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# THE AIRBAG SYSTEM FOR 2-WHEELER VEHICLE SYSTEM

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## Abstract

The Airbag system is first introduced in 4-wheeler vehicles, this paper gives an information about the introduction of the airbag system can be used in the two wheelers(bikes) this paper shows the working, construction, installation and what will be problems can occurs are discussed. The concept of this airbag system is "To reduce the injuries to a rider when impacting with an opposing vehicle and/or opposing object in frontal collisions by absorbing rider kinetic energy and by reducing rider separation velocity from motorcycle in the forward direction."[2] With the help of the ANGLE sensor with an angle indicator and sense of the collision and the large frequency vibration for to open the air bag.

***Keywords****:* Airbag, sensor, two wheeler.

## 1. Introduction

Nowadays the increment in the death rate of India is 20% because of the accidents on the highways hence this invention can help us to reduce the death rate by 7% to 10% since this can be used in the pedestrian and safety department. In 4 wheeler vehicle the operations is based on the collision of two vehicles or collision with any object. This system is installed in dashboard and the battery power is consumed for working of this system [1].

Figure 1 – graph shows accidents occurs yearly in Germany

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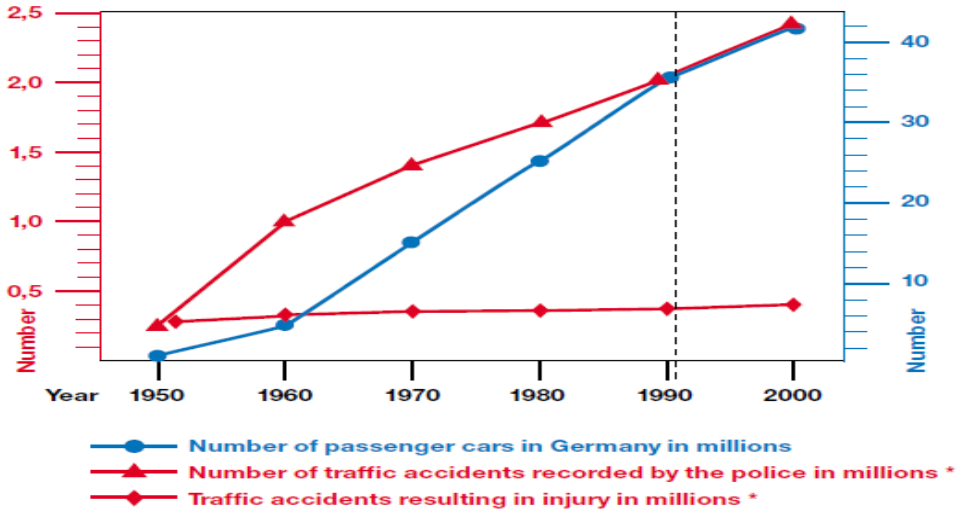


The figures speak for themselves. Over the last 50 years, the number of passenger cars has multiplied. As roads have become increasingly busy, the number of traffic accidents has also increased dramatically [1].The new system which can help to severity of injuries caused by frontal collision is to be made available on the new gold Wing motorcycle [7].In the 2-wheeler system there is installation of the airbag system in between and at both sides of the bike. There is usage of the battery of bike for working of system. There are two cases when system runs by both the angle difference calculation and collision of the 2 bikes or by the any accident of bike with any object.

## 2. Design with required instruments

There are following instruments used for the 2 wheeler AIRBAG system—
2.1 Air bag (leather material with grip technology)
2.2 Chemical cylinders for releasing the air or gas
2.3 Sensors (angle sensor and crash sensor)
2.4 Fitting cage
2.5 Angle measurement instrument (angle indicator)
2.6 Battery used (bike battery)

### 2.1 Air bag (leather material with grip technology)

Airbags are stretchable fabrics or other materials that are tightly packed in various locations throughout your vehicle. These bags are compressed and kept in a small area. When there is an accident, the airbags fill up with air very quickly to provide a cushioning system for the people on the motorcycle so that they are not thrown around in the event of a crash. While this does not necessarily prevent total injury or death, it can be very helpful in cushioning the passengers in many cases. [6]

### 2.2 Design of strong leather grip technology air bag

- Strong leather with grips is used to construct the air bags.
- Especially as the lower surface of the air bags take the friction caused due to the road surface.
- The grip is used to avoid slipping or skidding of the bike on the oily or wet surface areas.
- The shape of the air bag is semi-circular “D” shape on both sides of the bike.

### 2.3 Chemical reaction behind opening of airbag

Actual opening of air bag is due to the chemical reaction occurred in between two chemical cylinders which are fitted at the bottom of bike. When an external force or collision of two objects with bike occur then those two chemical cylinders mixes with each other and the chemical reaction takes place inside the cylinder.

At the outlet of the cylinder, the high pressure exhaust gas (air) is expanded from exit valve. The pressure can be controlled by pressure valve in between air bag and chemical cylinder. This exhaust air or gas is used to fill the air bag and hence an air bag will open. The signals from the various sensors are fed into the Airbag control unit, which determines from them the angle of impact, the severity, or force of the crash, along with other variables. Each restraint device is typically activated with one or more pyrotechnic devices, commonly called an initiator or electric match. The electric match, which consists of an electrical conductor wrapped in a combustible material, activates with a current pulse between 1 to 3 amperes in less than 2 milliseconds. When the conductor becomes hot enough, it ignites the combustible material, which initiates the gas generator. In a seat belt pre-pensioner, this hot gas is used to drive a piston that pulls the slack out of the seat belt.[5]

In an airbag, the initiator is used to ignite solid propellant inside the airbag inflator. The burning propellant generates inert gas which rapidly inflates the airbag in approximately 20 to 30 milliseconds. An airbag must inflate quickly in order to be fully inflated by the time the forward-traveling occupant reaches its outer surface. Typically, the decision to deploy an airbag in a frontal crash is made within 15 to 30 milliseconds after the onset of the crash, and both the driver and passenger airbags are fully inflated within approximately 60-80 milliseconds after the first moment of vehicle contact. If an airbag deploys too late or too slowly, the risk of occupant injury from contact with the inflating airbag may increase. Since more distance typically exists between the passenger and the instrument panel, the passenger airbag is larger and requires more gas to fill it.

Airbag systems contained a mixture of sodium azide ($NaN_3$), $KNO_3$, and $SiO_2$. A typical driver-side airbag contains approximately 50-80 g of $NaN_3$, with the larger passenger-side airbag containing about 250 g. Within about 40 milliseconds of impact, all these components react in three separate reactions that produce nitrogen gas. The reactions, in order, are as follows [5].

(1) $2\ NaN_3 \rightarrow 2\ Na + 3\ N_2\ (g)$

(2) $10\ Na + 2\ KNO_3 \rightarrow K_2O + 5\ Na_2O + N_2\ (g)$

(3) $K_2O + Na_2O + 2\ SiO_2 \rightarrow K_2O_3Si + Na_2O_3Si$ (silicate glass)

The first reaction is the decomposition of $NaN_3$ under high temperature situation using an electric impulse. This impulse generates to 300 °C temperatures required for the decomposition of the $NaN_3$ which produces Na metal and $5N_2$ gas. Since Na metal is highly reactive, the $KNO_3$ and $SiO_2$ react and remove it, in turn producing more $N_2$ gas. The second reaction shows just that. The reason that $KNO_3$ is used rather than something like $NaNO_3$ is because it is less hygroscopic. It is very important that the materials used in this reaction are not hygroscopic because absorbed moisture can de-sensitize the system and cause the reaction to fail. The final reaction is used to eliminate the $K_2O$ and $Na_2O$ produced in the previous reactions because the first-period metal oxides are highly reactive. These products react with $SiO_2$ to produce a silicate glass which is a harmless and stable compound [5].

The effect of introducing a helmet and backing surface as well as seat belts to avoid head/neck injury are currently being studied. The study is limited by the fact that the only one type of the airbag (some folding pattern and single cylinder) was used in study[8].

In 2-wheeler vehicle system, the air bags are fitted in both sides of the bike. Figure 1 shows the position of the air bag system to be fitted so that the total protection of the vehicle can be covered hence they pedestrian safety can be achieved.

### 2.4 Sensors (angle sensor and crash sensor)

The most important parts of the success of the airbag system are the sensors. These small pieces of electronics are designed to tell when the vehicle has been damaged in an accident. They respond to several different sets of stimuli, including sudden stopping, increased pressure as pieces of the motorcycle are moved due to the force

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of the collision, and angle between road surface and tires of motorcycle. Different types of sensors measuring wheel speed, seat occupant status, brake pressure and impact, and other vehicle status indicators are monitored by the airbag control unit located in the front portion of the cabin. The sensors relay signals to the airbag control unit, which analyzes the data and can orchestrate safety features like seat belt lock, automatic door locks, as well as airbag deployment. Two types of airbag sensors used in automobiles are electrical and mechanical. Electrical sensors vary in design. Some use an electromechanical "ball and tube" mechanism, which basically consists of a small tube containing a circuit switch and ball that's held together by a small magnet. If a collision occurs, the ball is dislodged from the magnet and rolls forward in the tube, hitting a switch that completes the electrical circuit. Other electrical designs are similar in principle, using a metal roller or spring loaded weight instead of a ball, Mechanical sensors work independent of the electrical system and respond similarly to the electrical sensors, with a design that actuates a firing pin triggering a small explosion after a crash. Since a mechanical sensor does not require a power source, it cannot be deactivated like an electrical sensor can when the battery is disconnected.

The success of the airbag system relies upon the crash sensors working not only accurately but also extremely quickly, so the most expensive and technologically advanced part of the airbag system are here[4].

### 2.5 Inflator

Once the control unit determines there is an accident, it sends a signal to the inflator system. The inflator sets off a chemical charge, producing an explosion of nitrogen gas, filling up the airbag. As the airbag fills up, it bursts through the paneling that contains it and order to protect you.

This all happens in an instant, usually within 25 or 50 milliseconds. That translates to almost 200 miles per hour. The airbag then will deflate itself on its own once it deploys [4].

### 2.6 Angle sensor

The TLE5012B is a 360° angle sensor that detects the orientation of a magnetic field. This is achieved by measuring sine and cosine angle components with monolithic integrated Giant Magneto Resistance (iGMR) elements. High precision angle values are achieved over temperature and lifetime using internal auto calibration algorithm. Data communications are accomplished with a bi-directional SSC Interface that is SPI compatible. The absolute angle value and other values are transmitted via SSC or via a Pulse-Width-Modulation (PWM) Protocol. Also the sine and cosine raw values can be read out. These raw signals are digitally processed internally to calculate the angle orientation of the magnetic field (magnet).

The TLE5012B is a pre calibrated sensor. The calibration parameters are stored in laser fuses. At start-up the values of the fuses are written into Flip-Flops, where these values can be changed by the application specific parameters [3].

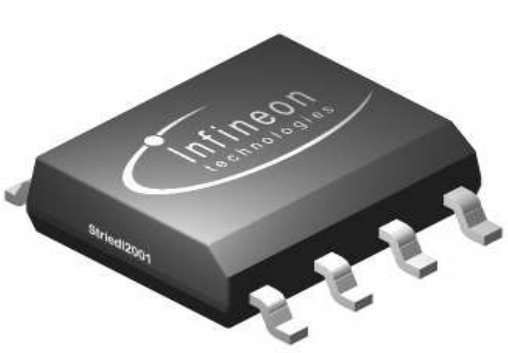


Figure1.angle sensor (TLE5012B)

## 3. Technical feathers

• Giant Magneto Resistance (GMR)-based principle
• Integrated magnetic field sensing for angle measurement
• Full calibrated 0 - 360° angle measurement with revolution counter and angle speed measurement
• Two separate highly accurate single bit SD-ADC
• 15 bit representation of absolute angle value on the output (resolution of 0.01°)
• 16 bit representation of sine / cosine values on the interface
• Max. 1.0° angle error over lifetime and temperature with activated auto-calibration
• Bi-directional SSC Interface up to 8Mbit/s
• Supports SIL with diagnostic functions and status information
• Interfaces: SSC, PWM, Incremental Interface (IIF), Hall Switch Mode (HSM), Short PWM Code (SPC)
• 0.25 µm CMOS technology
• Automotive qualified: -40°C to 150°C (Junction Temperature)
• ESD > 4kV (HBM)
• RoHS compliant (Pb-free package)

3.3 Application Circuit

The application circuit in Figure shows the different communication possibilities of TLE5012B.

Figure shows a basic block-diagram of the TLE5012B with PWM Interface. Additionally to the PWM the SSC Interface could be used. Within the SSC Interface the PWM mode is selectable between Push-Pull and Open Drain [3].

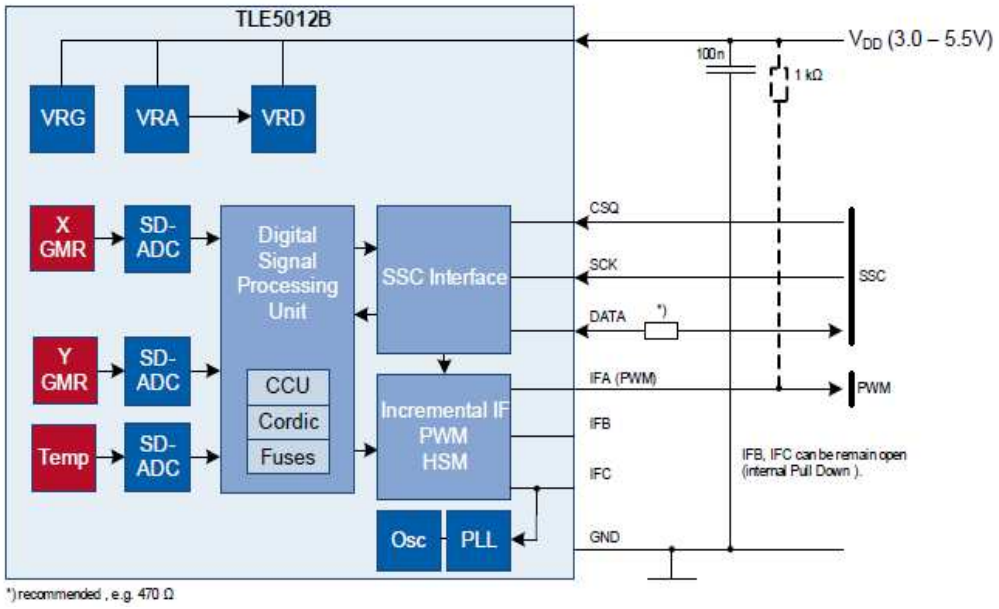


Figure2. Application circuit for TLE5012B with SSC and PWM interface (using internal CLK)

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## 4. Fitting cage

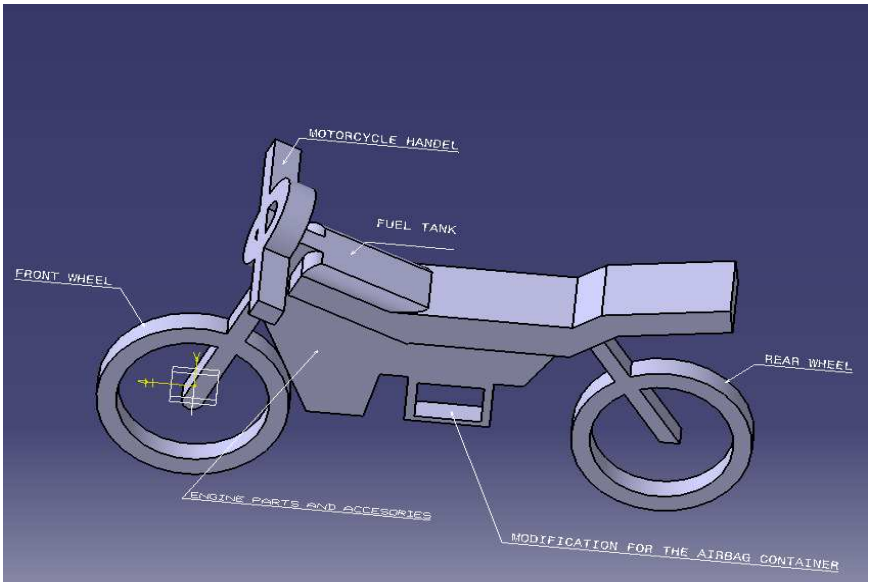


Figure 3. Modification for the airbag container

Figure 3 shows that the modification is required for the storage of airbag. This cage is made up of metal strips with two openings for airbag.

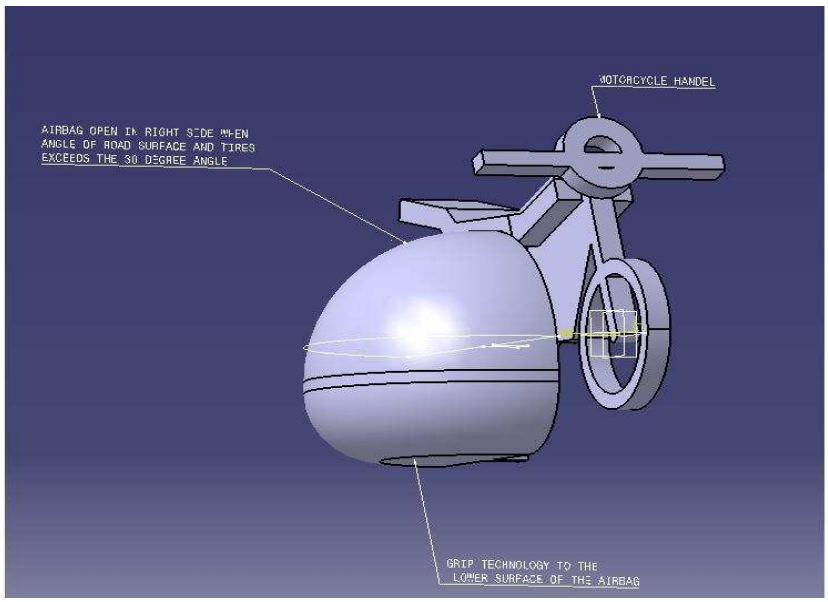


Figure 4 airbag open in right side of bike due to exceeds the angle less than 30 degree

From figure 4 motorcycle exceeds the angle less than 30 degree in between road surface and motorcycle tires by using an angle sensor, hence as given above chemical reaction takes place and airbag opens in right side of the motorcycle. In this figure 4 shows that the airbag contains Grips to the lower surface of it.

In figure 5 airbag open in both directions when any object collapse to the motorcycle. When any object collides with the motorcycle at that time the airbag open in both directions to protect the passenger who is riding.

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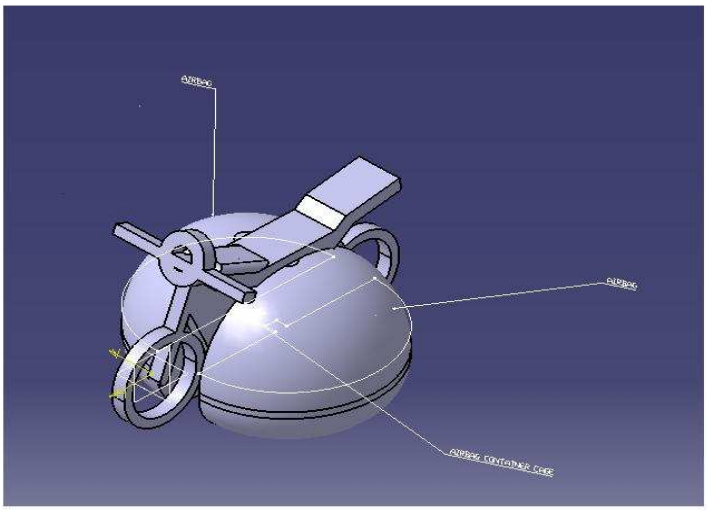

Figure 7- airbag open in both directions when any object collapse to the motorcycle.

## 5. Angle measurement instrument (angle indicator)

- When the proximity sensor is active then it will measure the angle between road surface and the tires of the bike.
- This angle is displayed on the angle indicator which is fitted near the speedometer on the handle.
- This indicator will give signal about the degrees in which the bike will turn/tilt.
- When the angle is less than 30 degrees to the right or to the left side, then the air bag will open.

**5.1The angle indicator –**

-The angle indicator looks like protractor used in geometry constructions.

-When bike tilts to the right side then the angle measured by the proximity sensor is positive and is less than 30 degrees, the air bag will open.

-When bike tilts to the left side then the angle measured by the proximity sensor is negative and is less than 30 degrees, the air bag will open.

-When needle of the indicator shown 90 degrees the bike is up and running on a flat surface. That is safe line as shown in the figure.

-This indicator is directly connected to the proximity sensor by the protective wires.

**How air bag system protects the human body parts –**The provision of air bags on motorcycles is more complex than installation in cars, because the dynamics of a motorcycle crash are more difficult to predict but we discuss following points on accident [6].These characteristics leads to act with very short reaction time and fast inflation but only if the motorcycle is involve in the accident the greater limit of these device is that they work properly only under the particular conditions Especially the rider must remain on the motorcycle during the accident and the impact dynamics must lead him to hit exactly thr part of his vehicle protected by airbags[9]

Normally, following kinds of bodily harms occur in the accident

-Hand/leg Cracks or fractures
-Head injury
-Bleeding from body parts
-Getting thrown from bike

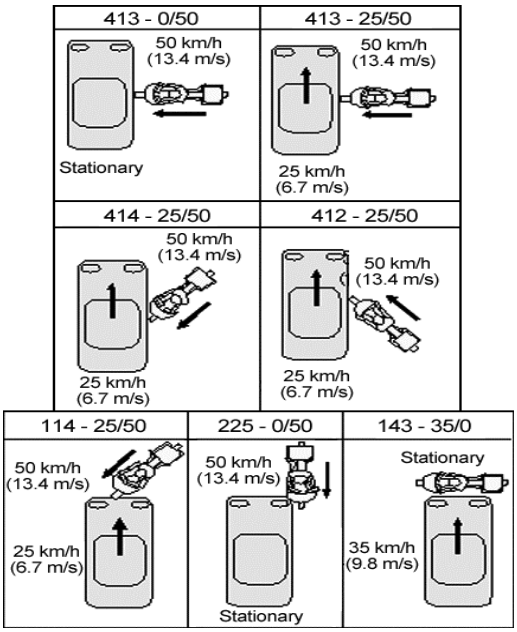

Figure 8:-configuration of impact of motorcycle to car

We can get protection from the above mentioned bodily harms as described as, the air bag system opens from the bottom to the left or right side of bike; hence we can avoid hand/leg cracks or fractures. The diameter of the air bag when opened is more than height of the bike and that of the rider, hence head injury is avoided. As the material used in the air bag construction is light weight strong leather the chances of bike skidding or slipping is diminished and external injuries like scratches are avoided. The chances of the rider being thrown from the bike are avoided as the leather belts are provided on both sides of the bike to secure the legs of the rider. The material used for constructing these belts is similar to those used for constructing the seat belts in the cars.

## Conclusion

By providing the total safety to the motorcycle rider by implanting the airbags in both sides of the motorcycle as mention in this paper we will reduce the fatality rate by 20% to 30%.by using this technology there is not only reduce the death rate but also we gives the total protection to the rider as well as motorcycle. The experimental research will show the how this system is useful and It may be published as soon as possible.

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