Collision Warning System using Ultrasonic Sensors and Automatic Brake System

Niveditha.P.R¹ and S.Gowri²
¹Sathyabama University/Information Technology, Chennai, India
Email: niviraj2303@gmail.com
²Research Scholar, Sathyabama University/Information Technology, Chennai, India
Email: gowriamritha2003@gmail.com

Abstract—Vehicle technology has increased rapidly in recent years, particularly in relation to braking system and sensing system. In parallel to the development of braking technologies, sensors have been developed that are capable of detecting physical obstacles, other vehicles or pedestrians around the vehicle. This development prevents accidents of vehicles using Stereo Multi-Purpose cameras, Automated Emergency Braking Systems and Ultrasonic Sensors. The stereo multi-purpose camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres. Cars can automatically brake due to obstacles or any hindrance when the sensor senses the obstacles. The braking circuit function is to brake the car automatically after receiving signal from the sensors. All cars are competent in applying brakes automatically to a maximum extent of deceleration of 0.4g. Integrated safety systems are based on three principles. They are: collision avoidance, collision mitigation braking systems and forward collision warning.

Index Terms—Avoidance, Mitigation, Integrated;

I. INTRODUCTION

Driving is a compulsory activity for most people. People use their car to move from one place to other place. The number of vehicle is increasing day by day. It is produced tack tightly and risk to accident. Nowadays, the numbers of accident is so high and uncertainly. Accident will occurs every time and everywhere and cause worst damage, serious injury and dead. Accidents are caused mostly due to the delay in applying of brakes. This work is designed to develop a new system that can solve this problem where drivers may not brake manually but the vehicles can stop automatically due to obstacles. This work is about a system that can control braking system for safety. Using ultrasonic as a ranging sensor, its function based on ultrasonic wave. After transmit by transmitter, the wave can reflect when obstacle detected and receive by receiver. The main target for this project is, car can automatically braking due to obstacles when the sensor senses the obstacles. The braking circuit function is to brake the car automatically after received signal from the sensor. To prevent these accidents of vehicles from taking place we are using Automated Emergency Brake Systems and Ultrasonic Sensors. The main target for this project is, car cans automatically braking due to obstacles when the sensor senses the obstacles. The braking circuit function is to brake the car automatically after received signal from the sensor. The avoidance of accidents and mitigation regarding their consequences are the integrated techniques followed by us. Under the unique term "Perceptive Drive", we systematically pursue this
method with numerous new assistance systems, greatly enhanced purposes and upheaval defensive systems. The Perceptive Drive changes the vehicle into a "perceptive associate". This identifies a particular range of dangers and proposes support through audible, visual and tactile warnings, also being able to augment the driver's reaction. Many systems are able to take required actions in an emergency situation, such as an automatic application of brakes to steer clear of an accident from taking place and reduce severity of injury. The driver is finally pleased and the level of comfort is increased. This perceptive and combination of innovative sensors and systems are a benchmark on the road to automatic and an accident preventive driving.

II. LITERATURE SURVEY

The existing approaches used for safety measure and preventing accidents are Emergency braking systems (EBS), traction control and stability control [1]. Even infrared (IR) sensors are also widely used as proximity sensors and for obstacle avoidance, [2] but not successful due to some drawbacks. System and approaches mentioned above employ different types of sensors to uniformly monitor (observe) the conditions and react quickly in emergency situations. Sensors are vastly used for measuring distances, but different sensors have different characteristics.

- **Drawbacks of Emergency braking systems:-**
  1. Inconsistent stop times: ABS can keep the direction of our car which helps us to avoid obstacles on the road without losing control of the vehicle. The ABS helps reduce braking distances on dry or wet, but increases slightly when braking on snow or gravel. [3]
  2. EBS: This system works under particular speed limit and when brakes are applied in specific ways.
  3. Delicate systems: As we increase the mechanics there are more possibilities of system damages to occur. Sometimes its reported that disorientation for the ABS occur, in which the compensating brake sensor, causes the vehicle to shudder, make loud noise or generally brake worse [4].

- **Drawbacks of Infrared Sensors:**
  As different sensors have different characteristics, IR sensor has non-linear characteristics and this depends upon the reflectance properties of the object surfaces. Surface properties must be known in prior. Different surfaces react differently whereas some surfaces scatter, reflect, and absorb infrared energy which will not work properly to interpret the sensor output as distance measure.

**Ultrasonic Sensors:**

Widely used sensors that are mainly used for the measuring of distances are Ultrasonic sensors (US). Since these ultrasonic sensors have provided a reliable source of obstacle detections. As ultrasonic sensors are not vision-based they can be used very efficaciously under the conditions of poor lighting and objects which are transparent in nature. Ultrasonic sensor (US) can provide the initial information on distance to obtain the parameters for further methods to perform task. They are signals that are almost like audible sound waves [5], except those frequencies are more higher. The ultrasonic transmitter has a piezoelectric crystal that resonates up to a required frequency.

III. RELATED WORKS

Related works based on ultrasonic sensors and emergency braking system are very vastly done in the world. There are some which we have introduced here.

[1] There is a project done by google which is known as "The Google Driverless Car". It is a project done by the google which involves the developing of technology related to autonomous cars. There is a software powering these google cars which is known as Google Chauffeur. Google is doing lettering for all such types of cars exactly at the side of each and every car. This makes it identify itself as a "self-driving car". The Lettering says "Self-Driving" car. This project is currently being done and is entirely led by an engineer in google names as Sebastian Thrun, who is the director of the Stanford Artificial Intelligence Laboratory and also a co-inventor of the Google Street View.

[2] Next is the project that is currently going on where cars are specially designed for 'BLIND' people. Dennis W.Hong who is an associate professor of engineering at Virginia Tech is working on this on-going project. The whole point of them designing such a concept is to make blind people also have a normal life by driving cars and making their comfort an importance and also it is very safe for them to go to their desired destinations.

[3] Mercedes Benz is also currently working on a project for an accident free type of car. Their development
team are working on Attention Assist and Distronic PLUS with Pre-Safe Brake for cars so that accidents can be prevented at the most crucial point.

[4] The United Nations Economic Commission for Europe i.e (UNECE) have broadcasted that the emergency braking system technology will become obligatory for newly heavy vehicles that have been designed from the year 2013. They have made a study which suggested that this system in the cars will reduce accident by up to 27 percent and save lives up to 8000 per year.

IV. PROPOSED SYSTEM

The scope of this work is to develop a safety car braking system using ultrasonic sensor (Fig.1) and to design a vehicle with less human attention to the driving. Currently in cars there aren’t technologies to prevent accidents. But they have introduced sensors that would detect any obstacles. Besides this it also gives an alert to the driver. In this work we are enhancing the existing work by introducing automatic brakes, which would get its input from the sensors, which will then generate the brakes and prevent from collisions to take place.

Here a stereo multi-purpose camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres. This camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres. Vehicles driving ahead and pedestrians also have a variety of traffic signals and on-road markings that are detected and have been assigned a spatial grouping. The data from short-range ultrasonic sensors that are positioned all around the vehicle as well as from a long-range ultrasonic sensors with an approximate-range detection capabilities provides data on the distance from detected objects. The stereo-multiple camera helps in detection of objects, pedestrians, vehicles or people. This detection is very reliable. It produces a framework to detect objects that are in motion on road using a stereo camera. This system detects moving features based mainly related to feature points projection i.e an error on the image which minimizes false detection from a far distance. There is a transmitter which is kind of like an ultrasonic wave which is used to detect any kind of physical obstacle. The ultrasonic transmitter has a piezoelectric crystal that resonates up to a required frequency. This also converts the electrical energy into acoustic energy and vice versa. While transmitting the ultrasonic wave, there is a part which is ultrasonic wave generator that functions to generate ultrasonic wave. The block diagram tells us how the sound waves that are transmitted are totally reflected from a particular target and then back to the transmitter. There is an output that is produced to perform some kind of indication or a controlling function. There is a minimum distance from the sensor that is needed to provide a delay in time so that the echoes could be elucidated. The targets could have any kind of reflective form- also round objects. There are variables which could affect the working of the ultrasonic sensing which includes reflective surface roughness or target surface angle.

![block diagram of the system](image)

Fig1: block diagram of the system

After ultrasonic waves were produced, 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 that used. The ultrasonic wave detects any kind of physical obstacle, hence it will produce a reflected wave.
Once the obstacle is detected there is a reflector which reflects the ultrasonic waves. An ultrasonic receiver is used for this which does the receiving of the ultrasonic waves, reflected from the road surface to generate a reception signal. There is ultrasonic transducer that will transform back the sound wave to electrical energy. This signal amplified by an amplifier. The amplified signal is compared with reference signal to detect components in the amplified signal due to obstacles on the road surface. The magnitude of the reference signal or the amplification factor of the amplifier is controlled to maintain a constant ratio between the average of the reference signal and the average of the amplified signal. This allows the ultrasonic sensor to examine the existence of vehicles. Once this is complete the sensors give an alarm as to an obstacle detected. The processed signal will be sent to the braking circuit. The braking circuit here is also known as the Emergency Braking System. The Emergency Braking System is known as an independent road safety system designed for vehicles. This is able to detect incidents where the speed relative to this and the distance between the target and the host suggests here that a collision is impending. At the braking circuit, brake pressures are applied here automatically. This provides maximum brake boost instantly as soon as the driver engages the brakes. After this if the driver's steering actions or the brake that he applies is not sufficient to avoid a collision then the Emergency Braking System with the maximum pressure given by the brakes will be to support mitigation of the impact. This system is recognised as Emergency Braking System and it ensures full reduction in speed. The emergency braking system plays a major role in this and it is the highest escalation step for a very safety system to immediately respond to a critical incident.

V. ANALYSIS TOOL

The purpose required for the tool are described below:

- Emergency braking system
- Stereo Multi-Purpose Cameras
- Ultrasonic Sensor

A. Emergency Braking System:

The entirely new purpose all depend on the existing sensor system, that comprises a new Emergency Braking System and an ultrasonic sensor. This behaves as eyes for the entire vehicle. Initially imagine a moving object on the ground which is accelerating at a speed of 100Km/hr (Fig.2) which is about to collide with another moving object. During the point of collision, the distance sensor which had already been installed in the vehicle gives an input to the alarm, which gives an alert to the person who is controlling the vehicle. This will then automatically activate the automatic brake system. In the automatic brake system the vehicle will come to a complete stop gradually when applying brakes automatically to a maximum extent of deceleration (Fig.3) of 0.4g, when it is about to collide.

![Graph](image)

Fig.2: Acceleration without brakes

B. Stereo Multi-Purpose Cameras

The intention of this method is to avoid from accidents from taking place. The stereo multi-purpose camera (SMPC), i.e is a camera for short and "5D Vision" technology, the range of visual for the vehicle is greatly increased. This camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres. Vehicles driving ahead and pedestrians also have a variety of traffic signals and on-road markings that are detected and have been assigned a spatial grouping. The data from
short-range ultrasonic sensors that are positioned all around the vehicle as well as from a long-range ultrasonic sensors with an approximate-range detection capabilities provides data on the distance from detected objects. This so-called ‘sensor blending’ enables the interactive cooperation of the vehicle’s active and passive protective and safety technology. The detection of moving object is very important and very essential for intelligent vehicles. It produces a framework to detect objects that are in motion on road using a stereo camera. Here this kind of approach also enables an assist to further develop the system to be able to detect slowly moving object in a very disturbed environment.

**C. Ultrasonic Sensor**

There are ultrasonic signals which are similar to audible sound waves, except its frequencies are much higher. Ultrasonic sensor (US) can provide the initial information on distance to obtain the parameters for further methods to perform task. They are signals that are almost like audible sound waves, except those frequencies are more higher. The ultrasonic transmitter has a piezoelectric crystal that resonates up to a required frequency. We have ultrasonic transducers that have piezoelectric crystals which reverberate to a desired frequency. This converts the electric energy into acoustic energy and also vice versa. The sound waves, which are transmitted in the shape of a cone, are reflected back from a target to the transducer. Here an output signal is fabricated to perform some kind of designating or control function. Minimum distance from the sensor is necessary to issue a delay in time so that the echoes can be elucidated. There are few variables that can affect the operation of ultrasonic sensing. Some of them are reflective surface roughness, target surface angle or changes in temperature or humidity. These targets could have any kind of reflective form such as round objects. Ultrasonic transducer produces an ultrasonic signal. These signals are generated through a sensing medium. The very same transducer is used to detect receiving signals. In many cases, the sensing medium is mostly and always air. One ultrasonic transducer is typically present in an ultrasonic sensor which does the transformation of an electrical energy into sound and vice versa a sound into an electrical energy. A housing enclosing the ultrasonic transducer. Optionally an electronic circuit for signal for signal processing and an electrical connection also enclosed in the housing. The ultrasonic sensor measures the distance from the selected point of the ground to the vehicle. The measurement of the ultrasonic sensor is based on the time of flight of an ultrasonic pulse to its reflected wave from the ground. The optimization technique with constraints is used to get the reflected pulse, which are been detected by the usage of threshold comparator. The sub-wavelength is detected with the technique of taking the frequency response into consideration. Low cost components are only compressed in this sensor. This sensor is adaptable for any kind of weather condition.

**VI. CONCLUSIONS**

The framework of the proposed system is developed for a safety car braking system using ultrasonic sensor and to design a vehicle with less human attention to the driving. This technology could be further enhanced. The same can be implemented in aircrafts, submarines. But automatic brakes cannot be used always. So it can be replaced by action of automatic diversion with the help of various sensors such as radar sensors, distance sensors, etc. The stereo multiple camera has a kind of approach which also enables an assist to further
develop the system to be able to detect slowly moving object in a very disturbed environment. There are experiments which are being conducted with challenging on-road datasets. The results displayed are that of a combined approach which outperforms than a feature-based approach in a disturbed environment.

REFERENCES