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Smart helmet for safe driving

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Abstract. A smart helmet is a type of protective headgear used by the rider which makes bike driving safer than before. The main purpose of this helmet is to provide safety for the rider. This can be implemented by using advanced features like alcohol detection, accident identification, location tracking, use as a hands free device, fall detection. This makes it not only a smart helmet but also a feature of a smart bike. It is compulsory to wear the helmet, without which the ignition switch cannot turn ON. An RF Module can be used as wireless link for communication between transmitter and receiver. If the rider is drunk the ignition gets automatically locked, and sends a message to the registered number with his current location. In case of an accident it will send a message through GSM along with location with the help of GPS module. The distinctive utility of project is fall detection; if the rider falls down from the bike it sends a message.

1 Introduction

In recent times helmets have been made compulsory in Telangana State. Traffic accidents in India have been increased every year. As per Section 129 of Motor Vehicles Act, 1988, every single person riding a two-wheeler is required to wear protective headgear following the standards of BIS (Bureau of Indian Standards). Also drunken driving under the influence (DUI) is a criminal offence according to the Motor Vehicle act 1939, which states that the bike rider will get punishment. Currently bike riders easily escape from the law [1]. These are the three main issues which motivates us for developing this project.

The first step is to identify whether the helmet is worn or not. If helmet is worn then ignition will start otherwise it remains off. For this, Force Sensing Sensor (FSR) sensor is used. The second step is alcohol detection[2]. Alcohol sensor is used as breath analyser which detects the presence of alcohol in rider's breath and if it exceeds permissible limit ignition cannot start. It will send message to the number saying that "Rider is drunk and is trying to ride the bike". MQ-3 sensor is used for this purpose. When these two conditions are satisfied then only ignition starts. The third main issue is accident and late medical help. If the rider has met with an accident, he may not receive medical help instantly, which is one of the main reasons for death. Every second people dies due to delay in medical help, or in the case where the place of accident is unmanned. In fall detection, we place accelerometer in the bike unit. By this mechanism accidents can be detected.

The aim of this project is to make a protection system in a helmet for the safety of bike rider. The smart helmet that is made is fitted with different sensors responsible for detection[3]. There are two main units in this project. Each unit uses a microcontroller. Signal transmission between the helmet unit and bike unit is done using a RF module.

2 Technical Studies

2.1 Force Sensing Resistor (FSR)

Force Sensing Resistor in Figure 1 is placed inside the helmet, where the actual human touch is sensed. It is determined by the helmet unit whether it is worn or not before starting the bike. If this condition is satisfied, then it sends the signal to bike unit to start. Force Sensing Resistors or FSRs are strong polymer thick film (PTF) devices whose resistance is inversely proportional to force applied to the face of the sensor.



Fig. 1. FSR

This sensor is used as human touch control in various applications, such as medical systems, automotive electronics and in robotics and industrial applications. Force sensing resistor is a two-wire sensor with a resistance that changes on applied force.

2.2 MQ-3 Alcohol Sensor

MQ-3 gas sensor shown in Figure 2 is used for identifying the alcohol content from breath. It can be positioned just in front of the mouth. The sensor responds to various molecules in alcohol and determines if the rider is drunk. The sensor also has a potentiometer to adjust the concentration of gases. We calibrate the detector for 0.4mg/L of alcohol concentration in air and use a resistance of 200 K Ω . It has a 4 pins namely GND, VCC, A out and D out. The sensor supports both analog and digital outputs. Here we use digital output of this sensor.



Fig. 2. MQ 3 sensor

2.3 Accelerometer ADXL345

The ADXL345 in Figure 3 is a tiny, tri-axial accelerometer with resolution of 13 bit. The output of accelerometer is digital and uses 16 bit 2's complement data. It can be connected via Serial Peripheral Interface (SPI 3-4 wire) or I2C interface. ADXL345 is used for both measurement of static and dynamic acceleration. In this project we use accelerometer, which measures the static acceleration of gravity. Free-fall sensing unit senses if the bike is falling. And Bike unit take decision that accident is occurred or not.



Fig. 3. ADXL345

2.4 RF communication circuit

An RF transmitter module is a small PCB sub-assembly capable of transmitting radio waves and modulating radio wave to carry data (see Figure 4). Transmitter modules are usually implemented alongside a microcontroller which will provide data to the module that can be transmitted. RF transmitters are usually subject to regulatory requirements which dictate the maximum allowable transmitter power output, harmonics and band edge requirements.

An RF receiver module receives the modulated RF signal and demodulates it. There are two modules, such as, super-heterodyne receiver and super-regenerative receiver. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage. Super-heterodyne receivers have a performance advantage over super-regenerative; i.e. they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in the past intended to mean a comparatively more expensive product. However, advances in receiver chip design now mean that currently there is little price difference between super-heterodyne and super-regenerative receiver modules.



Fig. 4. RF module

2.5 Vibration sensor

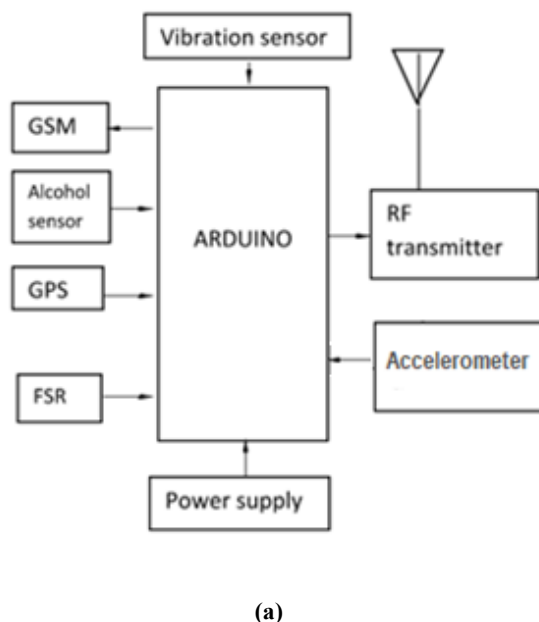
Digital vibration sensor (Figure 5, DFR0027) is a digital Plug and Play sensor block. It has vibration switch, digital input module and dedicated sensor expansion boards with the Arduino in combination. It can sense the weak vibration signals. When the accident occurs, it senses the pressure and sends it to the Arduino which in turn it sends the message to the registered mobile number.



Fig. 5. DFR0027 sensor

3 Construction

It is already mentioned that the project is divided into two units namely helmet and bike. In helmet unit, also called the transmitter unit shown in Figure 6 (a), the force sensing resistor is placed on inside upper part of the helmet where actually head will touch with sensor surface. And alcohol sensor is placed on in front of rider's mouth so that it can sense easily. Solar panels are mounted on upper side of helmet which is in direct sunlight. And the battery and regular circuits were fixed inside the helmet. Secondary controller and RF transmitter circuit were also placed inside the helmet. Antenna is located outside the helmet.



The receiver unit shown in Figure 6 (b) is placed in the bike. The RF receiver accepts all the data from the helmet (i.e transmitter) unit. Depending on the conditions, if true, the ignition starts and bike moves. The GSM can continuously send the location information of the bike. If any accident occurs, the vibration sensor gets activated and sends the location information to the registered mobile number.

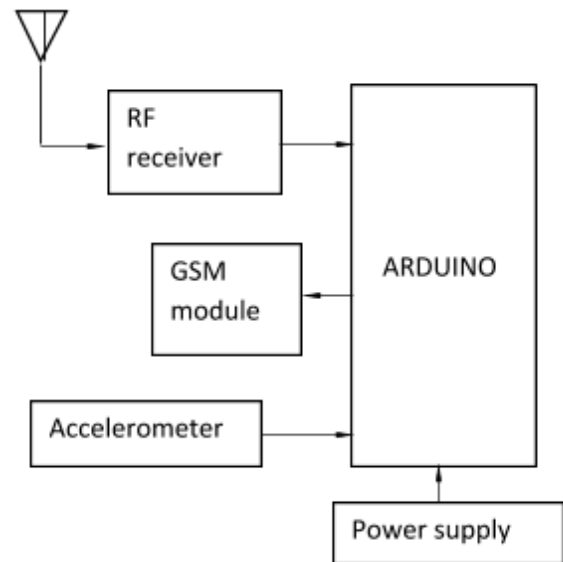


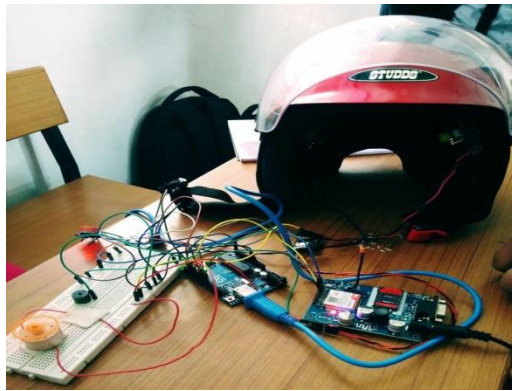
Fig. 6. (a) Transmitter unit and (b) Receiver unit

4 Working

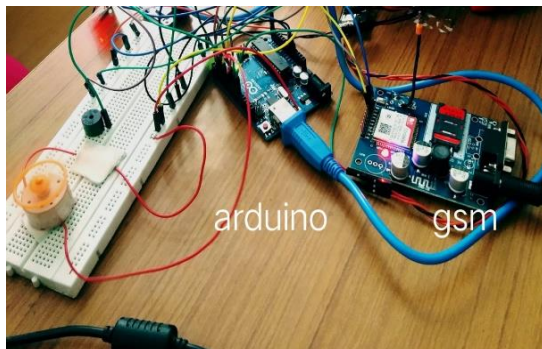
The first step of project is it initializes all the port and next step is accident detection using accelerometer. If No accident occurs, then it will go to third step. Third step is listening to RF module continuously for Data and interprets data using if conditions. Fourth step is to check whether helmet is wear or not. If Helmet is not wore then display Message "Please wear the helmet" will be displayed. Next step is to check the condition of drunk, if rider is drunk, display message "You are Drunk" and then send the message to stored number with location, and ask for the password. If password is correct then bike will start. If accident is detected in sixth step, then it will stop everything and send a message with location.

5 Design and Realizations

A smart helmet is designed using Arduino with transmitter (Figure 7). If alcohol concentration is present in human breath, then it displays the message on LCD and it sends the SMS to register no. with their current location. (shown in Figure 8). If accident occurs and bike falls, then it displays the message on LCD and sends an SMS to the registered numbered with the current geographical location.



(a)



(b)

Fig. 7 (a) Helmet with transmitter and receiver, (b) identification of Arduino and GSM part from (a)

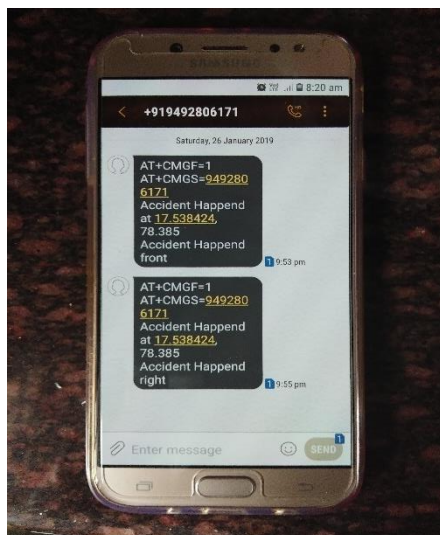


Fig. 8 Display of messages send to the registered mobile number

6 Advantages, applications and future scope

6.1 Advantages

1. Detection of accident in remote area can be easily detected and medical services provided in short time.
2. It will reduce the probability of accidents by simply avoiding drunken drive by using alcohol detector.

6.2 Applications

1. It can be used in real time safety system.
2. We can implement the whole circuit into small VLSI chip that can be embedded into the helmet and bike unit.
3. It can be designed for less power consuming safety system.
4. This safety system technology can further be enhanced in car or other vehicle by replacing the helmet with seat belt.

6.3 Future Scope

1. We can implement various bioelectric sensors on the helmet to measure various activities.
2. We can use small camera for the recording the drivers activity. It can be used for passing message from the one vehicle to another vehicle by using wireless transmitter.

7 Conclusion

The designed Smart helmet ensures the safety of the rider by making it necessary to wear helmet, and also ensures that the rider hasn't consumed alcohol more than the permissible limit. If any of these prime safety rules are violated, the proposed system will prevent the biker from starting the bike. The system also helps in efficient handling of the aftermath of accidents by sending a SMS with the location of the biker to the police station. This ensures that the victims get proper and prompt medical attention, if he/she met with an accident.

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