Aavishkar '18
lifeBEAM - Smart Helmet

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***Abstract*- The idea of developing this project came from our social responsibility. The objective of the project - *lifeBEAM*, is to implement high-end safety features in two-wheeled vehicles. The safety features include:**
1. Checking whether the helmet has been worn by the rider.
2. Checking the "Breath Alcohol Concentration" (BAC) with the help of an alcohol sensor.
By using these two inputs the helmet decides whether to start the vehicle or not and then sends appropriate information using an RF encoder. The vehicle is equipped with an RF decoder which decodes the incoming signals from the helmet and then stops or starts the motor. The vehicle unit is also equipped with a vibration sensor which is triggered when an accident occurs. In case of an accident, the GPS module extracts the precise location of the vehicle and sends an SMS to emergency services by using a GSM module. This way the helmet tries to avoid an accident from happening, but in case of a mishap, emergency services are informed via SMS.

I. Components Required

Sr No.	Apparatus	Quantity
1.	Breadboard	4
2.	Arduino Mega	2
3.	Arduino Uno	1
4.	Led	5
5.	16x2 LCD display	2
7.	GSM Module	1
8.	GPS Module	1
9.	SW420 Vibration Sensor	1
10.	MQ-3 Alcohol Sensor	1
11.	434 MHz RF Module	2
12.	Limit Switch	2
13.	DC Motor	2
14.	Jumper wires	Many

II. INTRODUCTION

Wikipedia defines accident as - "an undesirable and incidental event that could have been prevented had circumstances leading up to the accident been recognized and acted upon prior to its occurrence. Carelessness of the driver is the major reason for such accidents."
In countries like India, accidents are a major problem nowadays. To prevent this we came up with the idea of a *Smart Helmet*.

DESCRIPTION OF COMPONENTS

- **Arduino :** Arduino is a micro-controller board based on a processor which is different for different boards. It has digital pins, analog inputs, 16 MHz crystal oscillator, ICSP header, UARTs and a reset button. The board can be programmed in C, C++ and various other languages. By selecting different pins in a programmed board as output and input pins we can control various devices.

- **GPS Module :** GPS stands for Global Positioning System. The module need at least a lock from 3-4 different satellites to work and obtain its position. The module consists of 4 pins V_{cc}, *GND*, RX, TX. To get the data from the GPS we use the RX pin as an input pin and connect it to the arduino board. The GPS gives it data in NMEA format (National Marine Electronics Association) from which we extract the longitude and latitude of the GPS.

Fig. 1. Ublox neo-6m GPS module

- **GSM Module :** GSM (Global System for Mobile communication) is a mobile communication modem. It is a widely used mobile communication system and is an open digital cellular technology used for transmitting mobile voice and data services. We are using the SIM900A GSM module because we are living in India and majority of mobile network providers here operate

at 900MHz frequency.

- **Vibration Sensor :** The vibration module based on SW-420 sensor is used to sense any amount of vibration. It consists of 4 pins which are V_{cc}, *GND*, A_{out} and D_{out}. The sensor works by producing an output voltage from the D_{out} pin which is equivalent to the degree of vibration. The pin is connected as an input pin in the arduino board and with the help of 'pulseIN' we calculate the time for which the vibration lasted. With the help of the voltage produced by the module and the time the vibration lasted we decide whether an accident has took place or not.

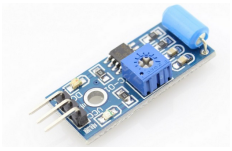


Fig. 2. Vibration Sensor - SW-420

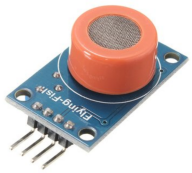


Fig. 3. MQ-3 Alcohol sensor

- **Alcohol Sensor :** MQ-3 alcohol sensor is a low cost device which uses semiconductor SnO_2 to detect the amount of alcohol present in surrounding environment. We will be using only 3 pins out of the 4 provided pins which are A_{out}, V_{cc} and *GND*. The sensor works by sensing the alcohol concentration in air and produces a corresponding voltage output from the A_out pin which we will use use as an input.

- **RF Module :** An RF Module (Radio Frequency Module) is an electronic device which is used to transmit/receive radio signals between two devices wirelessly. It works on many different frequencies like 433MHz, 315MHz, 2.4GHz etc. In our project we are using RF module which works at 434MHz.

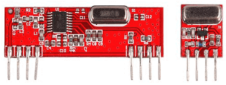


Fig. 4. RF module

Transmitter : The transmitter module consists of 4 pins V_{cc}, *GND*, DATA, Antenna. The V_{cc} and the *GND* pin are connected to +5V and ground of the arduino board respectively. The data pin is connected to any of the digital pin of the arduino board. The signal to be send is first converted in form of a string and then the message is transmitted using the antenna.

Receiver: The receiver module consists of 4 pins V_{cc}, *GND*, DATA, Antenna. V_{cc} and *GND* pin are connected to +5V and ground of the arduino board respectively. The data pin is connected to any of the digital pins of the arduino. The receiver works by receiving the data from the antenna. The message is then pushed to the board by the data pin and stored in form of a string.

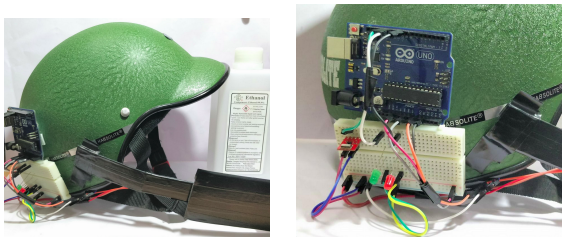
- **Motor Driver :** Motor driver is an IC that is mainly used in places where we have to program the behaviour of motors. It is a device that acts like a simple current amplifier. It takes a low-current control input and converts it to a higher-current control signal. In our project the motor driver is used as an interface between the arduino and the motors.

III. SYSTEM ANALYSIS

In this project, we have used two Arduino boards one of which is installed in the helmet unit and the other one is present in the vehicle unit. These Arduino communicate using wireless communication.

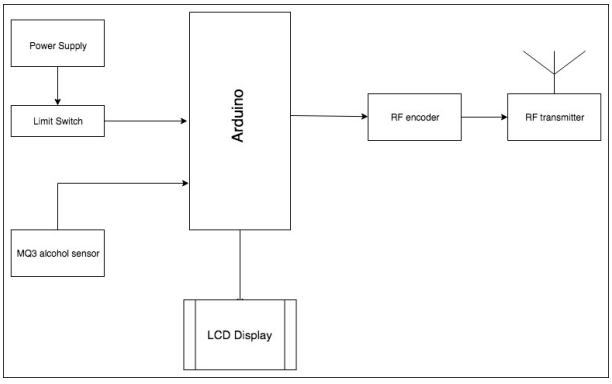
HELMET UNIT

The helmet unit comprises of limit switch, MQ-3 alcohol sensor and RF transmitter. The inputs coming from the limit switch and alcohol sensor are the main factors which decides whether the motor in vehicle unit will work or not.



(a) Side View (b) Circuit

Fig. 5. Helmet Unit



Necessary conditions to start the vehicle :

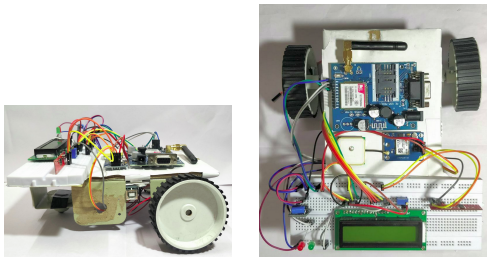
1. The limit switch is attached at the top of the helmet unit. When the driver wears the helmet the switch automatically turns on and starts to conduct whatever input is given at the *COM* terminal. The output coming out of the *NO* terminal is fed into a pin declared as an 'input pin' in Arduino. The value is stored in a variable for later decision making.

2. The alcohol sensor is attached near the mouth of the driver and it continuously senses the breath of the driver. The output coming out of the A_{out} pin of the sensor is fed into an input pin of the Arduino and saved in a variable for later decision making.

The outputs coming from the above two sensors are used to set a transmit message. If both values are HIGH the value of transmitting message becomes 0 and if both values are LOW, only then the value of the transmitting message becomes 1. The transmit message is then set in the data pin of the RF Transmitter which encodes and transmits this data to the vehicle unit.

VEHICLE UNIT

The vehicle unit includes RF Receiver, Vibration Sensor, GSM Module and GPS Module.



(a) Side view (b) Top view

(c) Bottom view

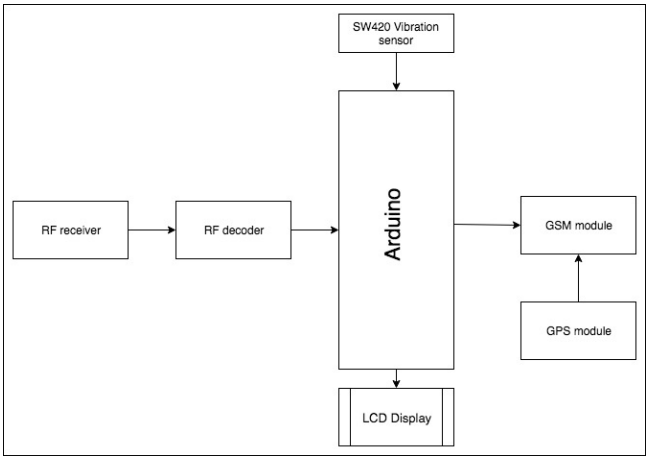
Fig. 6. Vehicle Unit

1. The RF receiver receives the data coming from the RF transmitter present in the helmet unit. It then decodes the data and feeds corresponding input to the Arduino. The motors start only when the input is 1 and it stops only when the input is 0.

2. The vibration sensor senses whether an accident has taken place or not. The output coming out of the D_{out} pin of the sensor is fed into an input pin of Arduino where its value is stored in a variable. If the value of the variable is above a threshold value it activates the GSM and GPS module.

3. GPS module reads the incoming data in NMEA form. The NMEA data is then converted into human-readable form and the value of the latitude and longitude is stored in two different variables whose values are fed to the GSM module for further procedures.

4. Depending on the input coming from the vibration sensor the module either activates or it doesn't. The GSM module is fed with the 2-D location of the place where the accident has occurred. It then sends a message to the family member of the driver informing them of the casualty.



IV. ALGORITHMS USED

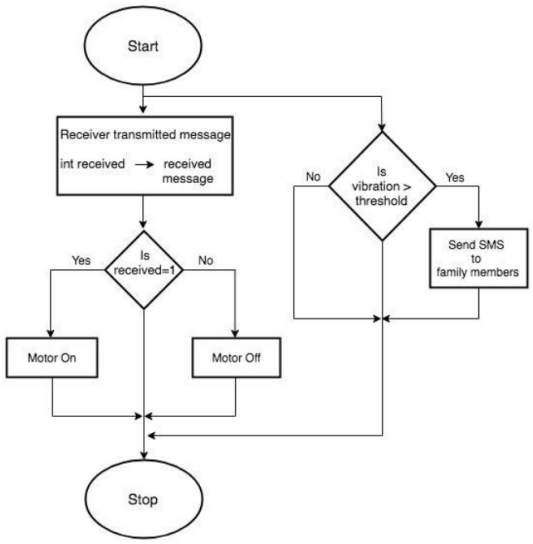


Fig. 7. VEHICLE UNIT ALGORITHM

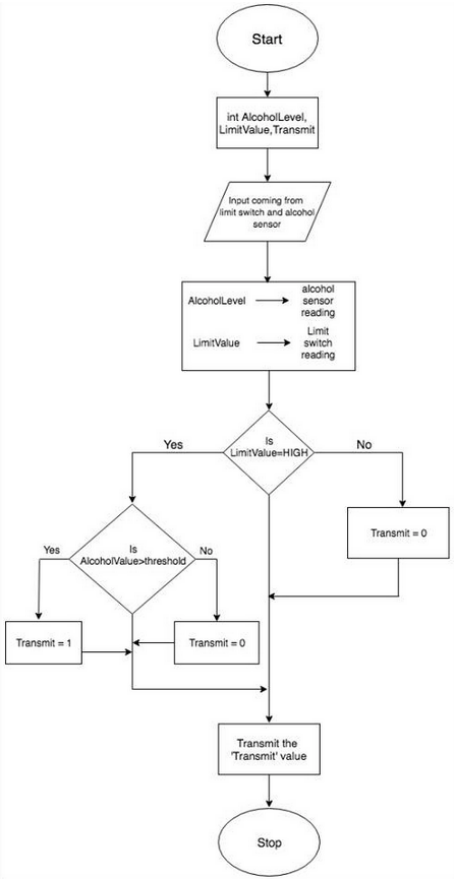


Fig. 8. HELMET UNIT ALGORITHM

V. MOTIVATION OF PROJECT

India reported around 4,64,674 road accidents in 2015 with a significant percentage of them occurring due to drunk driving. Many of the cases proved fatal because the rider was not wearing a helmet. People in India put comfort over safety and avoid wearing helmets as long as they are not fined for it. Also we have seen cases where casualties occur mainly because of delay in providing medical care to the accident victims. Using smart helmet, the information regarding location of vehicle can be sent to the hospitals, thus ensuring medical care to victims and saving lives. Our vision included a compact gadget ensuring safety on the roads, which we have finally developed.

VI. FUTURE POSSIBILITIES

In the future we plan to implement a more compact and sturdier design for the smart helmet. The system used in *lifeBEAM* should be implemented for every 2 wheeler and should be made compulsory. By implementing this system in 2 wheeler, the cases of drunk driving on 2 wheeler can be ideally brought down to zero. The helmet is required to be worn for the vehicle to start and hence the rider will avoid any major injuries to the head in case of an accident. Also the GPS and GSM systems used in the helmet can help in quickly informing the emergency services and drawing attention towards the victims of the accident. This will lead to higher chances of survival for the injured. One more application of the helmet is the ability to track the helmet and hence the vehicle in case of theft of the vehicle. We also plan to use the GPS to track the speed of the vehicle and thus set a limit on the maximum speed of the vehicle. This way we can prevent accidents happening due to over-speeding of vehicles.

In present scenario we can only keep track on the amount of alcohol the rider has consumed, but with the installation of a heart-rate monitor the pulse of the rider can be checked to determine if he has consumed any drugs and is fit to drive or not.

In the future, we plan to reduce the cost of GSM and GPS module by connecting the vehicle directly with the phone of the rider with help of mobile app which continuously communicates with the vehicle and in case of an accident it automatically gets the location from Google Maps and sends the SMS to nearby hospitals and the family member of the rider.

VII. RESULT

lifeBEAM carries out the following functions:

1) Checking whether the helmet is worn by the rider and allowing the vehicle to start only if the helmet is worn.

2) Checking the alcohol level in the breath of the rider and allowing the vehicle to start only if the alcohol content is below a specified threshold value.

3) Triggering the vibration sensor in case of an accident and sending an SMS regarding the accident with the location of the rider using GSM and GPS module.

VIII. CONCLUSION

lifeBEAM is a smart helmet developed to implement road safety. Our model was successful and worked efficiently.

The total cost of the project came at around Rs.6500. With an increase in the budget we can improve many aspects of our project to make a more efficient model.

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[5] **Theory about MQ-3 Alcohol Sensor:**
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[6] **Libraries included from:**
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[7] **[Fig-1] GPS Module :** https://bit.ly/2ki9eZ7
[8] **[Fig-2] SW-420 Vibration Sensor :** https://bit.ly/2s1q6qj
[9] **[Fig-3] MQ-3 Alcohol Sensor :** https://bit.ly/2keEubg
[10] **[Fig-4] RF Module :** https://bit.ly/2LmeWoS
[11] **[Fig-7],[Fig-8] Flow Chart :** https://www.draw.io/