Intelligent Braking System and Alcohol Detection based vehicle controlling- A Review

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Abstract - The braking system was designed and applied on a car to make the driving process safe by using embedded system design. Over past few Years accidents have become a major concern & the rate of accident have reached an all-time high. Most accidents happen mainly either due to the negligence of the driver or due to the delay of the driver in hitting the brakes in an intoxicated condition.

The system houses an ultrasonic sensor which senses obstacles & actuates the brakes automatically, providing an electronically operated passive braking system to avoid collision or at the least reduce the severity of the collision.

Keywords - Ultrasonic sensor, Arduino, solenoid valve, Pneumatic cylinder, alcohol sensor.

1 Introduction

Braking system is an extremely important component of a vehicle which ensures the safety of the vehicle and its occupants. The analysis of road accident data for 2017 reveals that about 1,500 accidents and 400 deaths take place every day on Indian roads. With almost one life lost every 3.8 minutes, road accidents need to be considered with greater seriousness [1].

The purpose of this paper is to develop a system that can apply the brakes automatically as soon as it senses any obstacle within a predefined distance. The auto braking system is incorporated in the system to replicate real-life scenarios. The conventional medium used for braking system (compressed air) can be now controlled with the speed and precision offered by modern electronic abilities. The extremely rapid response time provided by electronic control can be used for crucially shortening the braking distance by introducing advanced control in the braking process.

Nowadays, Driving Under the Influence (DUI) has also become a major cause for accidents. In this system, the Blood Alcohol Content (BAC) of the driver is continuously monitored and calibrated on a scale. When it exceeds a particular limit, the power supply to the Engine is cut-off.

In 2011, the Ministry had admitted that drunken driving was one of the leading causes of road accidents and attributed as many as 27,152 accidents to it [2]. In 2015, 501,423 road accidents were reported in india, of which 16,298(3.2%) were attributed to driving under the influence of alcohol, according to the latest available data from the ministry of road transport and highways (MORTH). The data further reveal that 6,755 people died and 18,813 injured in drink-driving accidents in 2015. [3]

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2 Litrature Survey

Over the recent years many automobile industry giants have started working on the concept of Intelligent Braking system and have introduced different versions to the market with the goal of improving the current safety standards.

- MERCEDES BENZ – In 2002 Mercedes launched the "PRE SAFE" SYSTEM, later in the year 2013 PRE SAFE was updated with Cross-Traffic Assist. The system uses a combination of stereo camera and radar sensors to detect pedestrians in front of the vehicle. Should the driver fail to react, the braking power will be boosted as the situation requires, up to full brake [4].
- HONDA - In 2003 Honda introduced "Collision Mitigation Brake System" (CMBS). Housing a radar based system to monitor situations ahead and provide brake assistance if the driver reacts with insufficient force on the brake pedal.
- VOLVO- In 2006 Volvo introduced "Collision Warning with Auto Brake", This system is powered by a radar/camera sensor fusion. If the driver doesn't react, the system pre charges the brakes and increases brake sensitivity to maximize driver performance.

  Volvo's laser assisted braking could not work effectively in rainfall and snowfall, and the laser is easily affected by atmospheric conditions.
- AUDI - In 2010 AUDI came up with the "PRE SENSE" autonomous emergency braking system using twin radar and a monocular camera sensor, designed to work in 4 phases. The first phase would provide warning of the impeding accident with the successive phases resulting in the application of brakes at varied brake pressures.

- FORD - In 2012 FORD came up with the concept of "ACTIVE CITY STOP". The system used wide screen mounted cameras, radars, lidars to monitor the road ahead. The system can prevent a crash occurring at speeds between 3.6kph and 30kph. The upper speed limit was later raised to 50kph.
- BMW- In 2013 BMW introduced the "DRIVING ASSISTANT PLUS" by combining the front facing camera, lane departure warning and front radar sensors to detect vehicles ahead. Should the driver not react to the warning of a potential collision, the system would gradually prime brake pressure and apply with maximum deceleration power.

The following studies have been made on Alcohol Detection based vehicle controlling system:

- In 1973 Verne R. Brown, has invented and patented the BREATH ALCOHOL DETECTOR AND AUTOMOTIVE IGNITION INTERLOCK which detects the alcohol content in the breath and interlocks the engine ignition system if the driver is intoxicated[5].
- In 2001 Dean Stockett Edmonds, has invented DRIVER ALCOHOL IGNITION INTERLOCK which uses blood alcohol detector that measures intensities of wavelengths of light emerging from finger. A microprocessor correlates these intensities with finger's BAC and interlocks the engine ignition system if the BAC level is above the threshold [6].
- In 2005 Dennis Bellehumeur patented his work on THE SYSTEM AND METHOD FOR PREVENTING THE OPERATION OF A MOTOR VEHICLE BY A PERSON WHO IS INTOXICATED which uses galvanic detector to measures epidermal elements such as alcohol content and engine turns off if the alcohol content is high [7].

In summary, the new system that we are proposing utilizes ultrasonic sensors for the purpose of obstacle realization and an alcohol sensor working in tandem to monitor alcohol consumption so as to avoid DUI.

This system can be easily installed in existing vehicles and is very cost effective. The ultrasonic and alcohol sensors are cheap. This factor, coupled with low power consumption could facilitate the application and mounting of this system in many low-end vehicles, thus helping to improve safety standards and offer a hassle free driving experience at a reduced cost.

3 OBJECTIVES

Accidents have become a serious concern in today's scenario. The rates of accidents are at an all-time high currently. Braking systems of commercial vehicles were always given the highest importance concerning safety issues and in particular passive safety system. Inappropriate braking of the vehicles may cause severe accidents due to relatively longer stopping distances and higher energy output of brakes particularly in the case of vehicle combinations. The conventional medium used for braking system (compressed air) can be now controlled with the speed and precision offered by modern electronic abilities.

The main objectives of this paper are:

- To improve the braking system of conventional vehicles by installing sensor controlled pneumatic brakes.
- To make the driving process easy by using embedded design.
- Try providing safety against collisions and thereby avoiding accidents
- To employ different types of sensors that constantly monitor the conditions of the vehicle and the driver, and subsequently respond in an emergency situation.
- To reduce the quantum of road accidents and fatalities due to drunk driving in the future
- To accurately determine the BAC level of the driver.
- To lock the engine immediately if the BAC level of the driver is greater than 0.03% in 100 ml of blood.
- In case of accidents the GSM unit sends SMS along with the location of the vehicle to three pre-selected contacts.

4 METHODOLOGY

In this system the major portion of work is done by the electronic unit to activate the solenoid valve which is an electromagnetic component used to actuate the pneumatic cylinders. The process flow diagram is shown in figure 1

The electronic unit consists of an Ultrasonic transmitter and a receiver as sensing device. The oscillator circuit generates 40KHz frequency wave signals. The ultrasonic transmitter emits this wave at regular intervals of time and in the presence of any obstacle in the path, the ultrasonic waves gets reflected. The ultrasonic receiver is used to receive the reflected wave as shown in the figure 2. Then the reflected wave is transferred to the signal conditioning unit in which the incoming wave is amplified and converted into square pulse. Then the square pulse is given to control unit. By measuring the length of time from the transmission to reception of the sonic wave, it detects the position of the object. Nearest dangerous distance value can be stored in the control unit. When measured distance reaches this value, control unit automatically activates solenoid valve allowing the air from compressor pass to cylinder through the connecting tube. This air pressure moves the piston which is connected to the cam of the braking unit inwards thereby applying the brakes.

Also, a method for preventing operation of vehicle when the operator's blood-alcohol content is above a threshold value has been incorporated in to the system. A fast-acting alcohol sensor is employed in breath alcohol detection system for vehicles, which operates to prevent an intoxicated person from operating the vehicle. In general, this is accomplished by means of a breath alcohol detector which is incorporated in automotive ignition system interlock and which employs a sensor which is responsive to exposure of alcohol to produce an electrical signal.

The MQ-3 gas sensor can be used that senses the gases like ammonia nitrogen, oxygen, alcohols, aromatic compounds, sulfide and smoke. The operating voltage of this gas sensor is from 2.5V to 5.0V. The sensing range is from 0.04 mg/L to 4 mg/L, which is suitable for breathalyz-

ers. The MQ-3 alcohol sensor consists of a tin dioxide (SnO2), a perspective layer inside aluminum oxide micro tubes (measuring electrodes) and a heating element inside a tubular casing. The end face of the sensor is enclosed by a stainless-steel net and the back side holds the connection terminals. Ethyl alcohol present in the breath is oxidized into acetic acid passing through the heat element. With the ethyl alcohol cascade on the tin dioxide sensing layer, the resistance decreases. By using the external load resistance, the resistance variation is converted into a suitable voltage variation.

4.1 Process flow diagram of the proposed system

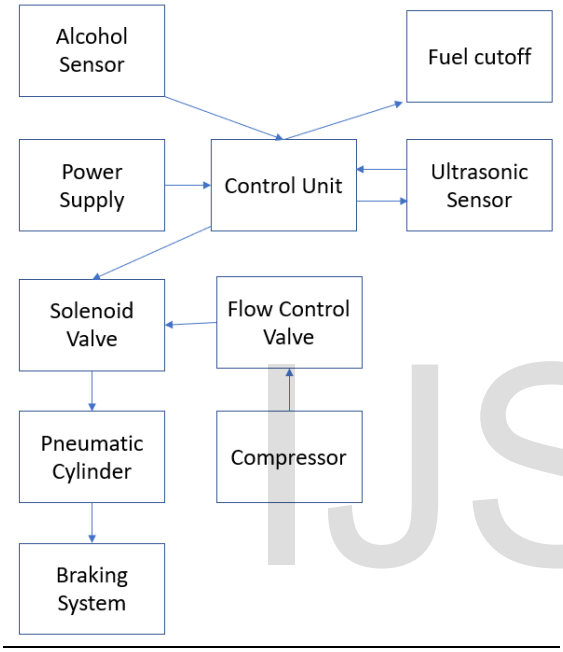

Fig. 1 Flow Diagram

4.2 Components of sensor based braking system

4.2.1 Ultrasonic Sensors: -

- The ultrasonic transmitter and receiver unit is placed in the front portion of the vehicle.
- Ultrasonic transmitter emits 40KHz frequency ultrasonic waves at regular intervals which strikes the object in front of it and the signal is reflected back as echo signal which is received by the Ultrasonic receiver.
- Ultrasonic unit utilizes less power and is available at affordable cost.
- The system houses an ultrasonic receiver which senses reflected waves from obstacle and applies brakes automatically.
- Ultrasonic sensors can perform even under harsh climatic conditions.

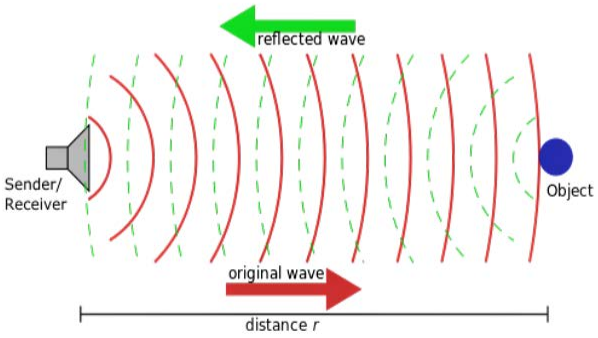

Fig. 2 Working of Ultrasonic Sensor
Source: Google

4.2.2 Alcohol Sensors: -

- The alcohol sensor is used to determine BAC of the driver as shown in the figure 3.
- This Sensor is used to sense the alcohol, the analog output of which is sent to control unit.
- The drive circuit is very simple and interface could be of 0-3.3V ADC.
- The alcohol sensor can be used to detect alcohol with different concentrations at low cost.

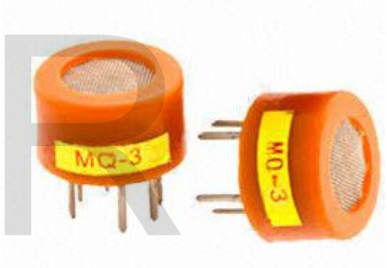

Fig. 3 MQ-3 Alcohol sensor
Source: Google

4.2.3 Pneumatic Cylinder: -

- Pneumatic cylinder is a mechanical device which uses air as a working medium to transfer reciprocating linear motion on to a piston inside a cylinder.
- Pneumatic cylinder receives air from the compressor to apply brakes when solenoid valve is actuated.
- Pneumatic cylinders are used because of their low cost, long life and acceptable performance with negligible maintenance throughout its life cycle.

4.2.4 Microcontroller Board (Arduino Uno) :-

- The System uses Arduino Uno as the control unit as shown in the figure 4.
- ATMega328P Microcontroller which runs at 16MHz
- Operating voltage of 5V and has 14 digital I/O pins.
- It also has 32Kb flash memory and 2Kb SRAM.
- Arduino Uno can be programmed using Arduino IDE in which code is written in C language.

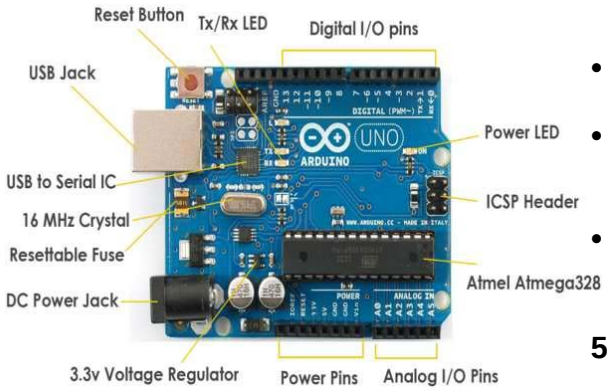

Fig. 4 Arduino Uno
Source: Google

4.2.5 Compressor: -

- A Compressor is a mechanical device that increases the pressure of air by reducing its volume.
- Compressed air is released through the discharge valve into pneumatic cylinder, where piston inside pneumatic cylinder is moved in linear motion to apply brakes.

4.2.6 Solenoid Valve: -

- 3/2 12v electrically controlled solenoid as shown in figure 5 valve can be used.
- The solenoid valve gets actuated when it receives signal from the control unit.
- Thus, compressed air is released into pneumatic cylinder through FCV.
- Solenoid valves offer fast and safe switching, high reliability and long service life.

Fig. 5 3/2 Electrically Controlled Solenoid
Source: Google

4.3 Advantages of Intelligent Braking System (IBS)

- An IBS prevents lock-ups and skidding, even in slippery conditions.
- IBS brakes have been proven to save lives in some situations by helping drivers keep control of a vehicle.
- Intelligent Braking Systems coordinates wheel activity with a sensor on each wheel that regulates brake pressure when necessary, so that all wheels are operating in a similar speed range.
- Ultrasonic sensor is cheaper and less demanding of hardware than other types of sensors presently used.
- This lower cost of ultrasonic sensors compared with other kinds of sensors, could facilitate the application and mounting of the system in many low-end vehicles.
- As system does not take complete control from driver, the risk factor due to false indication gets reduced. [8]

5 Summary

Proposed arrangement used for intelligent braking system has a lot of potential applications especially in developed countries where research on smart vehicles is receiving ample attention.

In this review paper, detailed information regarding IBS using ultrasonic sensors and alcohol detection-based vehicle controlling has been discussed. As ultrasonic sensors can detect any kind of obstacle, this system can also prevent collision of the vehicle at night time or at least reduce the injuries occurring. The system when integrated with other subsystems like automatic traction control system, intelligent throttle system, and auto cruise system, etc. will result in smart vehicle maneuverability.

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