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Vehicle External Airbag System

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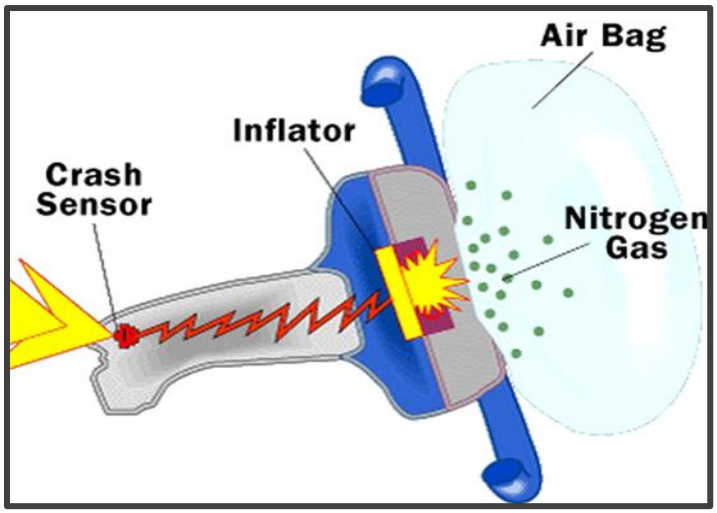
Abstract: The project is based on safety measures of vehicles. It is inspired by the daily observation during a drive related to the accidents caused around us or sometimes even with us. With increase in number of vehicles comes increase in number of road accidents, though the automobile sector have achieved a huge margin on reducing the number of accidents by advancing the safety systems in the vehicles still airbag system in cars need somewhat development, as it is observed in many cases the crash leads to some major casualties due to the failure of airbag system i.e. the airbags fail to open when required and the driver suffers injuries. These kind of casualties involved accidents are usually caused due to the drivers not reacting to the situation accordingly within the response time, to overcome the same issue a External Airbag System has been introduced which will surely contribute in reducing the number of casualties during accidents. The circuit, working and need of the system is briefly discussed in this paper.

Keywords: Microcontroller, Ultrasonic Sensor (HC-S04), Led, Airbag, etc.

I. INTRODUCTION

Not responding to some situations while driving within a specific response time can sometimes lead to some major casualties. The reason behind such incidents happening can be anything like a driver facing blackout, instantaneous shock because of the approaching situation, lack of attention while driving and many more. Drinking increases the reaction time of the driver, so the possibility of causing accident is increased . The point here which needs to be understood is your brain cannot multitask. At best, it can switch between tasks rapidly, which is why texting and car accidents sometimes go hand-in-hand. When you try to drive and perform another task at the same time, you are limiting your brain and body's ability to react. As your brain juggles its attention between driving and whatever else you are doing, important driving cues may be overlooked. If your brain is focusing its attention on the task of talking or listening, you may not recognize a pedestrian in the road or a red light in front of you, even if you are looking right at it.



Above shown image shows the working of the currently used airbag systems in cars. The current airbag systems sometimes fail and even are not capable of protecting the car from the damage caused. To overcome this issue a External Airbag System has been introduced which works considering the response time of human brain and braking distance depending on the current speed of the vehicle, this ensures complete security of the driver as well as vehicle in an accident as it does not depend on the driver but works based on data given and also does not inflates the airbags after the accident but before the accident to avoid the damage and impact of the accident.

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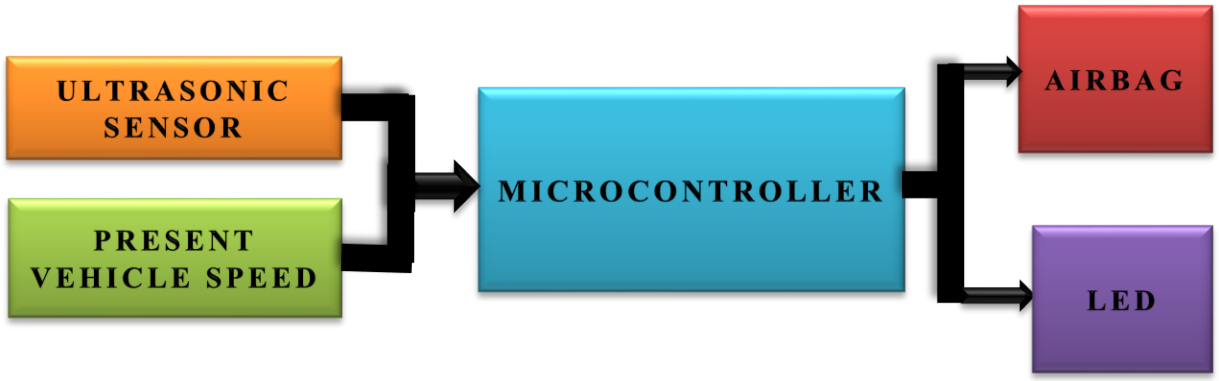
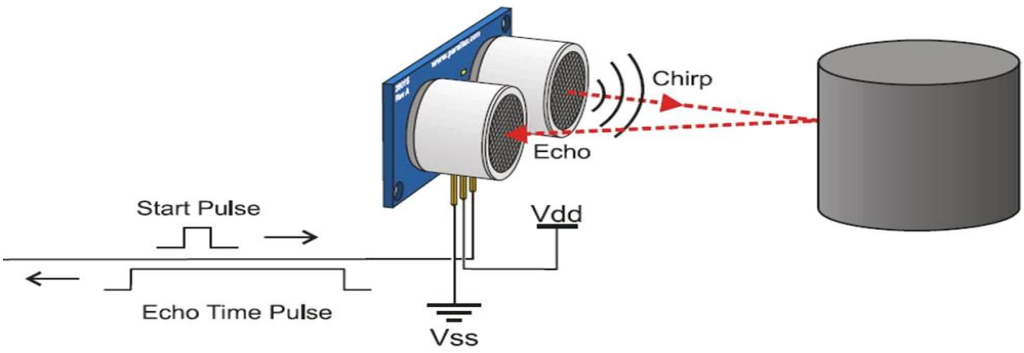
II. PROPOSED SYSTEM

Below shown is the block diagram representation of the "**VEHICLE EXTERNAL AIRBAG SYSTEM**".

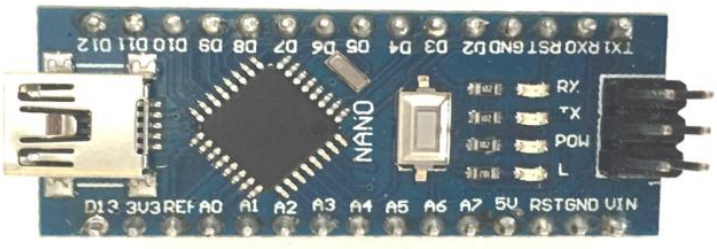


The system consists of total five blocks, the function of the five blocks are as follows:

1.Ultrasonic Sensor : An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). In this system the purpose of the sensor is to detect the presence of any object within 50 meters of range and send the corresponding signal to the microcontroller. Below shown is a working diagram of an ultrasonic sensor.



2.Microcontroller: A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. In this system we are using ARDUINO NANO as microcontroller. The purpose of choosing this as a microcontroller is due to its compact size and number of input/output pins available (14 digital and 8 analog pins available) which will make future development of the system of the easy and compact alongside.



3.LED: LED (Light Emitting Diode) is basically a small light emitting device that comes under “active” semiconductor electronic components. It’s quite comparable to the normal general purpose diode, with the only big difference being its capability to emit light in different colors. The two terminals (anode and cathode) of a LED when connected to a voltage source in the correct polarity, may produce lights of different colors, as per the semiconductor substance used inside it. Here, in out system the LED works as a alert signal for the driver in the vehicle.

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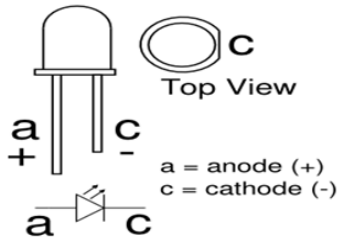

4.Air Pump: This is a DC motor driver air pump or air inflator. This is a small air pump and can be used in any DIY projects like aquariums to supply oxygen. It can be controlled by any controller like Arduino, Raspberry Pi, AVR, PIC or any other controller. The pump is very easy to assemble, interface and a low power device**.** The pump used for inflating the airbag can be changed as per the requirement or the scale of requirements.

5.Present Vehicle Speed: This block is given as input to the microcontroller . It consist of present speed of the vehicle. Continuous vehicle speed reading will be given as the Input.

III. NEED OF THE SYSTEM

The intention of this project is that the vehicle's internal airbags will take care of the safety of passengers and the driver but this project will take care of the vehicle as well as the object it is being hit. If the vehicle is going to hit another vehicle, external airbag will help to avoid the major damage to both the vehicles. Of course, there will be an impact during accident but the seat belt and internal airbag will keep the passengers safe.

Car accidents happen when we least expect them. Even though all modern cars have airbags, it's difficult to predict how, when, and (most importantly) if they're going to deploy. Airbags (also referred to as "air bags") create a soft barrier between the driver or passengers and other parts of the car. However, not all airbags work as they should; cases of improper or failed deployment of air bags have led to serious injuries as well as death.
Here are some manufacturer-based reasons why airbags may fail to function as they were intended:

- Lack of Internal Tethers: specialized straps help the bag inflate in a flat and wide shape; this helps cushion the body in a soft manner. However, if these internal tethers fail or are not available, the airbag inflates to a round shape, bringing it much closer to the car occupant and making it more dangerous.
- Faulty Crash Sensors: Airbags come equipped with sensors making them respond to a crash in a timely manner. However, some of these sensors in defective cars go off unnecessarily, making the airbags deploy at odd times, even where there's no collision.
- Failure to Carry Out Comprehensive Test Crashes: Some car manufactures release vehicles into the market without thoroughly testing the airbag system. For instance, the manufacturer might fail to test how these airbags would deploy in a number of different scenarios.
- Super Powerful Inflators: Some airbags come fitted with single-force inflators which have since been replaced with multi-force inflators. Single-force inflators usually fail to apply even pressure during deployment, thus causing injury.

According to research data released by the National Highway Traffic Safety Administration, tests have shown that airbags produced by the Japanese supplier for vehicles dating back to the 2001 to 2003 model-years may have a failure rate of as much as 50 percent. Newer models are expected to see increased failures as they age, as well.
Takata airbags are particularly prone to age-related failures, according to the NHTSA and other industry experts. The company used a highly volatile chemical, ammonium nitrate, in the inflator modules that produce the hot gases that propel its airbags out of their hiding place. An industry-funded research team this year concluded that the pyrotechnic chemical is especially sensitive to extended use in hot, damp climates, like southern Florida, but will eventually break down even in cooler, drier conditions.
All these issues can be resolved if the airbags open before the crash along with external airbag which is the basic motive of the External Airbag System.

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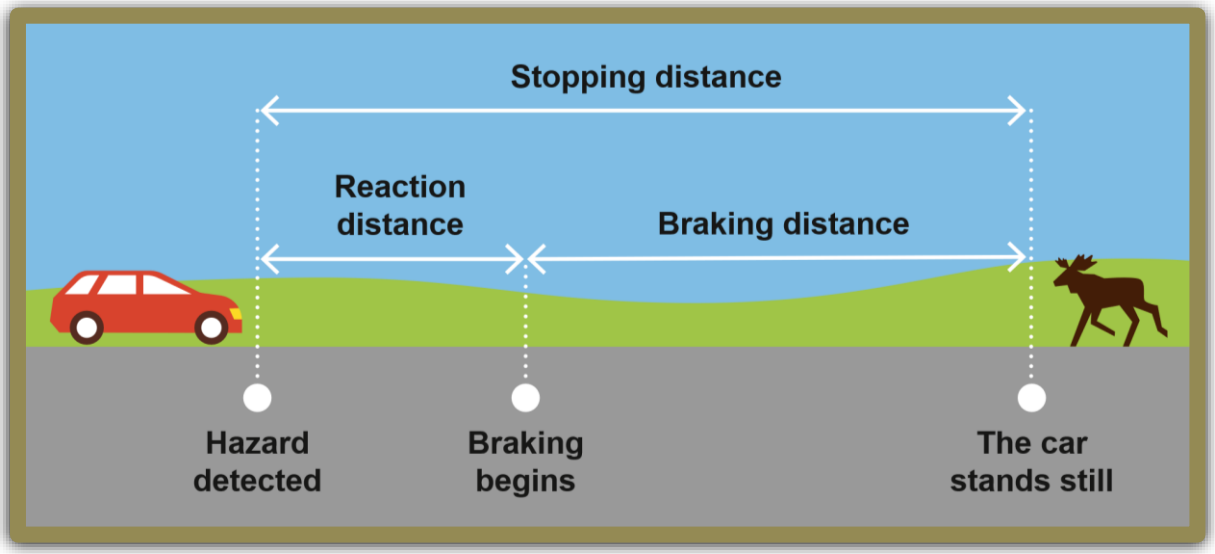
IV. WORKING

There are three stages in this project:

1) In the First Stage, the Ultrasonic Sensor gives continuous readings of the front distance as input to the microcontroller. Along with the Ultrasonic Sensor readings, Present Vehicle Speed will be given as input to microcontroller.
2) In the Second Stage, the microcontroller will process both the front distance and the present vehicle speed and compare with the below table.
3) During this process, the microcontroller will compare the distance readings. If the change in the distance readings is very less and the present vehicle speed is greater than zero, then this situation will occur when our vehicle and the front vehicles is at similar speed. In this situation, if the present vehicle speed is greater than required stopping distance's speed, then the LED will turn on until the driver should reduce the speed to increase the distance between our vehicle and the front vehicle. This LED will be an alert system for the driver that if incase the front vehicle instantly stops in this situation; the driver won't get enough distance to stop his vehicle from hitting.
4) In the Third Stage, if there is a situation where the driver ignores the alert system and the front vehicle stops suddenly and there is not enough stopping distance for our vehicle, then surely the accident is going to occur. During this accident, just seconds away the external airbags will be deflated and these airbags will prevent damage to the body and engine of the vehicle. The passengers and the driver's safety will be taken care by the internal airbags and this project will help to avoid major damage to the vehicle.



Stopping distance = Reaction distance + Braking distance

Formula for Reaction Distance : d = (s * r) / 3.6
d =reaction distance in metres (to be calculated).
s = speed in km/h.
r = reaction time in seconds.
3.6 = fixed figure for converting km/h to m/s.

Formula for Braking Distance : $d = s^2 / (250 * f)$
d = braking distance in metres (to be calculated).
s = speed in km/h.
250 = fixed figure which is always used.
f = coefficient of friction, approx. 0.8 on dry asphalt and 0.1 on ice.

Speed	Reaction distance	Braking distance	Total stopping distance
40km/h	17m	9m	26m
50km/h	21m	14m	35m
60km/h	25m	20m	45m

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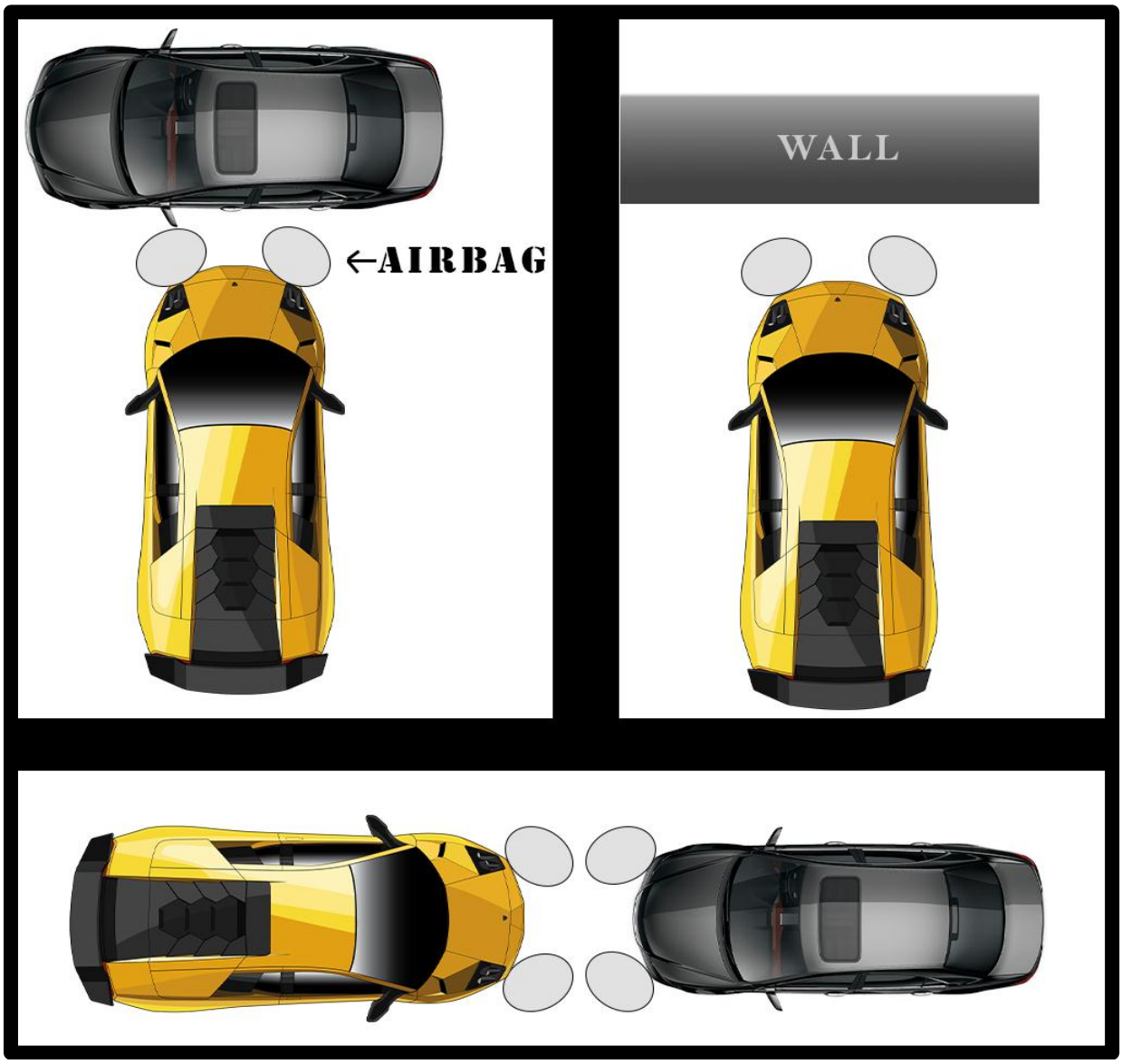
70km/h	29m	27m	56m
80km/h	33m	36m	69m
90km/h	38m	45m	83m
100km/h	42m	56m	98m
110km/h	46m	67m	113m

And now if we take the same car on a wet road:

Speed	Reaction distance	Braking distance	Total stopping distance
40km/h	17m	13m	30m
50km/h	21m	20m	41m
60km/h	25m	29m	54m
70km/h	29m	40m	69m
80km/h	33m	52m	85m
90km/h	38m	65m	103m
100km/h	42m	80m	122m
110km/h	46m	97m	143m

Below shown are the situations in which external airbags will help to avoid major damage to vehicles.



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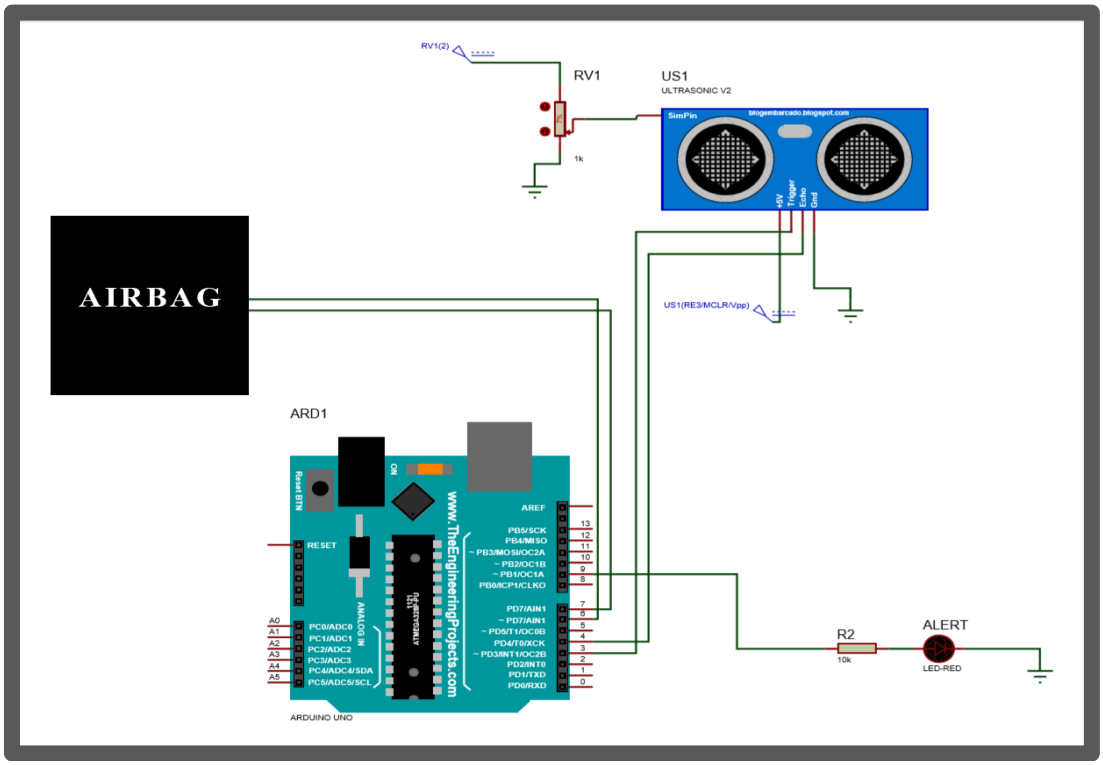
V. CIRCUIT DIAGRAM



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BIOGRAPHIES

Rohit Kothawale is pursuing Bachelor of Engineering in Electronics and Telecommunication at Sinhgad College of Engineering, Pune. His field of interests include Embedded System, Robotics & Automation.

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