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Automatic Braking System

Abstract: - With the proliferation of vehicles and the integration of technology into daily transportation, ensuring road safety has become paramount. Traffic accidents, often resulting in substantial damage and casualties, persist as a global concern. The Automatic Braking System (ABS) stands as a pivotal safety innovation adopted by vehicle manufacturers worldwide. This paper explores the significance and functionality of ABS in preventing wheel lock-up during braking, thereby enabling drivers to maintain steering control. Through an examination of ABS technology, its effectiveness, limitations, and potential advancements, this research aims to contribute to the ongoing discourse on enhancing road safety measures in the modern automotive landscape.

Keywords: ARDUINO, Automatic Braking System, Buzzer, LED, Ultrasonic sensor.

I. INTRODUCTION

As the number of vehicles on the road continues to increase, driving has become an integral aspect of daily life for a majority of individuals [1]. The evolution of technology has undoubtedly facilitated faster and more convenient travel; however, it has also introduced new challenges [2]. The escalation of speed, if left unchecked, significantly heightens the risk of traffic accidents, resulting in extensive damage and loss of lives. Globally, a staggering number of individuals are either killed or injured in traffic mishaps annually, underscoring the urgent need for robust safety measures in modern transportation. Among these measures, the Automatic Braking System (ABS) stands out as a critical safety innovation embraced by vehicle manufacturers worldwide. By preventing wheel lock-up during braking, ABS empowers drivers to maintain essential steering control, thereby mitigating the severity of potential accidents [3]. This paper delves into the importance, functionality, and implications of ABS technology, aiming to contribute to the ongoing discourse on enhancing safety standards within the contemporary automotive landscape [4] [5].

II. LITERATURE REVIEW:

ABS was initially launched in the 1960s and has since become extensively used in contemporary cars due to its ability to avoid skidding and preserve steering control during emergency braking conditions. ABS has seen tremendous advancements in response speed, dependability, and safety features throughout the years [1] [2] [4]

"Development of an Automatic Braking System for Emergency Situations Using Stereo Vision Sensors and a Fuzzy Logic Controller" by S. I. Kim, et al. - This paper proposes an automatic braking system that uses stereo vision sensors and a fuzzy logic controller to detect and respond to emergencies [1].

"Design and Implementation of an Automatic Braking System Using Ultrasonic Sensors" by R. K. Rana, et al. - This paper presents the design and implementation of an automatic braking system using ultrasonic sensors to detect obstacles and control the vehicle's speed [2].

"Automated Braking System: An Overview of the Current Technologies and Future Trends" by J. D. Kim and S. W. Lee - This paper provides an overview of current technologies and future trends in automated braking systems, including the use of sensors, algorithms, and communication networks [3].

"A Review on Development of Advanced Driver Assistance Systems with Focus on Automatic Braking System" by S. Khan and N. J. Ahn - This paper reviews the development of advanced driver assistance systems (ADAS) with a focus on automatic braking systems, including the history, benefits, and challenges of these systems [4].

"Simulation and Experimental Study of an Automatic Braking System Using a Fuzzy Controller" by J. Wang, et al. - This paper presents a simulation and experimental study of an automatic braking system using a fuzzy controller to improve the accuracy and reliability of the system [5].

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III. Problem Statement

Despite the safety precautions used by car manufacturers, road accidents continue to be a serious worry worldwide. Most of these incidents are the result of human mistakes, such as speeding or inattentive driving. As a result, enhanced safety measures are required to assist avoid accidents and mitigate the severity of their repercussions [6].

IV. Proposed System

One such safety element that has been found to be beneficial in lowering the likelihood of accidents is the Automatic Braking System (ABS). However, most ABS systems on the market are costly and only accessible in high-end cars. As a result, a low-cost ABS system that can be installed into any vehicle to increase its safety is required [7] [8].

V. Working Of ABS System

The Automatic Braking System (ABS) is intended to keep the vehicle from collapsing. The ultrasonic sensor-based technology operates by continually assessing the distance between the vehicle and any obstacles in front and behind it. The technology is meant to function in two modes: regular driving and emergency braking [9] [10].

The ultrasonic sensor sends out ultrasonic waves in regular driving mode and measures the time it takes for them to bounce back off an obstruction in front of the car. The distance between the vehicle and the obstacle is estimated and shown on the Nokia Display 5110 LCD based on this time measurement [10].

If the distance between the vehicle and the obstruction falls below a specified threshold when in emergency braking mode, the ABS system will activate to slow down the speed of the DC motor, as well as the buzzer and LED to inform the driver [8] [4] [10].

The Bluetooth module HC05 enables wireless connection between the ABS and a mobile device, allowing for remote system monitoring and control. The mobile device may be used to choose between driving modes such as Normal, Reverse parking, and Neutral [2] [11].

Normal driving mode: The car travels in forward direction this mode [10].

Reverse parking mode: In this mode, cars go backward, which is usually useful while parking [10].

The car is in a stable state when in neutral mode [10].

Overall, the ABS with an ultrasonic sensor adds an extra layer of protection to the driver and helps prevent accidents by allowing the car to stop swiftly in an emergency [1] [10].

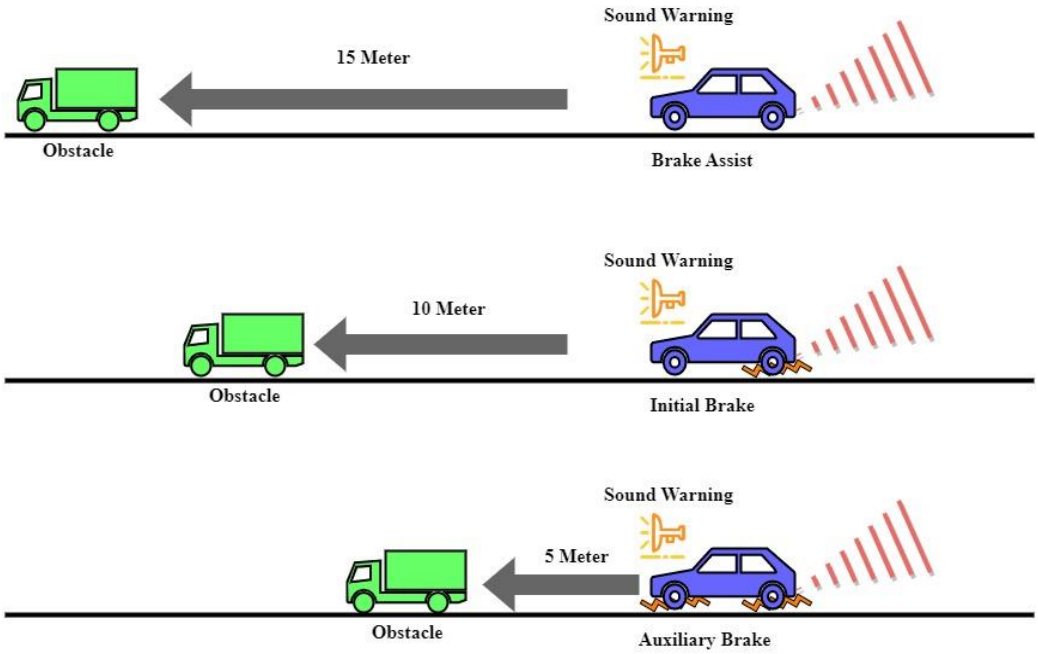


Figure 1. Working of ABS System

VI. SYSTEM DESIGN

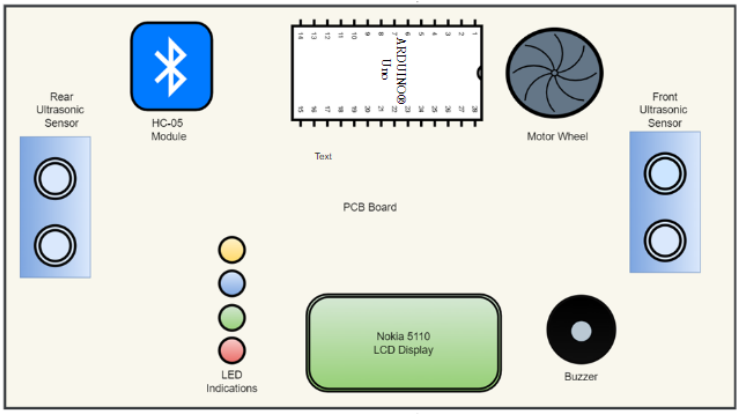
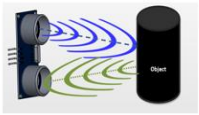
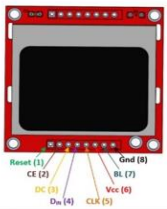


Figure 2. System Design

Choice of Hardware

Table 1: Hardware

ARDUINO UNO	
Ultrasonic sensor	
Nokia Display 5110 LCD	
Bluetooth Module HC-05	
Motor Driver	
DC Motor	
Buzzer	
LED	

VII. IMPLEMENTATION

Hardware Implementation

1. Block Diagram

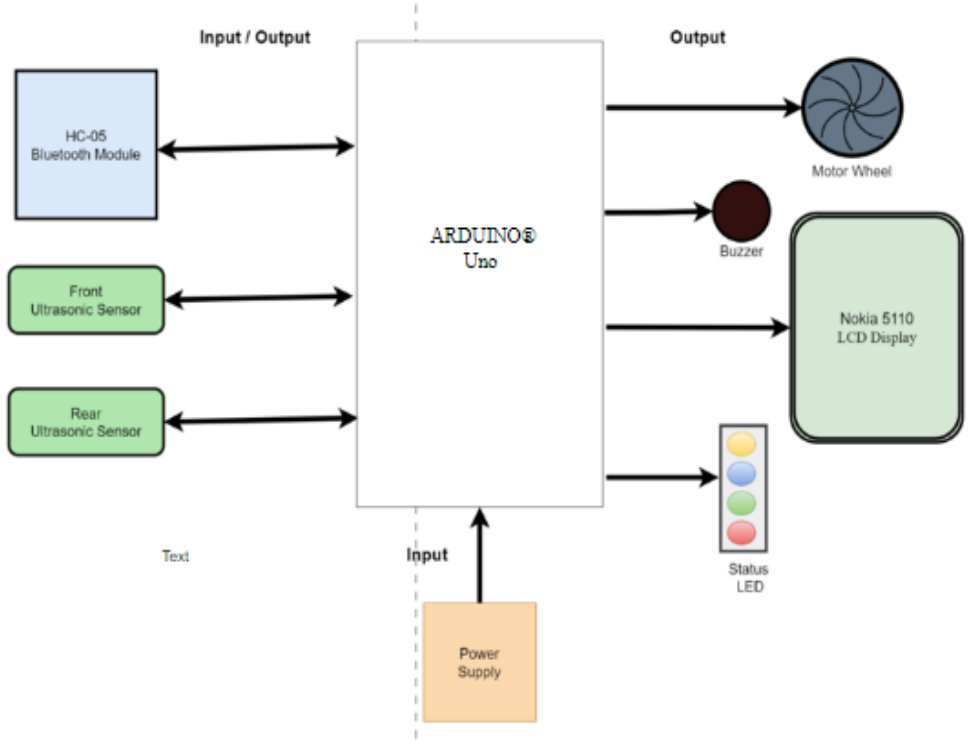


Figure 3. Block Diagram

For this system below pins of ARDUINO are used:
Bluetooth module HC-05 [1] [10]:
Rx pin is defined as Digital Input from ARDUINO Pin no.PD0
Tx pin is defined as Digital Output from ARDUINO Pin no PD1
Ultrasonic sensor HC-SR-04 [3] [10]:
Trigger_1 pin is defined as Digital Input from ARDUINO Pin no. PD2
Echo_1 pin is defined as Digital Output from ARDUINO Pin no. PD3
Trigger_2 pin is defined as Digital Input from ARDUINO Pin no. PD4
Echo_2 pin is defined as Digital Output from ARDUINO Pin no. PD5
Nokia LCD Display 5110 [5] [10]:
SCLK pin is defined as Digital Output from ARDUINO Pin no. PC5
DIN pin is defined as Digital Output from ARDUINO Pin no. PC1
DC pin is defined as Digital Output from ARDUINO Pin no. PC2
CS pin is defined as Digital Output from ARDUINO Pin no. PC3
RST pin is defined as Digital Output from ARDUINO Pin no. PC6
Buzzer [10]:
Buzzer pin is defined as Analog Output from ARDUINO Pin no. PC0
Warning LED [10]:
Led Out pin is defined as Digital Output from ARDUINO Pin no. PD1
Mode indicator LED [2] [10]:
Drive Modeled pin is defined as Analog Output from ARDUINO Pin no. PB5
Reverse Modeled pin is defined as Analog Output from ARDUINO Pin no. PD5
Neutral Modeled pin is defined as Analog Output from ARDUINO Pin no. PD4
Motor Driver [4] [10]:
MotorPin1 pin is defined as Digital Output from ARDUINO Pin no. PD2
MotorPin2 pin is defined as Digital Output from ARDUINO Pin no. PD3

Motor Driver [10]:
MotorPin1 pin is defined as Digital Output from ARDUINO Pin no. D2

Circuit Diagram

We created this circuit diagram in the open-source platform that is EasyEDA. EasyEDA is a web-based software platform for designing, simulating, and sharing electrical circuit designs [10] [12].

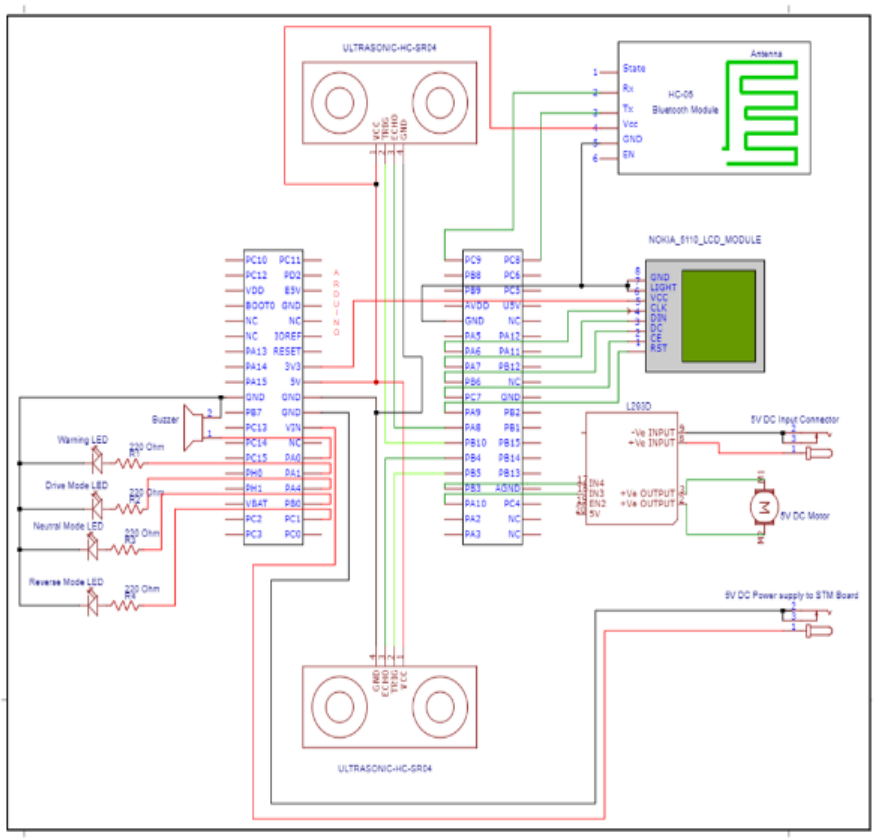


Figure 4. Circuit Diagram

Steps to draw circuit diagram –

1. Identify the components: Begin by identifying all the components and their corresponding symbols in the circuit diagram.
2. Identify the power source and how it is linked to the rest of the components.
3. Follow the connections between the components to learn about the flow of current and how the components interact with one another.
4. Voltage and current values: Confirm that the voltage and current values provided in the schematic are within the safe operating range of the components.
5. Determine how the ground connection is linked to the components.
6. Control logic: Determine the circuit diagram's control logic and how it interacts with the other components.
7. Identify the protective devices in the circuit diagram, such as fuses, circuit breakers, and overvoltage protection devices.
8. Signal processing: Locate any signal processing or filtering components, such as amplifiers, filters, or signal conditioning circuits, in the circuit design.
9. Testing and verification: Once the circuit diagram has been completed, it should be tested and confirmed to verify that it functions as planned [13] [10].

FLOW CHART

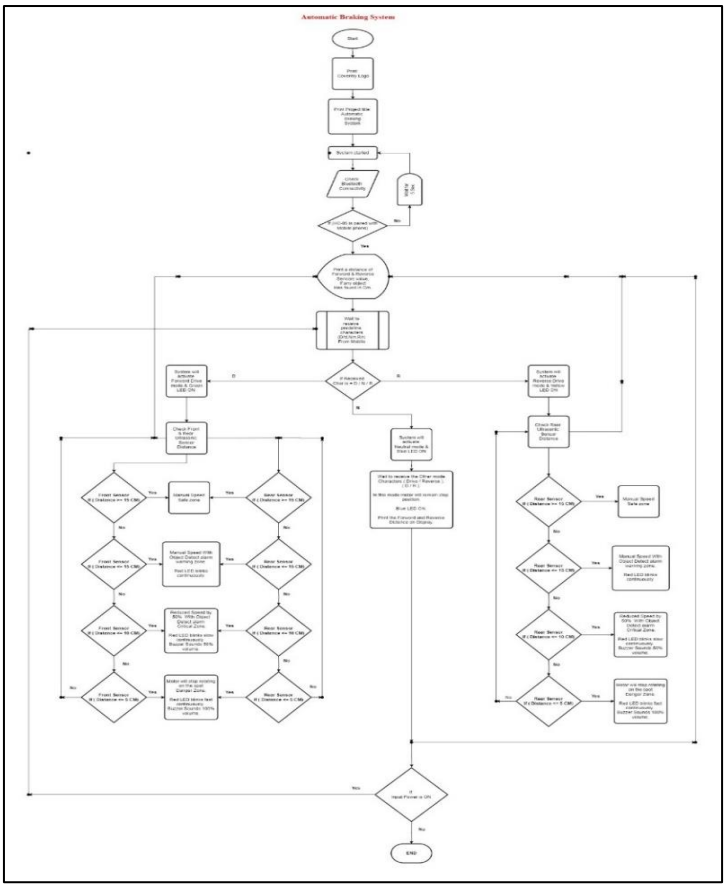


Figure 5. Flow Chart

VIII. TESTING AND EVALUATION

Table 2: Test Summary

Sr no.	Test Case code	Description of test case	Result
1	Test Case_1	When System is turn On Initially, the welcome message is displayed and after that the image of vehicle is displayed on the LCD screen. The vehicle is in still motion and the forward & reverse sensor readings are displayed above the screen	PASS
2	Test Case_2	Mode = Neutral (N).In neutral mode the vehicle mode is indicated by neutral indicating led on system.	PASS
3	Test Case_3	Mode = Drive (D). Distance of obstacle <= 5 cm in front of forward sensor.	PASS
4	Test Case_4	Mode = Drive (D). Distance of obstacle <= 10 cm in front of forward sensor.	PASS
5	Test Case_5	Mode = Drive (D). Distance of obstacle <= 15 cm in front of forward sensor.	PASS
6	Test Case_6	Mode = Drive (D). Distance of obstacle > 15 cm in front of forward sensor.	PASS
7	Test Case_7	Mode = Drive (D). Distance of obstacle <= 10 cm in front of reverse sensor.	PASS
8	Test Case_8	Mode = Reverse (R). Distance of obstacle <= 5 cm in front of reverse sensor.	PASS
9	Test Case_9	Mode = Reverse (R). Distance of obstacle <= 10 cm in front of reverse sensor.	PASS
10	Test Case_10	Mode = Reverse (R). Distance of obstacle > 10 cm in front of reverse sensor	PASS

Advantages-

- The Automatic Braking System (ABS) is an important safety feature in modern cars. It works by using sensors to monitor the speed of the wheels and automatically applying the brakes if the wheels begin to lock up. The benefits of ABS are numerous [14].
- Greater Control: ABS helps drivers to maintain greater control over their vehicles, especially in emergencies. By preventing the wheels from locking up, the driver can steer the car more effectively and avoid collisions.
- Versatility: ABS is not just useful for nighttime driving; it can be helpful in many other situations where unexpected road impediments or crises occur. For example, if a driver suddenly encounters a large pothole, ABS can help them avoid losing control of the car [5].
- Reduced Injuries: ABS helps to reduce the risk of accidents, which in turn reduces the number of fatalities and injuries on the road. By allowing drivers to maintain control of their vehicles, ABS can help prevent collisions and reduce the severity of any accidents that do occur [15].
- Cost Savings: Incorporating ABS into cars can save insurance costs while improving overall transportation safety. Insurance companies often offer lower premiums for cars equipped with ABS, as they are less likely to be involved in accidents [16].

Limitation –

- Sensor Reliability: ABS systems rely heavily on sensors to detect changes in wheel speed and apply the brakes accordingly. Any issues with the sensors can result in the system malfunctioning, which can be dangerous.
- Slippery Conditions: While ABS systems are effective in dry road conditions, they can be less effective in slippery conditions such as ice or snow. The system may not be able to prevent the vehicle from skidding or sliding [11].
- Cost: The cost of implementing ABS systems in vehicles can be high, making it difficult for some manufacturers to include them in their models.
- Maintenance: Like any other technology, ABS systems require regular maintenance to function properly. Failure to maintain the system can lead to issues and malfunctions [17].
- False Sense of Security: Drivers may become overly reliant on ABS systems, assuming that they can prevent all accidents. However, ABS systems have their limitations and cannot always prevent accidents from occurring [18].

Future Scope-

- Artificial Intelligence Integration: By incorporating AI algorithms, ABS systems may be made more sensitive and adaptive to changing road conditions, resulting in more efficient and effective braking [9].
- Multi-sensor Fusion: The fusion of numerous sensors, including ultrasonic, LiDAR, radar, and cameras, can increase obstacle recognition and avoidance, hence increasing vehicle safety [19].
- Vehicle-to-Vehicle Communication: By allowing vehicles to interact with one another and share information about road conditions, traffic, and dangers, ABS systems may be made more intelligent, resulting in a safer and more efficient driving experience [18].

IX. Conclusion

The implementation of an Automatic Braking System (ABS) featuring an ARDUINO UNO module and an Ultrasonic sensor has demonstrated promising capabilities in identifying obstacles and halting the vehicle during emergencies. This technology holds significant potential in mitigating accidents arising from driver fatigue or distraction, especially during extended journeys or nighttime driving. By leveraging the advanced functionalities of the ARDUINO UNO module and Ultrasonic sensor, such as precise distance measurement and real-time data processing, the ABS offers an additional layer of safety to vehicles. However, to ensure the reliability and effectiveness of the system across diverse driving conditions and scenarios, further testing and refinement are imperative. Continued research and development efforts are necessary to optimize the ABS technology and bolster its contribution to enhanced road safety standards in the automotive domain.

X. Acknowledgments

We would like to express our innermost gratitude to my research manager, Dr. Manik Deosarkar for their non-stop steerage, support, and knowledge during this challenge. Their insights and encouragement had been worthwhile in shaping my studies and developing my abilities as a researcher. We also are thankful to all the professors of the

Department of Chemical Engineering for supplying the possibility & and helping with the finishing touch of this paper. Their comments, assistance with information evaluation, and considerate discussions have greatly better the exceptional of this research. This research might not have been possible without the contributions and assistance of those people, and for that, we are deeply grateful.

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