



SAFETY SYSTEM FOR MOTORCYCLES

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Abstract: Motorcycles have been one of the major modes of transport in everyday life. Nearly 74.8 percent of the vehicle users depend on two wheelers. Motorcyclists are more vulnerable on the road and are more likely to get injured or killed compared to other modes of transport. With the increasing levels of technology, comforts, ease of work and entertainment is also increasing but safety of occupants of a vehicle are yet to be developed more, most importantly two wheelers. Two wheelers are widely used because of their ease of operation but in the same way accidents of motorcyclists are unavoidable. Most of the fatality occur because they fail to use proper safety measures. In case of cars, airbag provides the minimal safety to prevent fatality. To provide safety for the bike riders we came up with a project which aims to reduce fatality rate of bike riders. Airbag setup is fitted on either side of the vehicle which inflates with help of appropriate sensors when the vehicle is tilted less than its safety limit or when hit by another vehicle. When the airbag is inflated, the motorcyclist falls over the airbag and is saved from any major injuries.

IndexTerms - Airbag, Motorcycles, Accident, Safety, Reusable.

Introduction

Transport in India consists of transport by land, water, and air. Public transport is the primary mode of road transport for most Indian citizens. India's public transport system is among the most regularly used transport. India's road network is transporting 8.225 billion passengers and over 980 million tons of cargo annually. About 21% of households have 2-wheelers whereas 4.70% of households in India have cars or vans.

Road accidents in India kill almost 1.5 lakh people annually. Accordingly, India accounts for almost 11% of the accident-related deaths in the world. Nowadays, there is an increase in the death rate by 20% in India because of accidents on highways.

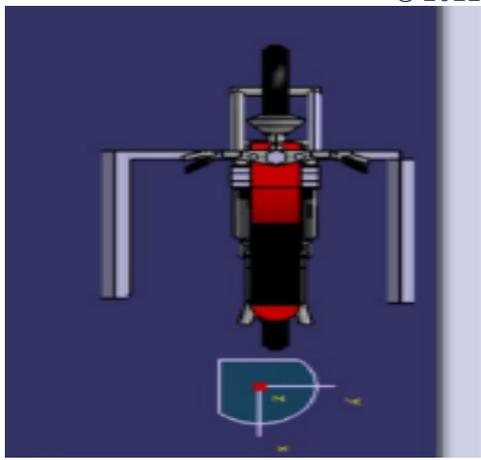
At present, helmets are regarded as the only primary safety device which can safeguard the rider against any major head injuries. Out of most motorcyclists, only a few percent of them prefer to wear a helmet as they claim a helmet doesn't provide them the riding comfort. Another type of safety measure includes a Riding gear which is heavy, not economical, and not suitable for Indian weather conditions.

The above safety measures can be of great help only if the rider is willing to wear them. Another issue includes the negligence of riders even though heavy fines are imposed on those who don't follow traffic rules. There are cases where accidents may occur not because of you, but the other person's carelessness which results in the collision. Whatever may be the case, negligence and carelessness can cost your life.

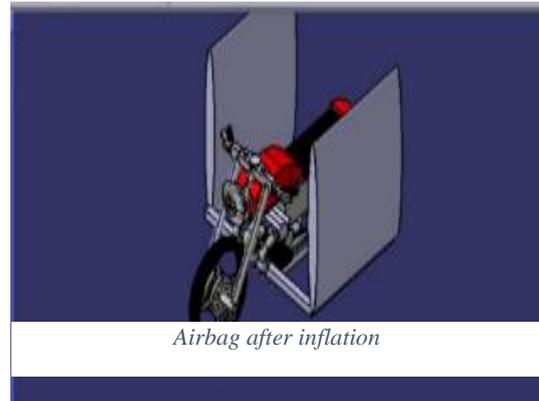
To overcome these problems, we are introducing a safety system i.e., Airbags in Two Wheelers which saves the motorcyclists during an accident or when the motorcycle skids and the person falls either to the left or right.

Methodology

This safety system works with the help of a C - shaped channel is welded to the crash guard in such a way that the longer arms of the channel are parallel to the length of the vehicle. The channel consists of an airbag that is compressed in such a way that it opens vertically when inflated and also the mechanism for inflation is reserved here. The top surface of the channel is covered some light material in such a way that it gets blown away when the airbag is inflated. All this setup is attached to either side of the vehicle. The inflated airbag of a motorcycle is designed in Catia V5.



Airbag setup before inflation



Airbag after inflation

The components we use for the two-wheeler airbag system are as follows:

1. Airbag
2. Sensors (Angle sensor)
3. Air inflation mechanism
4. Fitting rod
5. Battery (Mostly bike battery)

Airbag: These are fabrics that can be stretched and are placed in the channel attached to the motorcycle. These airbags are compressed while they are in the channel. When an accident occurs, the airbag is inflated with air and it acts as a cushion so that the person on the bike falls on the stretched airbag rather than directly falling on the road. While this may not necessarily prevent total injury or death, but it definitely helps in reducing the chances of any major injury. The airbag is made with strong leather and it is rectangular in shape. To determine the exact dimensions of the airbag, we considered Hero Splender Plus and its dimensions are as given below

Dimensions	in mm	in cm	in inches	in feet
Length	1970	197	77.56	6.46
Width	720	72	28.35	2.36
Height	1040	104	40.94	3.41
Wheelbase	1230	123	48.43	4.04
Ground Clearance	159	15.9	6.26	0.52

Body Dimension of Hero Splender Plus

After considering the above dimensions of the bike, we concluded the following dimensions of the airbag when it is inflated i.e., 5.5 ft (66 in) height, 24 length of the airbag depends upon the distance from crash guard to rear end of the rear wheel of the bike (we approximated length to wheelbase i.e., 76.2 cm (30 in)), the safe thickness of the airbag is 18 cm (7 in). From the above-mentioned dimensions, the volume of the airbag would be 13,860 cu in (227 lit).

Sensors: A Micro Inertial Measurement Unit (μ IMU) which is based on MEMS accelerometers and gyro sensors is developed as the motion sensing part of the system. A weightless recognition algorithm is used for real-time falling determination. With the algorithm, the microcontroller integrated with μ IMU can discriminate falling-down motion from normal motorcycle motions and trigger an airbag system when a fall occurs.

Airbag Inflation Mechanism: The airbag system is a multi-sensor detection system that follows the motorcycle movements more than 1000 times per second and analyses the situation in real-time. Once the system detects that the bike is tilting over a certain angle, the airbag inflates automatically before the motorcyclist hits the road. The system uses sensors that follow and analyse the motion in real-time. The powerful algorithm and the analysis of the data enable the system to distinguish an accident from a normal situation. As soon as the motorcycle tilts over a certain angle, the electronic system analyses the situation and sends a signal to the e-cartridge i.e., the cylinders containing CO₂ that trigger the airbag in a fraction of a second.

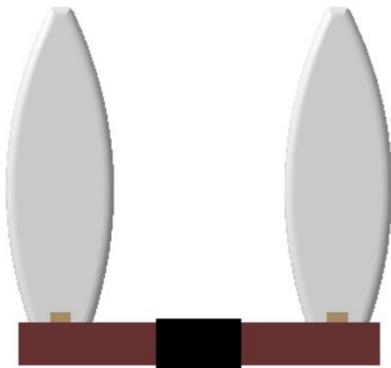
C – Shaped Channel: Two channels of the same cross-section are mounted on either side of the motorcycle, next to the foot pedal. The channels are supported with the help of the crash guard at the front. The airbag is compressed and stored inside the channel in the shape of a rectangular balloon.

Product Design in CATIA V5

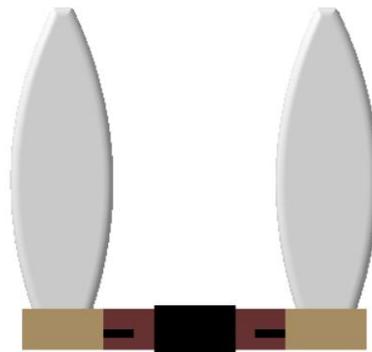
Idea has been designed in Catia V5. Different views of our project are as shown below



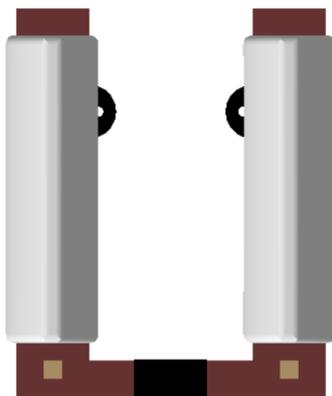
Perspective View



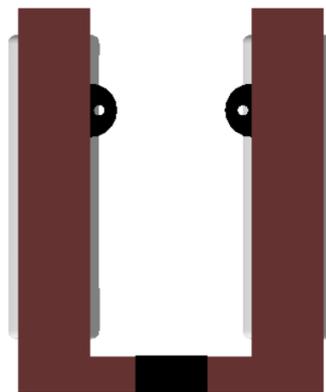
Front View



Rear View



Top View

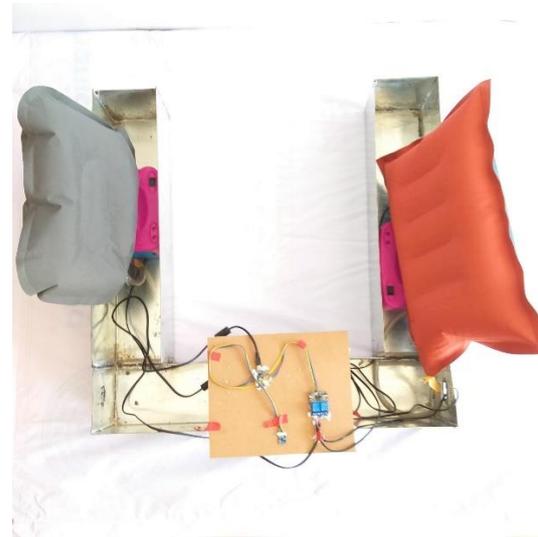


Bottom View

*Right Side View**Left Side View*

Prototype

Our idea includes inflation of airbags. In order to portray that we considered 2 AC air pump motors, MS sheet of gauge 30, 2 air pillows, accelerometer ADXL 345, Arduino Nano board and SPDT relay module. An MS sheet is bent, cut and welded into a C-shaped channel. All the above-mentioned components are placed in appropriate position in the C-shaped channel as shown in figure.



Two AC air motors are controlled by SPDT relay module. This relay module is connected to Arduino Nano board and it acts as an output to the board and on the other hand an accelerometer ADXL 345 is acting as an input to the Arduino Nano board. The board is powered by means of DC supply through USB cable. The motors are powered through AC supply. When the setup is tilted either to the left or right the accelerometer sends signal to the Arduino Nano board which in turn causes the relay module activates the respective air motor.

Relay: A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long-distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations. There are four types of relay designations

- i. SPST – Single Pole Single Throw
- ii. SPDT – Single Pole Double Throw
- iii. DPST – Double Pole Single Throw
- iv. DPDT – Double Pole Double Throw

From the above-mentioned designations as per our requirements we choose SPDT because we are getting a single output from the accelerometer and sending the signal to dual motors.

SPDT – Single Pole Double Throw. A common terminal connects to either of two others. Including two for the coil, such a relay has five terminals in total.

If there is not enough DC supply in coil terminals then Relay represents idle condition that is common terminal connected in N/C terminal. When the coil gets required DC supply then coil gets Magnetically Energized and this magnetic flux force attracts common terminal lever which is made of iron and makes the connection to N/O terminal, now the N/C becomes open.

Relays are used to and for:

- Amplify a digital signal, switching a large amount of power with a small operating power.
- A telegraph relay, repeating a weak signal received at the end of a long wire.



SPDT

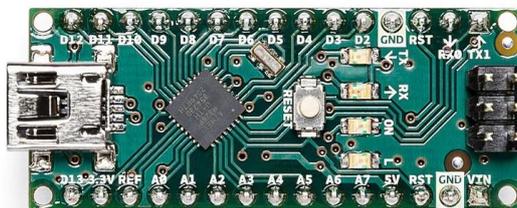
Accelerometer ADXL 335: An accelerometer is a device that measures proper acceleration ("g-force"). Proper acceleration is not the same as coordinate acceleration (rate of change of velocity).

It is Breakout board for the Analog Device’s ADXL345 Triple axis accelerometer with Voltage regulator onboard. The module is populated with MOSFET based Voltage level conversion circuitry to enable you to interface different type of microcontrollers (3V3 & 5V). Apart from the above all necessary components like decoupling capacitors, filter capacitors, pull up resistors and LED are also populated on board.



Accelerometer ADXL 335

Arduino Nano: The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.



Arduino Nano

The above-mentioned sequence works on the following code

```
#include<SoftwareSerial.h>
SoftwareSerial mybt(2,3); //mybt function declaration
//SoftwareSerial mySerial(D7,D4);//serial port of gsm
int m=0, n=0;
```

```

void setup() {
pinMode(10, OUTPUT);
pinMode(11, OUTPUT);
pinMode(12, OUTPUT);
pinMode(13, OUTPUT);
pinMode(A0, INPUT);
pinMode(A1, INPUT);
mybt.begin(9600);           //Function Call
Serial.begin(9600);
}

void loop() {
m = analogRead(A0);       //m is the stop constant
n = analogRead(A1);       //n is the angle variable
//Serial.println(m);
//delay(500);
//Serial.println(n);
//delay(500);
if(n>=375){
digitalWrite(10, LOW);
digitalWrite(11, HIGH);
digitalWrite(12, HIGH);
digitalWrite(13, HIGH);
mybt.write("F");
Serial.println("F");
}
else if(n<=320)
{
digitalWrite(10, HIGH);
digitalWrite(11, LOW);
digitalWrite(12, HIGH);
digitalWrite(13, HIGH);
mybt.write("B");
Serial.println("B"); }
else if(m>=375)
{
digitalWrite(10, HIGH);
digitalWrite(11, HIGH);
digitalWrite(12, HIGH);
digitalWrite(13, HIGH);
mybt.write("R");
Serial.println("R");
}
}

```

```

}
else if(m<=315)
{
  digitalWrite(10, HIGH);
  digitalWrite(11, HIGH);
  digitalWrite(12, HIGH);
  digitalWrite(13, HIGH);
  mybt.write("L");
  Serial.println("L");
}
else
{
  digitalWrite(10, HIGH);
  digitalWrite(11, HIGH);
  digitalWrite(12, HIGH);
  digitalWrite(13, HIGH);
  mybt.write("N");
  Serial.println("N");
}
}
}

```

Description of Code:

#include<SoftwareSerial.h>:

The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino Nano, using software to replicate the functionality (hence the name "SoftwareSerial").

It is possible to have multiple software serial ports with speeds up to 115200 bps. A parameter enables inverted signalling for devices which require that protocol.

pinMode:

Configures the specified pin to behave either as an input or an output.

Syntax: pinMode(pin, mode)

serial.begin():

The serial. begin() sets the baud rate for serial data communication. The baud rate signifies the data rate in bits per second. The default baud rate in Arduino Nano is 9600 bps (bits per second).

analogRead:

Reads the value from the specified analog pin.

Syntax: analogRead(pin)

Serial.println():

Prints data to the serial port as human-readable ASCII text followed by a carriage return character (ASCII 13, or '\r') and a newline character (ASCII 10, or '\n'). Serial. println() is the same as Serial.

delay():

Pauses the program for the amount of time (in milliseconds) specified as parameter. (There are 1000 milliseconds in a second.)

Syntax: delay(ms)

Here we took delay 0.5s or 500ms

digitalWrite():

If the pin has been configured as an OUTPUT with pinMode(), its voltage will be set to the boards) for HIGH, 0V (ground) for LOW.

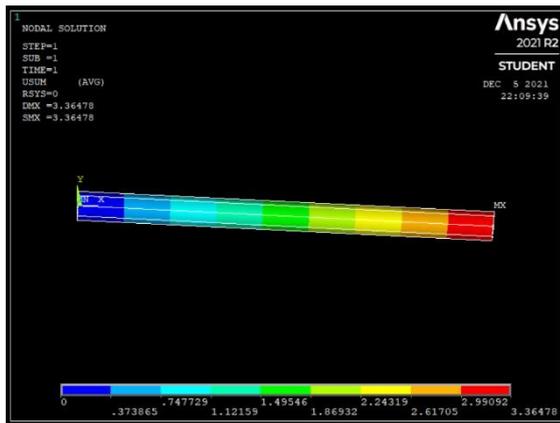
If the pin is configured as an INPUT, digitalWrite() will enable (HIGH) or disable (LOW) the internal pullup on the input pin. It is recommended to set the pinMode() to INPUT_PULLUP to enable the internal pull-up resistor

If you do not set the pinMode() to OUTPUT, and connect an LED to a pin, when calling digitalWrite(HIGH), the LED may appear dim. Without explicitly setting pinMode(), digitalWrite() will have enabled the internal pull-up resistor, which acts like a large current-limiting resistor.

Syntax: digitalWrite(pin, value)

Material Analysis

Airbag setup is fitted in a mild steel rod. We decided to use mild steel because it resists rusting and it provides great strength. Analysis of the mild steel has been done in Ansys and the results are attached below.



PRNSOL Command

File

PRINT U NODAL SOLUTION PER NODE

***** POST1 NODAL DEGREE OF FREEDOM LISTING *****

LOAD STEP= 1 SUBSTEP= 1
TIME= 1.0000 LOAD CASE= 0

THE FOLLOWING DEGREE OF FREEDOM RESULTS ARE IN THE GLOBAL COORDINATE SYSTEM

NODE	UX	UY	UZ	USUM
1	0.0000	0.0000	0.0000	0.0000
2	0.0000	-3.3574	0.0000	3.3574

MAXIMUM ABSOLUTE VALUES

NODE	2	0	2	
VALUE	0.0000	-3.3574	0.0000	3.3574

Advantages:

- 1 Safety of the rider is improved using this system.
- 2 This system would help to reduce the impact of the accident on the rider in case of the rider's lack of interest to wear any extra safety measures.
- 3 Major injuries or deaths can be reduced significantly.
- 4 This equipment is attached directly to the motorcycle so that the occupant need not wear any special riding suits to avoid injuries and is user friendly.
- 5 Dynamic balance of the vehicle is not bothered as equal amount of weight is added on both sides of the vehicle.
- 6 The replacement of the cylinders in the mechanism can be replaced very easily by the user themselves.
- 7 This cost of this airbag system is comparatively less than other safety airbags in automobiles.
- 8 Not only the rider, but every person on the bike will be saved from injury.

Results and Discussions

Deployment of an airbag according to the sensor's detection is the final output of this project. Here are some possible cases in which the airbag saves the person from any severe injuries or death.

- When the bike skids or gets overturned and loses its control.
- When a motorcycle hits a stationary vehicle from any angle.
- When a motorcycle hits a moving vehicle from any angle.
- When a motorcycle hits a person or an obstacle.
- When the driver from a stationary car opens the car door and it accidentally hits the moving motorcycle beside him.
- In most of the cases of accidents where the motorcyclist falls to the side, this airbag proves to be helpful by avoiding any major injuries.

Conclusions

The main theme of this project is to provide a better assurance to the safety of the motorcyclist. Airbags are of great importance in today's life since safety of human life is of prior importance. Our main objective is to utilize technology in such a way that it promises the rider safety.

Most of the people use two-wheelers as their mode of transport because of its ease for driving and maintenance but it does not provide proper safety both to the rider and the passenger where as in case of cars, airbags, seatbelts, power mechanisms and a closed environment provides enough safety.

Technology in the automobile field is booming day by day in both two-wheelers and cars but none are concerns about the safety for motorcyclists even though it is widely used vehicle. If airbags are installed in a two-wheeler as a safety system fatal injury would reduce to minor injuries and minor injuries to being totally safe.

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