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Design and Fabrication of Emergency Braking System

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Abstract
An emergency braking system is a safety feature in vehicles designed to automatically apply the brakes in the event of an impending collision or other dangerous situation. The system utilizes sensors such as cameras, radar, and/or lidar to detect obstacles in the vehicle's path, and then activates the brakes to either prevent a collision or minimize its severity. Emergency braking systems are becoming increasingly common in modern vehicles and are an important component of overall vehicle safety. An emergency braking system is a safety feature designed to prevent or reduce the severity of accidents by automatically applying the brakes when it detects a potential collision or danger. The system works by using sensors, such as radar or cameras, to detect objects or pedestrians in the vehicle's path and calculate the distance and speed of the vehicle. If the system determines that a collision is imminent.

Keywords: Crash, Arduino Ultrasonic System, Automatic Braking system

INTRODUCTION

An emergency braking system (EBS) is a safety feature in vehicles that helps prevent collisions or reduce their severity by automatically applying the brakes in the event of an imminent collision. This technology can help drivers avoid accidents, especially in situations where they may not have enough time to react.

Forward Collision Warning (FCW) - This system alerts the driver when they are approaching a vehicle or object too quickly and may collide with it.

Pedestrian Detection - This system uses cameras and sensors to detect pedestrians in the vehicle's path and apply the brakes if necessary.

Emergency braking systems are becoming increasingly common in new vehicles, and they have been shown to be effective in preventing accidents and reducing the severity of collisions. However, it's important to note that these systems are not foolproof and should never be relied on as a substitute for safe driving practices.

1.2 SET UP LAYOUT AND BRAKING SYSTEM STRUCTURE

1.3 CIRCUIT LAYOUT

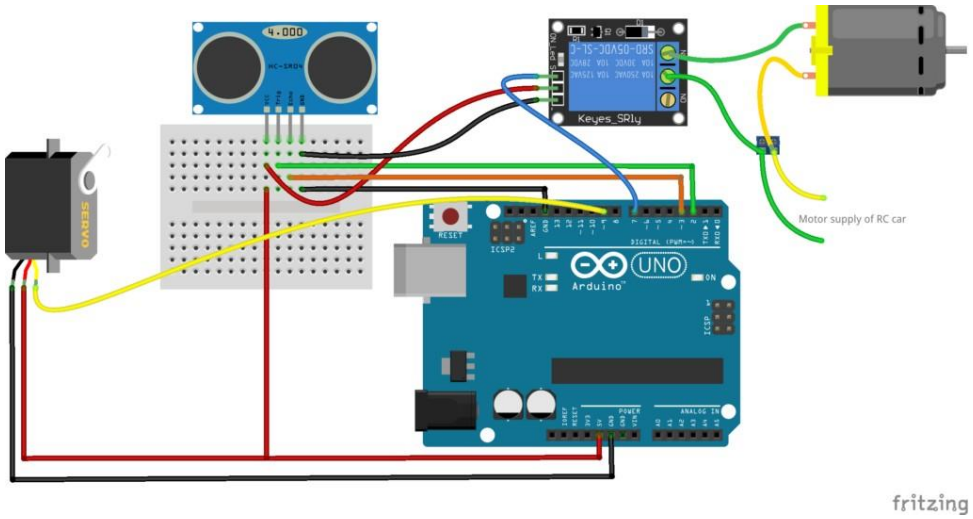


Fig 1.3: Circuit layout of the intelligent braking system

1.4 SENSORS USED

- Arduino based mechatronic system
- Ultrasonic sensor
- Camera sensor

1.5 ARDUNIO BASED MECHATRONIC SYSTEM

Fig-1.4 Single type micro-controller

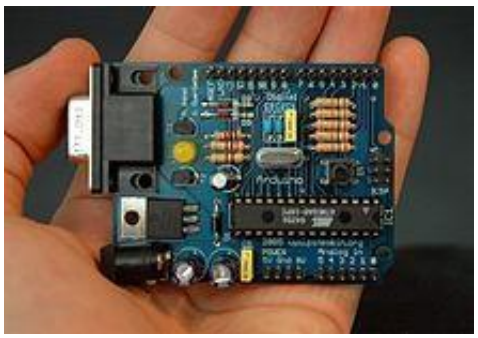
Arduino is one of the most used term in software company, project, and user community, Arduino

is a popular open-source platform used for building electronic projects, including those related to automotive systems such as emergency braking systems. The An emergency braking system built with Arduino could potentially include sensors to detect sudden stops or collisions, and then trigger the brakes to engage automatically. For example, a sensor could detect a sudden drop in speed or deceleration and send a signal to the Arduino board, which in turn would trigger the brake system to engage.

However, it's important to note that building such a system would require a thorough understanding of both Arduino programming and automotive braking systems. It would also need to comply with relevant safety standards and regulations.

In general, it's recommended that any modifications or additions to a vehicle's braking system be done by a qualified mechanic or automotive engineer to ensure they are safe and effective.

Hardware:



An Emergency braking systems typically involve several hardware components, including:

Brake pedal and brake system: This is the primary interface between the driver and the vehicle's braking system. When the driver applies pressure to the brake pedal, it activates the brake system to slow or stop the vehicle.

Sensors: These are used to detect potential hazards or obstacles that could cause an accident. For example, a forward collision warning system might use radar or camera sensors to detect when the vehicle is approaching another vehicle or obstacle too quickly.

Control unit: This is the brain of the emergency braking system. It receives input from the sensors and other components and determines when to activate the brakes. It may also adjust the braking force based on the vehicle's speed, road conditions, and other factors.

Actuators: These are the components that physically apply the brakes. In some systems, the control unit may send a signal to the vehicle's existing brake system to activate the brakes. In others, the emergency braking system may have its own dedicated braking system.

Overall, the hardware in an emergency braking system is designed to work together to quickly and effectively stop the vehicle in the event of an emergency.

Fig-1.5 Arduino board

An official Arduino Uno with descriptions of the I/O locations

The Arduino is an open-source electronics platform based on easy-to-use hardware and software. It includes a microcontroller board that can be programmed to control electronic devices and respond to inputs from various sensors.

In an emergency braking system, an Arduino board can be used to receive input from sensors such as a brake pedal sensor, speed sensor, and accelerometer. The board can then analyze this data and send a signal to activate the braking system in case of an emergency.

The Arduino board can be programmed using various programming languages, including C++, and there are several libraries and modules available that can simplify the development process. Additionally, there are many resources and communities available online where developers can share their projects, ideas, and troubleshooting tips

1.6 Ultrasonic sensor

An ultrasonic sensor can be a useful component in an emergency braking system. Ultrasonic sensors use sound waves to detect the distance between the sensor and an object, and can therefore be used to measure the proximity of a vehicle to obstacles in front of it.

1.6.1 Introduction

An emergency braking system, also known as an autonomous emergency braking system (AEB), is a safety feature installed in modern vehicles that automatically applies the brakes in an emergency situation to prevent a collision or reduce its severity. The system uses sensors such as radar, lidar, and cameras to detect the presence of obstacles, such as other vehicles, pedestrians, or obstacles in the road, and alert the driver if a potential collision is imminent. If the driver does not respond quickly enough, the system can automatically apply the brakes to avoid or reduce the impact of a collision.

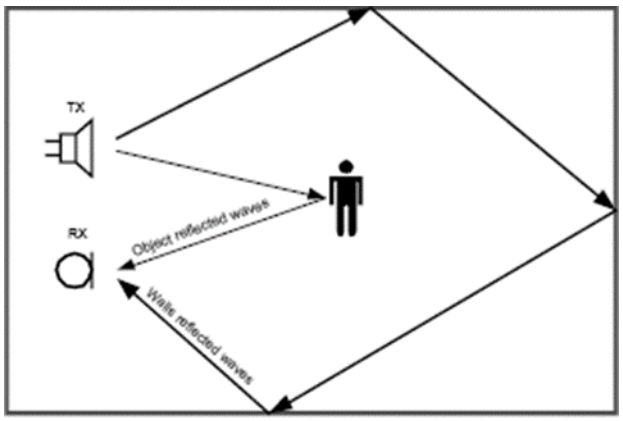


Figure : Basic Sensor Operation Principle

An emergency braking system is a safety feature that automatically activates the brakes in a vehicle when it detects an imminent collision with an obstacle or another vehicle. The system uses sensors, such as radar or cameras, to detect objects in the vehicle's path and calculates the distance and speed of the object relative to the vehicle.

When the system detects a potential collision, it sends a warning to the driver, typically in the form of an audible or visual alert. If the driver fails to respond to the warning, the system will automatically apply the brakes to slow down or stop the vehicle to avoid or mitigate the impact of the collision.

Emergency braking systems are becoming increasingly common in modern vehicles, particularly in cars with advanced driver assistance systems (ADAS). The systems can greatly reduce the risk of collisions and improve overall road safety, particularly in situations where a driver may be distracted or unable to react in time to avoid an accident.

Fig 1.6: Ultrasonic sensorCHAPTER-2

2.1 LITERATURE SURVEY

Emergency braking systems are a crucial safety feature in modern automobiles. These systems use a

combination of sensors, algorithms, and actuators to detect an impending collision and apply the brakes automatically to prevent or mitigate the impact. Here is a brief literature survey of the research related to emergency braking systems:.

2.2 Collision Avoidance Program

The Collision avoidance programs are a critical component of emergency braking systems. These programs use various sensors and cameras to detect potential collisions and help the system to take appropriate action to avoid or reduce the impact of an accident. Here are some examples of collision avoidance programs that can be integrated with emergency braking systems

Forward Collision Warning (FCW): FCW uses sensors to detect vehicles or objects ahead of the vehicle and warns the driver if there is a risk of collision. The warning can be visual or auditory, and if the driver fails to respond, the emergency braking system can automatically engage

2.3 Emergency Brake Assist (EBA)

This Emergency Brake Assist (EBA) is a feature that can be integrated into emergency braking systems to help reduce the stopping distance in emergency situations. When a driver suddenly applies the brakes, EBA detects the force and speed of the brake pedal application and automatically increases the brake pressure to ensure maximum stopping power.

EBA works in conjunction with the Anti-lock Braking System (ABS) to prevent wheel lock-up and skidding, allowing the driver to maintain steering control during an emergency stop. Here are some benefits of EBA in emergency braking systems:

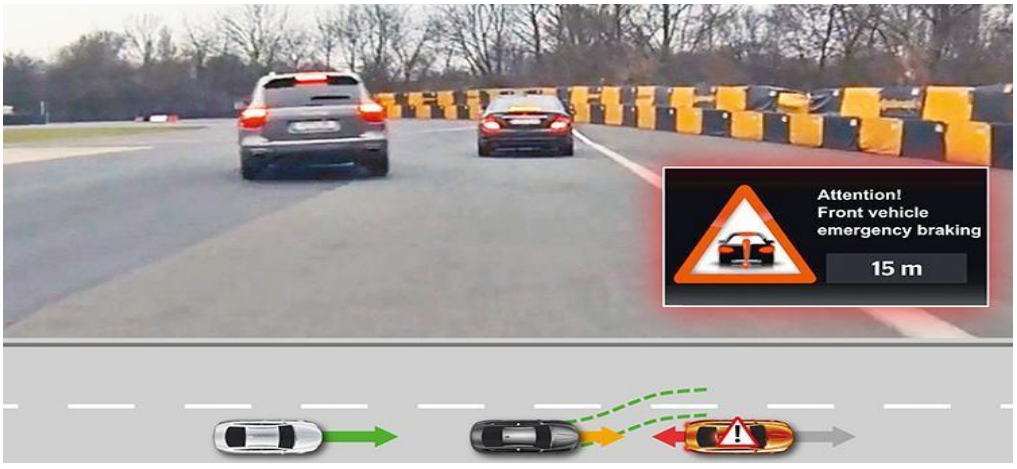


Fig:2.3 Emergency brake assist

2.4 Electronic Brake Force Distribution (EBD or EBFD)

It is an Electronic brakeforce distribution (EBD) is a safety feature in modern vehicles that helps to improve braking performance and stability. EBD works by electronically controlling the distribution of brake force between the front and rear wheels of the vehicle, based on factors such as vehicle speed, wheel slip, and road conditions.

In an emergency braking situation, EBD can help to reduce the risk of skidding or losing control of the

vehicle by ensuring that the brakes are applied evenly and efficiently across all four wheels. By distributing brake force to the wheels with the most traction, EBD can help to maximize stopping power and reduce stopping distance

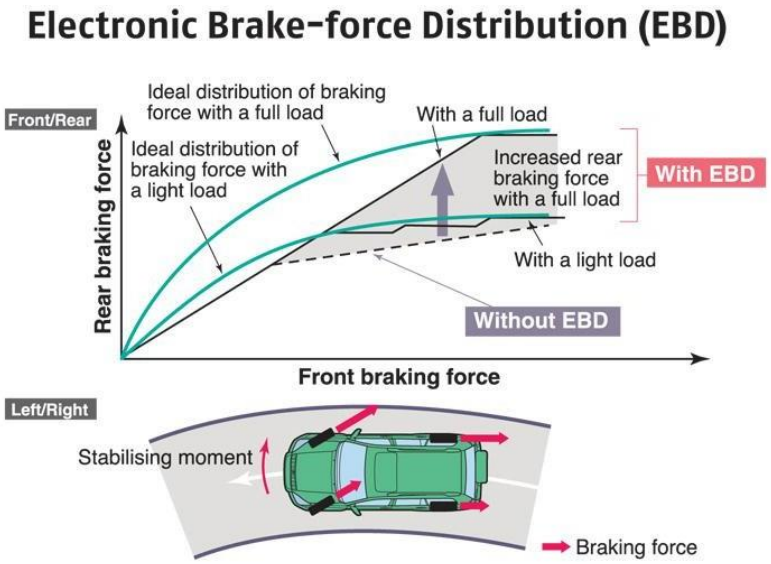


Fig 2.4: electronic brake-force distribution

Automated Emergency Braking (AEB)

An Automated emergency braking (AEB) is a key feature of an emergency braking system. AEB uses sensors, cameras, and radar to detect an imminent collision with a vehicle, object, or pedestrian, and automatically applies the brakes to avoid or reduce the impact of the collision.

The AEB system typically uses a combination of sensors, such as radar, lidar, or cameras, to continuously monitor the environment in front of the vehicle. When the sensors detect an obstacle or a pedestrian in the vehicle's path, the system will alert the driver with visual or audible warnings. If the driver does not take action to avoid the collision, the system will automatically apply the brakes to slow down or stop the vehicle.

2.5 Anti-lock Braking System (ABS)

It is an anti-lock braking system (ABS) is a safety system that prevents the wheels of a vehicle from locking up during braking. The ABS system is designed to maintain traction between the tires and the road surface, which helps the driver to steer the vehicle during sudden braking or emergency braking situations.

In an emergency braking situation, the ABS system applies and releases the brakes rapidly, preventing the wheels from locking up and allowing the driver to maintain control of the vehicle. The system operates by monitoring the speed of each wheel and adjusting the brake pressure accordingly..

CHAPTER-3

COMPONENTS USED IN THIS SYSTEM

- Arduino nano breakout board-1
- Arduino nani-1
- Arduino IDE Software
- Ultrasonic sensor-1
- Mg990 metal gear servomotor-1
- RF TX RX with Ht12e and Ht12d
- Arduino nano buck converter-1

Servomotor

Fig:3.5.1: servomotor

Mechanism

An emergency braking system is designed to help prevent accidents by quickly stopping a vehicle when necessary.

The mechanism of an emergency braking system varies depending on the type of vehicle and the specific system in use, but generally involves the following components:

Sensors: The system uses sensors to detect when a collision is imminent. These sensors can include cameras, radar, lidar, or a combination of these.

Control unit: The control unit processes the information received from the sensors and decides whether to activate the emergency braking system.

Actuators: Once the control unit decides to activate the emergency braking system, actuators are used to

apply the brakes. These can include hydraulic, electric, or pneumatic actuators.

Brakes: The brakes are the final component of the emergency braking system. When the actuators apply pressure to the brake pads or shoes, friction is generated between the brake pads and the wheels, causing the vehicle to slow down or stop.

Motors

The motor in an emergency braking system is an essential component of the system, as it is responsible for ensuring that the brakes are released and reapplied quickly enough to prevent a skid. If the motor fails, the system may not be able to apply and release the brakes quickly enough, reducing the effectiveness of the emergency braking system.

Therefore, it is important to maintain the motor and other components of the emergency braking system to ensure that they are working correctly. The motor in an emergency braking system is responsible for controlling the pressure in the brake system. When the ABS system detects that a wheel is about to lock up, it sends a signal to the motor to release pressure in the brake system. This causes the brakes to release slightly, allowing the wheel to regain traction and preventing a skid.

Control

The control in an emergency braking system, or anti-lock braking system (ABS), is responsible for monitoring the speed of the wheels and controlling the pressure in the brake system. The control unit consists of a computer, sensors, and a hydraulic control unit.

Integrated servomotors

An integrated servo motor consists of a motor and pump assembly that are combined into a single unit. The motor is used to drive the pump, which generates the pressure needed to operate the ABS system.

Battery:

The emergency brake system, also known as the parking brake or handbrake, is typically operated manually and is designed to prevent a parked vehicle from moving.

While some emergency brake systems may be electrically powered, they typically do not rely on a battery to function. Instead, the brake system uses a mechanical mechanism, such as a cable or a lever, to apply the brakes.

Various cells and batteries (top-left to bottom-right): two AA, one D, one handheld ham radio battery, two 9-volt (PP3), two AAA, one C, one camcorder battery, one cordless phone battery.

Miniature cells are used to power devices such as hearing aids and wristwatches whereas larger batteries provide standby power for telephone exchanges or computer data centers.

APPLICATION:

- As Preventing collisions: The primary application of emergency braking systems is to prevent collisions. By detecting obstacles or other vehicles on the road ahead, the system can apply the brakes automatically to prevent a collision.
- Avoiding rear-end collisions: Emergency braking systems can detect when a vehicle ahead has stopped or slowed down suddenly, and apply the brakes to avoid a rear-end collision.
- This Pedestrian and cyclist safety: Emergency braking systems can also detect pedestrians and cyclists on the road ahead and apply the brakes to prevent a collision.

- Reducing accident severity: Even if a collision is not completely avoidable, emergency braking systems can reduce the severity of the impact by slowing down the vehicle before impact.

Brake Release

As the brake release in an emergency braking system refers to a mechanism that allows the driver to release the brakes quickly in case of an emergency. This feature is typically found in vehicles that use an electronic parking brake or an electrically controlled hydraulic brake system.

In the event of an emergency, the brake release allows the driver to quickly release the brakes without having to lift their foot off the brake pedal. This allows the vehicle to regain traction and avoid a collision.

Prototype:

We all created a prototype of the Emergency Breaking system. We have used a battery (Dc) in the place of electric car and amicro servo battery. The follows:

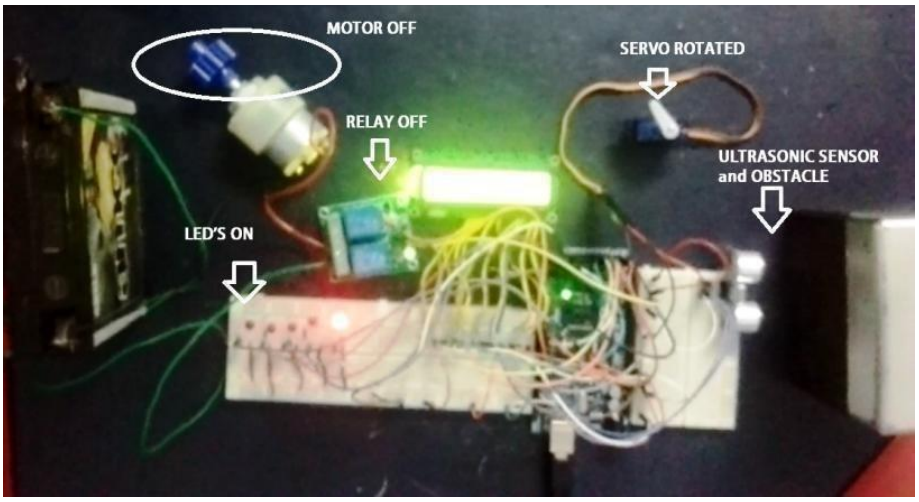


Fig:3.6 prototype without obstacleCONCLUSION

The project's aim was to develop and test an emergency braking system, the conclusion would involve testing the system under various scenarios and conditions to determine its effectiveness in preventing accidents. The system's performance and reliability would be evaluated, and any necessary modifications or improvements would be identified and implemented.

If the project's goal was to develop a prototype emergency braking system, the conclusion would involve demonstrating the system's functionality and evaluating its potential for further development and refinement.

Overall, the conclusion of an emergency braking system project would typically involve a comprehensive evaluation of the system's performance, as well as recommendations for further development and implementation, if applicable.

FUTURE SCOPE: Autonomous Vehicles: With the increasing trend towards autonomous vehicles, emergency braking systems will play a crucial role in ensuring safe operation. As self-driving cars become more prevalent, the emergency braking system will need to be more sophisticated to handle various unpredictable scenarios

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