AUTOMATIC BRAKING SYSTEM

Anuradha Deshmukh[1], Shruti Zade[2], Bhushan Maind[3], Harsh Mashakhetri[4]

Bachelor of Engineering, Dept. of Electronics and telecommunication Engineering, Government college of Engineering, Chandrapur, Maharashtra, India

Abstract :

An automatic Braking system is mostly an effective mechatronic system that has an Ultrasonic wave emitter provided on the front portion of a car producing and emitting Ultrasonic waves. An Ultrasonic receiver is additionally placed on the front portion of the car operatively receiving a reflective Ultrasonic wave signal. The reflected wave (detected pulse) gives the space between theobstacle and therefore the vehicle.

In this project, we will be using an ultrasonic sensor ,an Arduino Uno, an L298N motor driver, a DC motor, and a servo motor to develop an automatic braking system. The speed of a DC motor can be controlled by changing its input voltage. A widely used technique to accomplish this is Pulse Width Modulation (PWM). PWM is a technique in which the average value of the input voltage is adjusted by sending a series of ON-OFF pulses.

Key Words: Effective mechatronic system, Ultrasonic waves,Microcontroller

1. INTRODUCTION

Automatic braking may be a safety technology that automatically activates the vehicle's brake, to the point, when necessary. Systems can vary from pre-charging brakes to slowing the vehicle to reduce damage. Nowadays, some advanced and updated systems completely take over and stop the vehicle before a collision happen. The precise capabilities of their car's automatic braking system. Regardless of a vehicle's autonomous technologies, drivers should remain conscious of their surroundings and maintain control in the least times. the automatic braking or brake assist is an integral component of crash avoidance technologies, including front crash prevention systems, back over prevention systems, and cross-traffic alert systems. Each automaker may have a special name for such technologies, but the rock bottom line is that the brake assistis supposed to attenuate accidents.

An automatic braking system is an important and crucial part of safe technology for automobiles. It is an advanced system, specifically designed to either prevent a possible collision or reduce the speed of the moving vehicle, prior to a collision with another vehicle, pedestrian, or an obstacle ofsome sort. These systems are a combination of sensors, such as ultrasonic to detect for possibleobjects in front of the vehicle, and then use brake control to prevent collision if the object is in fact, detected. Automaticbrakes are one of many car safety features and are often integrated with other technology, such as pre-collision systems and adaptive cruise control.

2. LITERATURE REVIEW

Automatic braking systems (ABS) have been the subject of extensive research and development over the past few decades. The purpose of this system is to prevent or reduce the severity of collisions by automatically applying the brakes when the system detects an imminent collision.

Several Studies have evaluated the effectiveness of ABS in reducing the number and severity of collisions. A study by the National Highway Traffic Safety Administration (NHTSA) foundthat vehicles equipped with ABS were 31% less likely to be involved in fatal crashes

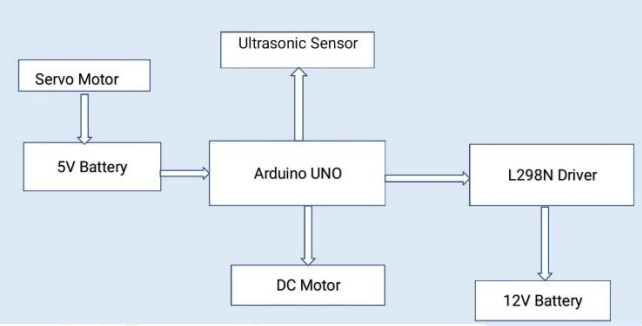
Then vehicles without ABS. Another study conducted by the Insurance Institute for Highway Safety (IIHS) found that vehicles equipped with forward collision warning (FCW) and autonomous emergency braking (AEB) reduced rear-end crashes by 40%.

Research has also been conducted on the development of ABS technology. A study by

M. I. Saripalle et al. evaluated the performance of an adaptive ABS algorithm in various drivingscenarios. The results showed that the adaptive algorithm improved the performance of theABS system in comparison to a fixed-gain algorithm.

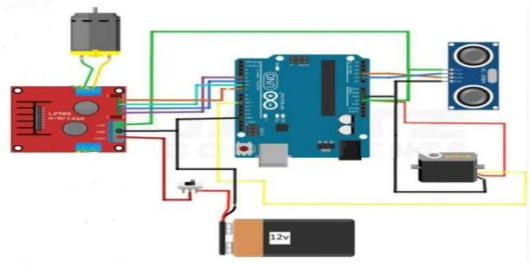
Additionally, research has been conducted on the development of ABS for specific applications, such as off-road vehicles and motorcycles. A study by S. T. Cherian et al. evaluated the effectiveness of ABS in reducing the stopping distance of off-road vehicles. The results showed that the ABS system reduced the stopping distance by up to 24% in some scenarios. Another study by A. J. Wang et al. evaluated the performance of ABS on motorcycles. The results showed that the ABS system reduced the stopping distance

2.WORKING OF AUTOMATIC BRAKING SYSTEM



Each carmaker has its own automatic braking system technology, but all of them believe some sort of sensor input. The ultrasonic sensor contains transmitter and receiver units, and the ultrasonic transmitter detects the obstacle by transmitting the signals and reflects back to the ultrasonic receiver unit. The ultrasonic sensor input is then used to determine if there are any objects present in the path of thevehicle. If an object is detected, the system can then determine if the speed of the vehicle is bigger than the speedof the thing ahead of it.

The ultrasonic sensor is used to detect an obstacle or an object in the path of the vehicle. The sensor sends out ultrasonic waves which bounce off the object and are received back by the sensor. The time taken for the waves to return is used to calculate the distance between the sensor and the object.



The Arduino Uno receives the distance information from the sensor and sends signals to the L298N motor driver. The motor driver controls the DC motor, which is attached to the wheels of the vehicle. When an obstacle is detected, the motor driver applies the brakes by stopping the DC motor.

The servo motor is used to control brake lever . The servo motor receives signals from the Arduino Uno to control the brake lever .The DC gear motor rotates uniformly at a set rpm and gradually decreases speed while automatically breaking the system through servomotor braking mechanism phenomena.

3.COMPONENT IN AUTOMATIC BRAKING SYSTEM

- There is mainly some component used in
- **Automatic braking system**:
- **Ultrasonic sensors (transmitter and receiver)**
- **L298N motor driver**
- **Electric motor (DC gear**
- **motor)**
- **Servomotor**
- **Jumper wires**
- **12v battery**
- **Braking system**

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 obstacle. The range that obstacle detected is depends on the range of ultrasonic sensors used.

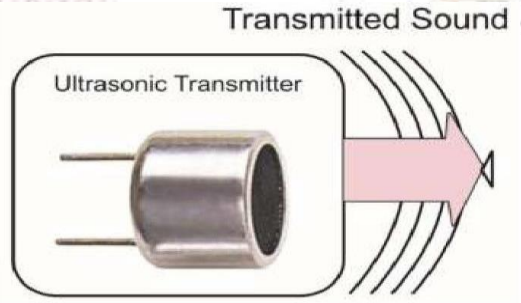


Fig -: Ultrasonic Transmitter

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 isan ultrasonic transducer that will transform

Fig -: Ultrasonic Receiver

back the soundwave into electrical energy. This signal amplified by an amplifier. The amplified signal is compared with a referencesignal to detect components within the amplified signal thanks to obstacles on the paved surface. The magnitude ofthe 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.

1.3. ARDUINO UNO

The Arduino Uno is poplar microcontroller board based on the ATmega328P microcontroller chip. It was released in 2010and since become one of the most widely sed board in the Arduino family.

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.

Fig -: Arduino Uno

Here are some key details about the Arduino Uno:

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz

1.4 L298N Motor Driver:-

The L298N is a popular motor driver IC (integrated circuit) that can control two DC motors or a single stepper motor. It is commonly used in robotics and other motor control applications.

Fig -: L298N Motor Driver

The L298N can handle a maximum current of 2A per channel and a voltage range of 7V to 46V. It has two H-bridge circuits, which allow it to control the direction and speed of the connected motors. The H-bridge circuit can switch the polarity of the motor connections to reverse the direction of rotation, and it can vary the voltage applied to the motor to control its speed. To use the L298N motor driver, you need to provide power to the VCC and GND pins. You can then connect the motor power supply to the motor power input pins, and connect the motor to the motor output pins. The control signals for the L298N can be provided by a microcontroller or other digital circuitry. There are four input pins for controlling the motor direction and speed: IN1, IN2, IN3, and IN4.

1.5 DC GEAR MOTOR:

A DC gear motor may be a fairly simple electric gear motorthat 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 anelectric coil, which acts as an electric magnet. The repellent and attractive electromagnetic forces of the magnets providethe 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

Fig -: DC Motor

1.5 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 180degrees, and it's mechanically unable of turning any fartherthanks 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 thesignal 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

Fig -: Servo Motor

A servo motor is a type of rotary actuator that can precisely control the position, velocity, and acceleration of a shaft or other mechanical device. It is widely used in robotics, automation, and other industrial applications.
A servo motor typically consists of a DC motor, a gear train, a position sensor, and a control circuit. The control circuit receives a control signal from an external device, such as a microcontroller, and uses the position sensor to adjust the motor shaft position to match the desired position specified by the control signal. The position sensor in a servo motor is usually a potentiometer or an encoder that provides feedback on the motor shaft position. The control circuit compares the feedback signal with the desired position signal and adjusts the motor speed and direction to minimize the error.
Servo motors can rotate over a limited range of motion, usually between 180 and 360 degrees, and can maintain a precise position within a few degrees. They can also provide high torque at low speeds, which makes them suitable for applications that require precise control of position and speed, such as robotics, CNC machines, and camera gimbals.

4. Advantages:

1. Increased safety: ABS can help prevent accidents by automatically applying the brakes to avoid a collision, especially in emergency situations.
2. Better control: ABS can help the driver maintain better control of the vehicle during sudden braking, which can reduce the risk of skidding or losing control.
3. Shorter stopping distance: ABS can reduce the stopping distance of a vehicle, which can be especially helpful in wet or slippery conditions.
4. Reduced wear and tear: ABS can reduce the wear and tear on the brakes by
preventing lock-ups, which can extend the life of the brake pads and rotors.

5.Disadvantages:

1. Cost: ABS systems can be expensive to install and maintain, which can increase the cost of the vehicle.
2. Maintenance: ABS systems require regular maintenance to ensure proper functioning, which can be
an added expense for the owner.
3. Complex system: ABS systems are complex and require advanced technology, which can increase the risk of malfunction or failure.
4. Reliance on technology: Some drivers may become overly reliant on ABS and may not be prepared to handle emergency situations if the ABS fails or malfunctions

6. CONCLUSION :

This paper presents the implementation of an Automatic Braking System for forwarding Collision Avoidance, intended to use in vehicles where the drivers may not brake manually,but the speed of the vehicle is often reduced automatically thanks to the sensing of the obstacles.
an ultrasonic sensor, an Arduino Uno, an L298N motor driver, a DC motor, and a servo motor. The system is able to detect an obstacle in the path of the vehicle and apply the brakes to prevent a collision. With further improvements, this system can be developed into a fully functional automatic braking system for vehicles.

7. References :

E. Coelingh, A. Eidehall and M. Bengtsson, "Collision Warning with Full Auto Brake and Pedestrian Detection a practical example of Automatic Emergency Braking,"
13th International IEEE Conference on Intelligent
[1] Transportation Systems, Funchal, 2010, pp. 155-160.
[2] Neil R. Storey, "Safety Critical Computer Systems,", Addison- Wesley Longman Publishing Co., Inc., Boston, MA, USA, ISBN 0201427877, 1996.
[3] Hasan Öktem, Ilyas Uygur, Murat Çevik, "Design, construction and performance of a novel brake pad friction tester," Measurement, ISSN 0263-2241, vol. 115, pp. 299-305, 2018.
[4] Kan Shimazaki, Tasuku Ito, Ai Fujii, Toshio Ishida, "The public's understanding of the functionality and limitations of automatic braking in Japan," IATSS Research, ISSN 0386-1112, vol. 42, issue 4, pp. 221-229, 2018.
[5] Jessica B. Cicchino, "Real-world effects of rear automatic braking and other backing assistance systems," Journal of Safety Research, ISSN 0022-4375, vol. 68, pp. 41-47, 2019.
[6] Jingliang Duan, Renjie Li, Lian Hou, Wenjun Wang, Guofa Li, Shengbo Eben Li, Bo Cheng, Hongbo Gao, "Driver braking behaviour analysis to improve autonomous emergency braking systems in typical Chinese vehicle-bicycle conflicts," Accident Analysis & Prevention, ISSN 0001-4575, vol. 108, pp. 74-82, 2017.

[7] Hiroshi Ohno, Toshihiko Suzuki, Keiji Aoki, Arata Takahasi, Gunji Sugimoto, "Neural network control for automatic braking control system," Neural Networks, ISSN 0893-6080, vol. 7, Issue 8, pp. 1303- 1312, 1994.

[8] R. Isermann and M. Schorn and U. Stählin, "Anticollision system PRORETAwith automatic braking and steering," Vehicle System Dynamics, Taylor & Francis, vol. 46, sup1, pp. 683-694, 2008.
[9] Joshua Pérez, Fernando Saco, Vicente MI lanes, Antonio Jiménez, Julio C. Diaz and Teresa de Pedro, "An RFID based Intelligent Vehicle speed controller using active traffic signals," SENSORS, vol. 10, issue 06, pp. 15872-5888; doi: 10.3390/s100605872, 2010.
[10] Van NE‟s. N; Houtenbos. M; van SC Hagen. I, „Improving Speed behavior: The Potential of In-Car Speed Assistance and Speed Limit Credibility," IET Intel. Transp. Syst. vol. 2, pp. 323-33, 2008
[11] MI lanes, V. Onieva, E. Perez, J. De Pedro, T. Gonzalez, C. "Control of Velocidad Adaptativo para Entornos Urbanos Congestionados," Rev. Iberoam, automat. Informat. Ind., pp. 66-73, 20

.