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Automatic Emergency Braking System

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ABSTRACT –

The Automatic Emergency Braking System (AEBS) is a significant advancement in automotive safety, designed to prevent or mitigate collisions through swift and autonomous brake application in emergency situations. It uses a network of sensors, including radar, lidar, and cameras, to continuously monitor the vehicle's surroundings and analyze real-time data to identify potential collision risks. The system assesses factors such as relative speed, distance, and trajectory of objects in the vehicle's path. Upon detection of an imminent collision, the AEBS initiates rapid and precise braking, independent of driver intervention. This proactive response significantly reduces collision severity or, in some cases, prevents them altogether. The integration of artificial intelligence and machine learning enhances the system's adaptability, allowing it to learn from diverse driving scenarios and continuously improve its performance. The AEBS aligns with global safety standards, making it a key focus for automakers and regulatory bodies in discussions around standardizing safety features in modern vehicles.

KEY WORDS: Automatic Emergency Braking System (AEBS)[1], Rode safety[2], emergency situation[3], collision[4], brake[5], Arduino[6], ultrasonic sensor[7].

1. INTRODUCTION -

Automatic Emergency Braking System (AEBS) is an advanced safety technology designed to prevent or mitigate collisions by automatically applying the vehicle's brakes in critical situations. Using sensors such as cameras, radars, or lasers, AEBS continuously monitor the road and detect potential collisions with vehicles, pedestrians, or other obstacles. When an imminent collision is detected and the driver doesn't respond in time, the system intervenes by applying the brakes, either slowing down the vehicle to reduce the impact or stopping it altogether. This technology significantly enhances road safety by reducing the severity of accidents and, in some cases, preventing them altogether. AEBS are a crucial component of modern vehicle safety suites, contributing to the overall goal of reducing traffic accidents and saving lives on the road. Automatic Emergency Braking System. AEBS is an advanced safety feature that can automatically apply the brakes in emergency situations, such as when a collision is detected or a pedestrian is in the path of the vehicle. This system uses a combination of sensors and cameras to detect potential hazards and take quick action to prevent or mitigate the impact.

1.1 BACKGROUND -

The Automatic Emergency Braking System (AEBS) is a significant advancement in automotive safety technology, utilizing advanced sensors and algorithms to detect potential collisions and automatically engage the vehicle's brakes. This proactive approach reduces accident severity or even prevents them entirely. The AEBS combines automotive engineering and artificial intelligence, allowing vehicles to make split-second decisions for passenger safety. This discussion will explore the underlying mechanisms, technological components, real-world effectiveness, and impact of AEBS on road safety, providing a comprehensive understanding of this transformative safety feature in the modern automotive landscape.

1.2 OBJECTIVE –

The Automatic Emergency Braking System (AEBS) is a technology designed to improve road safety by preventing or mitigating collisions. It works by autonomously applying the vehicle's brakes when it detects an imminent collision with an obstacle or another vehicle. This system can react faster than a human driver, especially in sudden obstacles. AEBS also acts as a safety net, providing an additional layer of protection. When equipped with pedestrian detection capabilities, it can detect people in the vehicle's path and automatically apply the brakes, potentially preventing accidents involving pedestrians. The system aims to reduce the severity of accidents, minimize property damage, and prevent injuries and save lives. AEBS can also reduce insurance costs and positively influence liability determinations in the event of accidents. This reduces the force of the collision, minimizing injuries and damage to both people and property. Automakers are motivated to implement AEBS technology to meet safety regulations and provide safer vehicles for their customers.

2 METHODOLOGY –

Figure 1. Hardware model

2.1 COMPONENT -

S. N	Name of components	Specification	Quantity
	Arduino uno	ATmega328P	1
	Ultrasonic sensor	HC-SR04	1
	Buzzer	3300HZ	1
	Servo motor	SG-90	1
	Motor driver	L298N	1
	Battery	9V 6F22	2
	Switch		
	Jumper wire	4-20mA (200MM)	
9	Mini Breadboard	SP400 Ties	1

2.2 Arduino Coding

```
#include <Servo.h>
const int trigPin = 2;
const int echoPin = 3;
const int motorPin = 5;
const int buzzerPin = 12;
Servo servoMotor;
void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(motorPin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);
   servoMotor.attach(9);
}
```

```
void loop() {
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
    duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;
  if (distance < 20) { // Adjust this threshold according to your needs
    // Activate emergency braking
    digitalWrite(motorPin, 0); // Apply brakes
    servoMotor.write(0); // Bring servo to a neutral position
    digitalWrite(buzzerPin, HIGH); // Activate buzzer
    delay(300); // Buzzer sound duration
    digitalWrite(buzzerPin, LOW); // Turn off buzzer
  } else {
    // No obstacle detected, normal operation
    digitalWrite(motorPin, 255); // Release brakes
       servoMotor.write(40); // Bring servo to a neutral position
     }
}
```

3. WORKING –

Automatic Emergency Braking (AEB) systems are advanced safety features that detect potential collisions in vehicles and automatically apply brakes to reduce or avoid them. These systems use sensors, cameras, and radar to scan the surrounding area and identify road dangers. They operate in three stages: detection, warning, and intervention. Low-speed AEB systems are designed for urban driving situations, where collisions are more likely to occur at lower speeds. High-speed AEB systems are optimized for highway driving conditions, where collisions can occur at higher speeds.

The effectiveness of AEB systems depends on several factors, including sensor fusion, algorithmic intelligence, braking performance, integration with other safety features, and driver awareness and education. Sensor fusion allows systems to cross-reference information from multiple sensors, improving detection accuracy and reliability. Algorithmic intelligence analyzes sensor data in real-time, assesses collision risks, and determines the appropriate response. Braking performance is crucial, with factors like brake response time, brake pedal feel, and brake system calibration playing crucial roles. Integration with other safety features enhances overall vehicle safety.

In conclusion, AEB systems are advanced safety features that can help prevent or mitigate collisions by automatically applying brakes when a potential collision is detected.

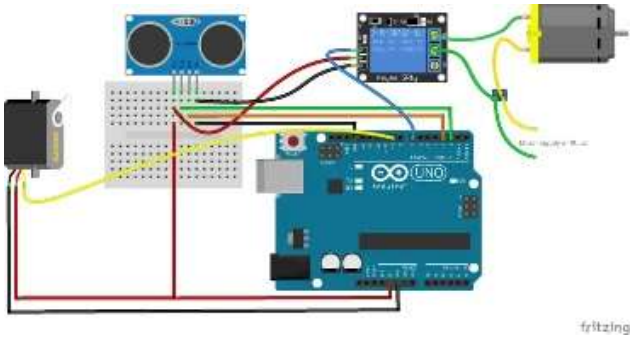

Figure 2. Circuit Diagram

4. RESULT –

Automatic Emergency Braking Systems (AEBS) are a significant advancement in automotive safety technology, designed to detect and prevent forward collisions. The system, which operates independently of the driver, can potentially reduce road accidents, especially those resulting from delayed reaction times. The system's ability to accurately detect obstacles and initiate braking in a timely manner is paramount. Studies have shown that AEBS can significantly reduce crashes, especially rear-end collisions, by alerting drivers and applying the brakes faster than a human could react. The prototype's ultrasonic sensor has a ranging accuracy of approximately 2 cm to lm, functioning well within the specified range.

5. CONCLUSIONS

5.1 CONCLUSION –

Automatic Emergency Braking Systems (AEBS) are a significant advancement in vehicle safety technology, combining advanced sensors, sophisticated algorithms, and rapid response mechanisms to prevent collisions and save lives. AEBS's effectiveness in reducing accidents caused by human error, distractions, and delayed reactions is widely supported. The commitment to advancing AEBS represents a collective stride towards a future where road safety is a tangible reality for every individual, making journeys safer, more secure, and more enjoyable. As automakers, researchers, and policymakers continue to collaborate, addressing challenges, improving algorithms, and ensuring seamless integration with other safety systems will further enhance AEBS's capabilities and reliability. The widespread adoption of AEBS signifies a paradigm shift in automotive safety and a commitment to creating safer roadways for everyone.

5.2 FUTURE SCOPE –

Automatic emergency braking systems are set to revolutionize road safety by integrating advanced sensor technologies like lidar, radar, and cameras. These sensors, combined with AI and machine learning algorithms, will adapt to various driving scenarios, including complex urban environments and unpredictable road hazards. The integration of vehicle-to-vehicle and vehicle-to-infrastructure communication will improve situational awareness and enable proactive collision avoidance. As autonomous driving technology evolves, these systems will serve as a safety net, preventing accidents and enhancing transportation efficiency.

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