Vivilia and R. Madhupriya "Side Sweep Accidents and Jamming Control Methods for Vehicles" International Journal for Research in Applied Science & Engineering Technology,Researsh gate, Volume 6, Issue III, ISSN: 2321-9653,page no: 466-472, March 2018