Int. Conf. on Signal, Image Processing Communication & Automation, ICSIPCA

Accident Monitoring and Reporting System in Motorcycles

Mrinali M[1], Nivedha M[2], Nakul R.B[3], Ankit R. Nath[4] and Anu H[5]
[1,2,3,4]Dept. of Electronics and Instrumentation, JSS Academy of Technical Education, Bangalore
mrinalimuralidhara@gmail.com, nivedha.muniraju2395@gmail.com, nakulred1@gmail.com, ankitrnath@gmail.com
[5]Dept of Electronics and Instrumentation, JSS Academy of Technical Education, Bangalore
shamaiah.anu@gmail.com

***Abstract*— This project is to develop a wireless smart device to monitor various parameters such as speed, force of impact and tilt angle of a motorcycle using MEMS accelerometer and GPS tracking system for accidental monitoring. The system consists of cooperative components of an accelerometer, microcontroller unit, GPS device and GSM module. In case of an accident, this wireless device will send a short message to a mobile phone indicating the location of the incident through GPS system to family member, emergency medical service (EMS) and nearest hospital. The threshold algorithm and speed of motorcycle are used to determine fall or accident in real-time. The tilt sensor senses the angle of tilt of the motorcycle and when it exceeds a certain tilt angle, the message is sent. This device can sense all the tilt angles occurring from front or rear wheel, left and right side. In this project we will also be using a flex sensor which is interfaced to the micro controller. With the help of this sensor we can measure force of impact and if the threshold exceeds beyond a specific value, a message is sent. The message is sent only when the motorcycle is switched on and is in motion.**

***Index Terms*— Accident monitoring, GPS, GSM, MEMS, accelerometer, microcontroller.**

I. INTRODUCTION

These days accidents have become a major concern in many countries and cities. This problem is due to rider's poor behaviors such as rash driving, drunk driving, riding with no helmet protection, riding without sufficient sleep etc. The numbers of death and disability are very high because of late assistance to people those who have met with an accident. Technology must be made use of and made sure that help reaches the person in the shortest possible time. The development of a transportation system has been the generative power for human beings to have the highest civilization above creatures in the earth. Continuous development in automobile technology has led to the invention of increasingly powerful engines in both four-wheeler and two-wheeler categories. While there are various safety features such as airbags, impact protection bars incorporated in four-wheelers, there are not much viable implementable safety features for two-wheelers. Thus, there is an ever increasing need for a two-wheeler alert system that notifies the family of the driver as well as the emergency medical services in case of an accident. This system can help save people's lives by reducing the time between the event of the accident and arrival of medical services at the location of accident.

Grenze ID: 02.ICSIPCA.2017.1.43

In this case, a wireless device using MEMS accelerometer and GPS tracking is developed for accident monitoring. In the event of an accident, this device will send a message to the rider's family members and to the emergency medical services so that instant medical treatment can be provided to the rider.

II. Hardware Description

A. Microcontroller Unit

Arduino Uno [4] based on ATmega328P is used to intercept the data from the sensors and act accordingly. It has 14 digital input/output pins and 6 analog inputs. Using Arduino is advantageous as it is open source, easy to program and many compatible accessories are available in the market which can easily be interfaced with the Arduino board.

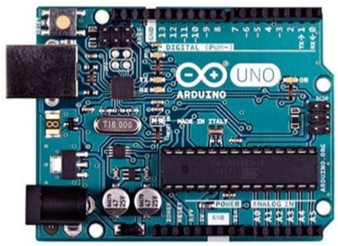

Figure1. Arduino Uno microcontroller board

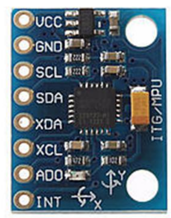

Figure2. MPU-6050 Accelerometer

B. Accelerometer (MPU-6050)

This device consists of a 3-axis gyroscope and a 3-axis accelerometer both on the same silicon die together with an onboard Digital Motion Processor™ (DMP™) capable of processing complex 9-axis MotionFusion algorithms. This helps in avoiding the cross-axis alignment issues that can creep up on discrete parts. The auxiliary master I2C bus allows the MPU-6050 [5] to access external magnetometers and other sensors, allowing the devices to gather a full set of sensor data without intervention from the system processor.

C. SIM808 Shield

SIM808 [6] module is a GSM/GPS/BT three-in-one function module. It supports GSM/GPRS Quad-Band network and utilizes GPS technology for satellite navigation. It has a high GPS receive sensitivity with 22 tracking and 66 acquisition receiver channels. Besides, it supports A-GPS that available for indoor localization, and it also supports for Bluetooth 4.0. The module is controlled by AT commands via UART and is compatible 3.3V and 5V logical level. Using a shield module increases the compactness of the complete system enclosure and hence adds to the portability of the system.

Figure3. SIM808 Shield module

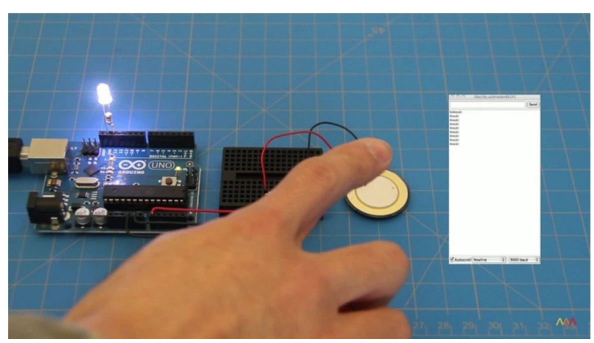

Figure.4 Piezo sensor interfaced to microcontroller unit using LED as an alert signal

D. Piezo vibration sensor

Piezo sensors [7] come in handy when we need to detect vibration or a knock. We use these for detecting an impact to the vehicle by placing multiple sensors on various locations of the bike. By setting a threshold and reading the voltage on the output, we can easily determine whether it was an accident or not. They can also be used for a very small audio transducer such as a buzzer. In this case, we interface the piezo sensor directly with the Arduino board and use an LED light as an alert signal when the piezo sensor detects an impact.

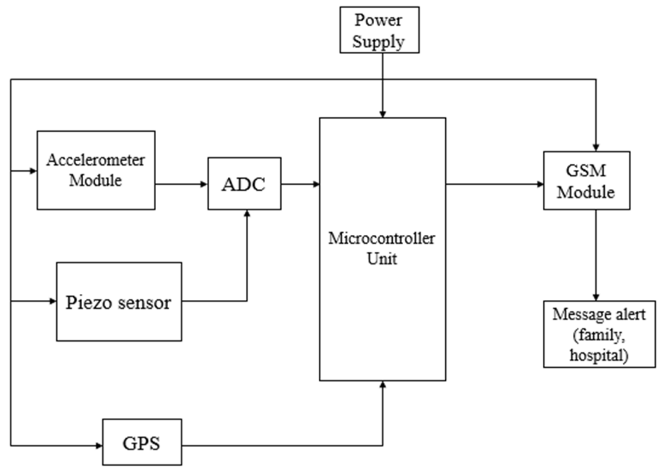

Figure. 5 Block Diagram of the system

III. SOFTWARE IMPLEMENTATION

Following softwares were used to design, program and configure the hardware.

A. Arduino IDE 1.8.2

Arduino Uno board is programmed and simulated using this software which is based on C++. It is open source and highly user friendly. Customized libraries can be added and used to simulate different codes in the Arduino board.

B. ELEMENTZ GSM Modem Test Utility

This software is basically a user interface for testing the GSM module which can be interfaced using UART Serial protocol with a system running Windows OS. It supports serial data transmission and reception similar to HyperTerminal. AT commands are used to interact with the GSM module and test it for its working.

IV. EXPERIMENTAL RESULTS

Table 1 shows the acceleration values of various bikes in the ranges of 0-100 km/hr and 0-60 km/hr depending on their engine capacity. These values are used to set the threshold for the accelerometer (MPU-6050) according to the acceleration values of different motorcycles. Once the accelerometer value exceeds the threshold (i.e. the bike accelerates out of control of the rider) an alert signal is generated and the message is sent via the GSM module. Using these values, various prototypes of this system can be implemented in different motorcycles regardless of their engine capacity and power. For example, a prototype is installed in ‘Pulsar 200NS’, which has an acceleration of 16.62 under the 0-60km/hr range (controllable acceleration). Thus, the accelerometer threshold will be set to 16.62 through Arduino programming. In the case of an uncontrolled acceleration, the accelerometer output will be greater than 16.62 and thus the threshold is exceeded which will trigger an SMS alert to be sent via the GSM module.

Table 2 are the values of the yaw, pitch and roll of the inbuilt gyroscope in the MPU-6050. These values are used to set a separate threshold to generate an alert signal in case the bike falls. Yaw, pitch and roll are the three axes (x, y, z). When the bike is stable, the values of the three axes remain constant or else vary minutely. Since the maximum turning angle for a bike is 45 degrees, threshold can be easily configured by reading the yaw, pitch and roll values at 45 degrees. Further modification of this system involves the use of a buzzer to warn the rider of high probability of accident when the bike approaches the maximum tilt angle. A buzzer can be configured to get triggered at a tilt angle of 40-45 degrees. The rider can be provided with a switch connected to the buzzer circuit to reset the buzzer and stop the device from sending an alert message. If the switch is not pressed in 10 seconds, the buzzer is reset and alert message is sent by the device

TABLE I. DIFFERENT ACCELERATION VALUES FOR DIFFERENT MOTORCYCLES

S. No.	Capacity	Bikes	Acceleration	
			0-100 km/h	0-60 km/h
1.	110 cc	TVS Sport Bajaj C7100 Hero Splendor Smart Honda CB Dreams Mahindra Centuro	A=6.67	---
2.	150 cc	Gixxer Hornet FZ Pulsar AS150 Apache 160 RTR	A=8.33	A=15
3.	200 cc	Pulsar 200NS Duke 200 Apache 200 RC 200 Pulsar RS200	A=11.11	A=16.62
4.	200-300 cc	FZ 250 R3 Ninja 300	A=14.29	A=12
5.	300-400 cc	RC 390 TNT 300 Dominar 400	A=20	---

Piezo sensors are installed on various parts of the bike that are likely to come in contact with the ground if the bike falls. The output of the piezo sensor is a voltage reading that is directly proportional to the force of impact. Thus, by setting an appropriate threshold value, we can detect whether the impact detected by the sensor was really an accident or not. Fig. 6 depicts the piezo sensor outputs for different force of impact. The values are voltage outputs from the piezo sensor which are directly proportional to the force of impact on the sensor. These values range from 0-1023 because of the limit of the microcontroller unit to read values till 1023 only. These values are read by the microcontroller and the alert message is sent if a value exceeds the pre-set threshold.

TABLE II. YAW, PITCH AND ROLL READINGS OF MPU-6050

Sl. No.	Yaw	Pitch	Roll
1.	47.10	50.21	-39.67
2.	47.03	50.18	-39.69
3.	46.84	50.12	-39.74
4.	46.66	50.07	-39.77
5.	46.51	50.05	-39.78
6.	46.38	50.03	-39.79
7.	46.25	50.02	-39.79
8.	46.09	49.98	-39.81
9.	45.91	49.92	-39.86
10.	45.74	49.87	-39.90
11.	45.58	49.83	-39.92
12.	45.45	49.80	-39.93
13.	45.32	49.79	-39.94
14.	45.19	49.76	-39.95

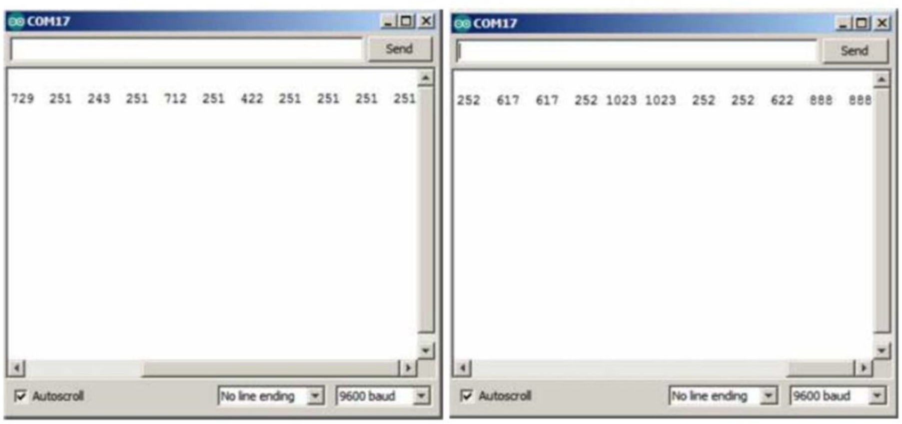

Figure 6. Output window displaying piezo sensor outputs

V. ADVANTAGES AND FUTURE SCOPE

This system notifies about an accident to the acquaintances of the rider and emergency services by using sensor inputs and threshold algorithm. An additional feature of this system is that the rider has an option of disengaging the alert system by pressing a buzzer switch. This is very useful in avoiding a false notification in case of the rider performing stunts or else if the rider is unharmed even after an accident. Besides, the system is highly portable and easy to install and connect in almost any bike. The system is also quite cost effective. Future modifications include system interfacing with other sensors such as ultrasonic sensors which can indicate the rider's vehicle proximity to other vehicles on the road. A camera can be interfaced to the system to take a photo of the accident spot and send it along with the location coordinates to the specified numbers.

VI. CONCLUSION

A wireless device to measure speed, impact of force, tilt angle, location of accident for accidental monitoring has been developed. The system can detect an accident by using threshold algorithm. After the accident is detected, an alert message will be sent to the programmed mobile number along with the location of the accident so that medical treatment can be provided to the rider as early as possible. This can ultimately save people's lives.

ACKNOWLEDGMENT

We would like to thank the management of our college and also our families and colleagues for their encouragement and support in helping us complete this work.

REFERENCES

[1] Watthanawisuth, N., T. Lomas, and A. Tuantranont. "Wireless black box using MEMS accelerometer and GPS tracking for accidental monitoring of vehicles", Proceedings of 2012 IEEE-EMBS International Conference on Biomedical and Health Informatics, 2012.
[2] Shaik Khadar Basha, "Wireless Black Box Report For Tracking Of Accidental Monitoring In Vehicles", International Journal of Professional Engineering Studies, Volume 1, Issue 2, December 2013.
[3] Anand Gunadal, Anjaney Koujalagi, Santosh Karavade and Shivkumar Konnuri, "Wireless Black Box Using Mems Accelerometer And Gps Tracking For Accidental Monitoring Of Vehicles", September 2014.
[4] https://www.arduino.cc/en/Main/ArduinoBoardUno
[5] https://www.i2cdevlib.com/devices/mpu6050#source
[6] http://simcom.ee/modules/gsm-gprs-gnss/sim808/
[7] https://www.arduino.cc/en/tutorial/knock
[8] www.ijpres.com
[9] www.ieeeproject.in