Accident Detection System using MEMS

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Abstract

A smart helmet is a special idea which makes motorcycle driving safer than before. This is implemented using GSM and GPS technology. The working of this smart helmet is very simple, vibration sensors are placed in different places of helmet where the probability of hitting is more which are connected to microcontroller board. So, when the rider crashes and the helmet hit the ground, these sensors sense and gives to the microcontroller board, then controller extract GPS data using the GPS module that is interfaced to it. When the data exceeds minimum stress limit then GSM module automatically sends message to ambulance or family members.

Keywords: Zone indicator, GPS and GSM, Sensors, Arduino, Microcontroller etc.

1. Introduction

1.1 Need

Smart Helmet for Motorcyclist is a project undertaken to increase the rate of road safety among motorcyclists. The idea is obtained after knowing that the increasing number of fatal road accidents over the years is cause for concern among motorcyclists. In India more than 37 million people are using two wheelers, since usage is high, accident percentage of two wheelers are also high compared to four wheelers. Motorcycles have high rate of fatal accidents than cars or trucks and buses. IOT can provide unprecedented real-time visibility into the status of assets. For example, sensor data from assets can be used to improve asset visibility, availability, and performance. By tracking asset status, as well as the movement of products and parts throughout the supply chain, asset-intensive companies can realize long sought-after manufacturing goals

such as lean manufacturing, which aims to eliminate waste and delays throughout the manufacturing process.
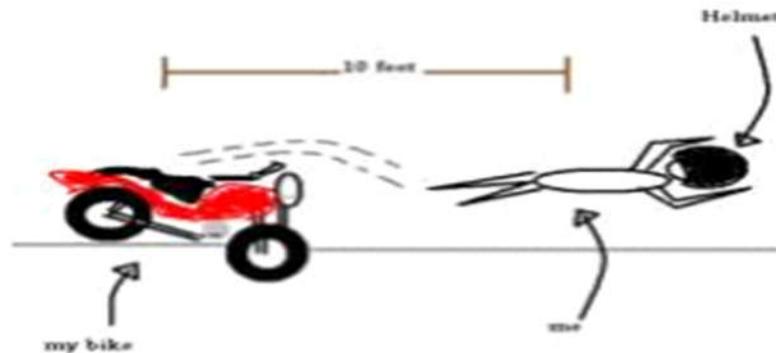

Figure 1: Accident Case

The idea of developing this project comes from social responsibility towards the society. This project aims for accident avoidance, safety and security of bike rider. The main intention of this project is to warn the rider about the Accident/Danger zones and to find the accident spot at any place and intimating it to ambulance and family members through the GPS and GSM networks. The main aims of an accident avoidance system are to avoid a loss of life and provide a safety mechanism for the driver. Motorcyclist will be alarmed when he enters Accident/Danger zones. This is found to be useful at night or when the rider is drowsy or tired, by this accident can be prevented.

Whenever any accident occurs MEMS sensor detects and sends mechanical force to ARM7, Also GSM technology is used to inform the family members in case of an accident. By using GPS, we will get particular location where accident occurs, and then GSM sends message to ambulance and family members. As the bikers in our country are increasing, the road mishaps are also increasing day by day, due to which many deaths occur, most of them are caused due to most common negligence of not wearing the helmets, also many deaths occur due to lack of prompt medical attention needed by the injured person. This motivates us to think about making a system which ensures the safety of biker, also to get proper and prompt medical attention, after meeting with an accident.

The project aims at the security and safety of the bikers against road accidents. A smart helmet is a special idea which makes motorcycle driving safer than before; this is implemented using GSM

and GPS technology. The working of this smart helmet is very simple, helmet hit the ground, these sensors sense and gives to the ARM7 Processor, then controller extract GPS data using the GPS module that is interfaced to it. When the data exceeds minimum stress limit then GSM module automatically sends message to ambulance and family members.

1.2 Objective

The objectives of this project are

1.   To design the circuit that can improve the safety of motorcyclists.
2.   To develop a Smart safety helmet for rider with features like road hazard warnings.
3.   To study the concept of RF Transmitter and RF Receiver circuit.

2. Existing System

- When an accident occurs, the information only is sent through GSM but there is no possibility to locate the spot.

- The thought of developing this project comes to do some good things towards the society. Day by day the two wheeler accidents are increasing and leads to loss of many lives. Accord to a survey of India there are around 698 accidents occurring due to bike crashes per year. Sometime the person is injured, the other diver may not be directly responsible for the accident, it may be fault of rider, but end of the day it's both the drivers involved in the accidents who is going to suffer. If accidents are one issue, lack of treatment in proper time is another reason for deaths. According to the survey India 698 accidents occur per year, nearly half the injured people die due to lack of treatment in proper time. The many reasons for this such as late arrival of ambulance, no persons at place where the accident occur to give information to the ambulance or parents.

3. Proposed Work

3.1 Warning of Accident/Danger zones:

We are placing a danger Zone indicator (RF transmitter) circuit in the places where there is a chance of accident which continuously transmits signal. Corresponding RF receiver circuit will be placed in the helmet
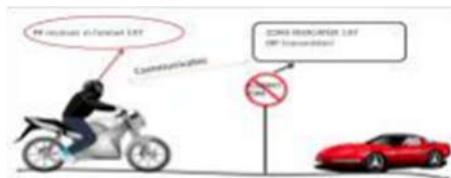

Figure 2: Sample Scenario

Whenever a person riding a bike enters the Accident Zone RF receiver communicates with the RF transmitter which is placed near accident Zone. RF receiver senses the presence of danger zone, it sends an interrupt to controller which activate the Buzzer (make sound until the Accident zone ends).

Figure 3: RF receiver and buzzer implemented in Helmet

3.2 For Accident Detection and Reporting

Vibration sensors are placed in different places of Helmet where the probability of hitting is more which are connected to ARM7. Whenever the driver met with an accident the vibration sensors are going to senses more vibration, then they are going to interrupt the ARM controller .To avoid the false detection another sensor is used i.e. Gyro Sensor. Controller checks Gyro sensor reading also .if both sensors readings are true than the controller takes coordinates value from GPS module. Then sends alert message to the driver family members using GSM module.

3.3 Problem statement

Now-a-days, it became very difficult to know that an accident has occurred and to locate the position where it has happened, also many deaths occur due to lack of prompt medical attention needed by the injured person, if person met with an accident, no one is there to help him, Simply leaving or ignoring the person he may die, In such situation, informing to ambulance and family members through mobile to rescue him for an extent. The project aims at the security and safety of the bikers against road accidents, also to get proper and prompt medical attention, after meeting with an accident. In India more than 37 million people are using two wheelers. Since usage is high, accident percentage of two wheelers are also high compared to four wheelers. Motorcycles have high rate of fatal accidents than cars or trucks and buses.

GPS and GSM makes the usage for intimation regarding an accident and identification of place, if Motorcyclist met with an accident it gives an information about location where he is met with an accident through GSM module to mobile numbers of family members, so have chosen GSM technology to give the information by sending SMS, using GSM module which has SIM

card slot to place the SIM and send SMS. Sending SMS alone can't help the driver, if we send and an SMS saying that accident had occurred where the ambulance will come without knowing the location of the accident. So to trace out the location where exactly accident occur using GPS module, and gives to ARM7 Processor, then it sends the SMS which contains the latitude and longitude of an area to family members mobile numbers. For this we use GPS module to extract the location of the accident, the GPS data will contain the latitude and longitude values using which we can find the accurate position of the accident place. With this reason, this project is specially developed as to improve the safety of the motorcycle's rider.

4.   Technologies Used

 The proposed system makes use of following technologies:

4.1 ARM7

The ARM7 is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based On Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core [7].

4.2 GSM Modem

A GSM modem is a wireless modem that works with a GSM wireless network. The GSM modem is having internal TCP/IP stack to enable you to connect with internet .It is suitable for SMS, voice as well as DATA transfer application in M2M interface, attending incoming calls etc., through simple AT commands. A GSM modem doesn't have a keypad and display to interact with. It just accepts certain commands through a serial interface and acknowledges for those. These commands are called as AT commands. There are lists of AT commands to instruct the modem to perform its functions. Every command starts with "AT". That's why they are called as AT commands. AT stands for attention. In our project, the program waits for the mobile number to be entered through the keyboard. When a ten digit mobile number is provided, the program instructs the modem to send the text message using a sequence of AT commands[8].

4.3 GPS Receiver

Global Positioning System (GPS) satellite broadcast signal from space that GPS receivers, use to provide three dimension location (latitude, longitude, and altitude) plus precise time. GPS receivers provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth. GPS GR87 is a highly integrated smart GPS module with a ceramic GPS patch antenna. The antenna is connected to the module via an LNA. The module is with 51 channel acquisition engine and 14 channel track engine, which be capable of receiving signals from up to 65 GPS satellites and transferring them into the precise position and timing information that can be read over either UART port or RS232 serial port. Small size and high-end GPS functionality are at low power consumption. The smart GPS antenna module is available as an off-the-shelf component, 100% tested. The smart GPS antenna module can be offered for OEM applications with the versatile adaptation in form and connection. Additionally, the antenna can be tuned to the final systems' circumstances.

4.4 Vibration Sensor

This sensor buffers a piezoelectric transducer. As the transducer is displaced from the mechanical neutral axis, bending creates strain within the piezoelectric element and generates voltages. These vibration levels could be given to any controller/processor and necessary decisions could be taken through it. Module triple output mode, digital output simple, analog output more accurate, serial output with exact reading.

Digital vibration sensing in the ADIS16220 starts with a wide- bandwidth MEMS accelerometer core that provides a linear motion-to-electrical transducer function. It uses a fixed frame and a moving frame to form a differential capacitance network that responds to linear acceleration. Tiny springs tether the moving frame to the fixed frame and govern the relationship between acceleration and physical displacement. A modulation signal on the moving plate feeds through each capacitive path into the fixed frame plates and into a demodulation circuit, which produces the electrical signal that is proportional to the acceleration acting on the device. These Digital vibration sensors are placed in different places of helmet where the probability of hitting is more

which are connected to ARE7.so, when the rider crashes and the helmet hit the ground, these sensors sense and gives to the ARM7, then necessary decision could be taken through it.

4.5 MEMS

Micro Electro Mechanical Systems is a technique of combining Electrical and Mechanical components together on a chip, to produce a system of miniature dimensions. Here we using Gyro Sensor, it is a device for measuring or maintaining orientation, based on the principles of angular momentum. Mechanically, a gyroscope is a spinning wheel or disc in which the axle is free to assume any orientation. Although this orientation does not remain fixed, it changes in response to an external torque much less and in a different direction than it would without the large angular momentum associated with the disc's high rate of spin and moment of inertia. The device's orientation remains nearly fixed, regardless of the mounting platform's motion, because mounting the device in a gimbals minimizes external torque. Gyroscopes based on other operating principles also exist, such as the electronic, microchip-packaged MEMS gyroscope devices found in consumer electronic devices, solid-state ring lasers, fiber optic gyroscopes, and the extremely sensitive quantum gyroscope.

4.6 RF Transmitter

The 212 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bit and 12- N data bits. Each address/data input can be set to one of the two logic states. The programmed address/data are transmitted together with the header bits via an RF transmission media upon receipt of a trigger signal. The 212 series of encoders begin a 4-word transmission cycle upon receipt of a transmission enable signal.

4.7 RF Receiver

The 212 decoders are a series of CMOS LSIs for remote control system application. They are paired with Holtek's 212 series of encoder. For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen. The decoders receive serial addresses and data from a programmed 212 series of encoders that are transmitted by a carrier using an RF transmission medium. They compare the serial input data three times continuously

with their local address. If no error or unmatched codes are found, the input data codes are decoded and then transferred to the output. The 212 series of decoders are capable of decoding information that consists of N bits of address and 12-N bits of data.

4.8 8051 Microcontroller

 The 8051 is one of the most popular microcontrollers. A microcontroller is a highly integrated single chip or circuit with a processor and which supports the other devices like program memory, data memory I/O ports serial communication interface, RAM, timers, interrupt controller etc.,

4.9 Advantages of Proposed System

- The vehicle which has undergone to an accident can be identified by using tracking technology without any delay.

- The immediate medication will be provided to the accident victims in the remote areas.

- To develop a Smart safety helmet for complete Rider, And to design a smart helmet with features like road hazard warnings.

- To design the circuit that can improve the safety of motorcyclists
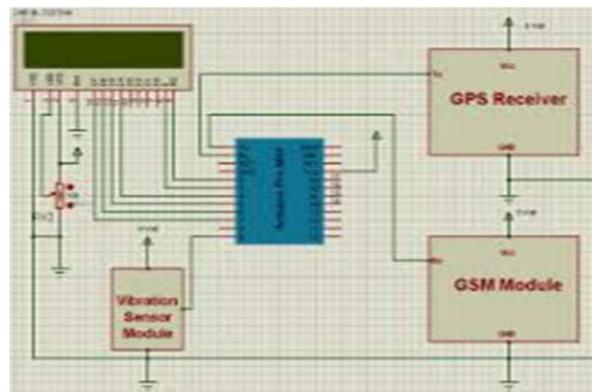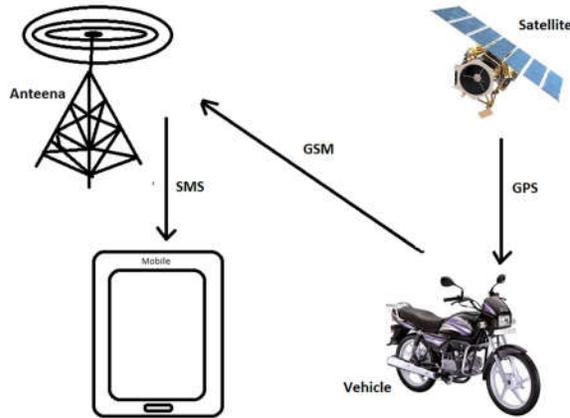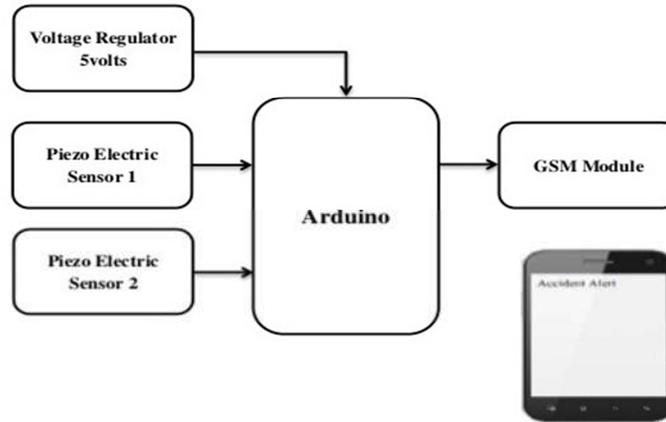
5. Design of Proposed System

Figure 4: Design of Proposed System with all Modules

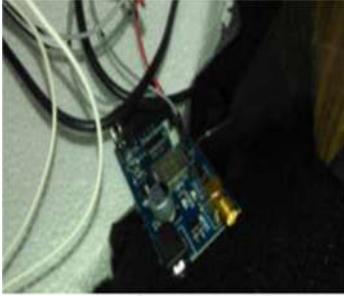## 5.1 System Architecture

5.2 Block Diagram

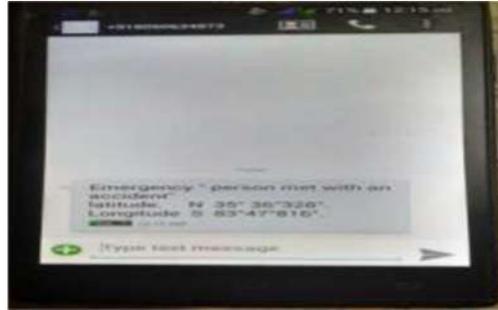## 5.3 Snapshots

Snapshot1: Vibration sensor implemented in Helmet

Snapshot2: GSM module

Snapshot3: GPS module   Snapshot4: Message sent to family member's phone number

6. Summary

To develop a Smart safety helmet for complete Rider, and to design a smart helmet with features like road hazard warnings. To study and understand the concept of RF Transmitter and RF Receiver circuit in implementing the project. The above design satisfies all the objectives of the paper.

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