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DEVELOPMENT OF HELMET AUTO TRACKING VIA SMS (HATS)

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Abstract
This project is about the design and implementation of motorcycle accidents triggering system using SMS notifications with GPS, Arduino and GSM technology. It is a compression and integration between a GPS receiver, vibration sensor, microcontroller and a GSM module. This combination of technologies produced a tracking system. A tracking system is an integration of two systems which is coordinated by the GPS receiver module and controlled by Arduino and triggered by vibration sensor, using command interfaces through GSM module as a transmitter and receiver of data. This project can be divided into two parts which are hardware and software development. The hardware development includes the GPS, vibration sensor, microcontroller wiring connection and its integration with the GSM module. The software development includes develop the Arduino source code. GSM message command, the AT protocol command. This system is placed on the motorcycle rider helmet.
Keywords: SMS, GSM Module, Arduino UNO, Vibration Sensor, Microcontroller, Tracking System, GPS Receiver.

INTRODUCTION

The thought of developing this project comes from social responsibility towards the society. Normally many accidents occurring around us, there is a lot of loss of life. According to a survey of Malaysia there are around 100,000 accidents occurring due to motorcycle accidents per year [1]. The reasons for the accidents may be many such as no proper driving knowledge, no fitness of the bike, rash driving, drink and drive etc. In some cases the person injured the accident may not be directly responsible for the accident, it may be fault of some other rider, but end of the day it's both the drivers involved in the accidents whom are going to suffer. If accidents are one issue, lack of treatment in proper time is another reason for deaths. According to the same survey from year 2000 to 2005, the killed or seriously injured cases are only about 30% of total casualties. However, in the year 2006 to 2010, the proportion of killed or seriously injured cases increases dramatically to more than 50% of total casualties in 2011 [1].

The reasons for this may again be many such as late arrival of ambulance, no person at place of accident to give information to the ambulance. This is what is running situation in our day to day life, a thought of finding some solution to this problem come up with this idea of giving the information about accident as soon as possible and in time, because after all time matters a lot, if everything is done in time, at least half the lives could be saved that are lost due to bike accidents. A thought from study as electronic engineering this project is in the right direction to help the society to make this project to avoid as much as it could. Through this project is to reduce the number of serious casualties that happen to take a person life to the

worse situation of life style of suffering the rest of her/his life. Development of helmet auto tracking accident via SMS project is going to place in motorcycle helmet to minimize the case if serious casualties.

PROBLEM STATEMENT

As we all know that every brand in the market for vehicles, especially motorcycles have a function, advantages and sophistication of its own. Although progress is increasing, the safety of motorcyclists on the road is still not guaranteed. One of the causes of the accident or death among motorcyclists is the late arrival of ambulance where it is very dangers for any casualty to stay without help for long time, for example, the motorcycle accident happen somewhere no people around and the motorcyclist is not able to contact police or ambulance.

Also the accident rate for motorcyclists is increasing from year to year, an development of helmet auto tracking via SMS (HATS), to have the faster contact to save casualties, as soon as the accident occur the DHATS system is able to send an SMS to the casualty friends and family members to tell about the accident location, in case they contact the police for ambulance help to be at the place of accident.

LITERATURE REVIEW

There are several papers have been studied throughout the project development. These papers have given idea, innovation and improve this project significantly.

3.1 Vehicle Accident Detection and Reporting System Using GPS and GSM

According to Aboli Ravindra Wakure, Apurva Rajendra Patkar, Manisha Vitthal Dagale, Priyanka Pradeepkumar Solanki from Dep. of Electronics, Veermata Jijabai Technical Institute, Matunga, Mumbai, India. Proposed project name “Vehicle Accident Detection and Reporting System Using GPS and GSM” [2].

This paper implies system which was the solution to people lose their lives because of accidents and poor emergency facilities. These lives could have been saved if medical facilities are provided at the right time. Accelerometer sensor can be used in car security system to sense vibrations in vehicle and GPS to give location of vehicle, so dangerous driving can be detected. When accident occurs, accelerometer will detect signal and will send signal to AVR controller, microcontroller will enable airbag to blow and message with accident location is sent to preprogrammed numbers such as ambulance, police station, etc via GSM. Automatic accident detection and reporting system designed in this paper. When accident occurs, it is sensed by accelerometer. Short message including location of accident obtained using GPS, is sent via GSM network. It provides more than 70% safety for four wheelers. It is the fact that implementation of system will increase cost of vehicle but it is better to have some percent safety rather than having no percent of safety [3].

3.2 GPS and GSM based Vehicle Tracing and Employee Security System

This paper researched by NiravThakor, TanmayVyas, Divyang Shah from School of Bharati Vidyapeeth Unv.Pune Pune-Satara road Pune 411043 has proposed GPS and GSM based Vehicle Tracing and Employee Security System. (January 2013)

A GPS & GSM Based Vehicle Tracking and Employee Security System combine the installation of an electronic device in a vehicle, with purpose-designed computer software to enable the company to track the vehicle's location. In vehicle tracking systems we use Global Positioning System (GPS) technology for locating the vehicle. Vehicle information can be viewed on electronic maps via the Internet or specialized software. Due to recently happened mishaps such as burglary, rape cases etc., the employee safety, esp. for the women employees, has become a number one priority for most of the companies. Even though the companies take good precautions to ensure that its employees are safe, there are some serious loop holes in the existing system. Firstly there is no full proof mechanism to track the outsiders to avoid this kind of problem we are going to implement a system that provides more security to the employee. The car Unit is placed inside the car .When the car picks up the employee; he/she needs to swap the RFID card. The micro controller matches the RFID card no. with its database records and sends the employee’s id, cab id & the cab position co-ordinates to the company unit via GSM module. The GSM Modem will receive the message through GSM in the company unit. If employee finds himself/herself in a problem, he/she will press the button. Microcontroller will detect the action & sends a signal to the GSM which will coordinate with to the company unit and police. Microcontroller will also send a signal to the relay which will turn off the car ignition & stop the car. The GSM Modem will receive the message. This message will then be transferred to the computer through the serial port. The employee name, employee id & cab position coordinates

(longitude and latitude) get displayed on computer. Once the data is obtained on the computer, it can be used for further analysis. In this way the company unit keeps a track of the vehicle [3]. This will be a much simpler and low cost technique compared to others.

3.3 Hybrid GPS-GSM Localization of Automobile Tracking System

This paper researched by Mohammad A. Al-Khedher, from Dep. of Mechatronics Engineering Department, Al-Balqa Applied University, Amman Jordan has proposed project name "Hybrid GPS-GSM Localization of Automobile Tracking System". (Dec 2012)

This paper integrated GPS-GSM system is proposed to track vehicles using Google Earth application. The remote module has a GPS mounted on the moving vehicle to identify its current position, and to be transferred by GSM with other parameters acquired by the automobile's data port as an SMS to a recipient station. The received GPS coordinates are filtered using a Kalman filter to enhance the accuracy of measured position. After data processing, Google Earth application is used to view the current location and status of each vehicle. This goal of this system is to manage fleet, police automobiles distribution and car theft cautions. In this paper, a real-time automobile tracking system via Google Earth was presented. The system included two main components: a transmitting embedded module to interface in-vehicle GPS and GSM devices in order determine and send automobile location and status information via SMS. The second stationary module is a receiving module to collect and process the transmitted information to a compatible format with Google Earth to remotely monitor the automobile location and status online. The transmitted location of the vehicle has been filtered using Kalman filter to achieve accurate tracking. The 2DRMS accuracy of estimated vehicle coordinates has been enhanced. The accuracy of filtered coordinates was less than 15 meters compared to about 43 meters for transmitted coordinates received by in-vehicle GPS module [4].

Cost Effective GPS-GPRS Based Object Tracking System

This paper researched by Khondker Shajadul Hasan, Mashiur Rahman, Abul L. Haque, M Abdur Rahman, Tanzil Rahman and M Mahbubur Rasheed, has proposed project name "Cost Effective GPS-GPRS Based Object Tracking System". (Sept 2009)

This paper proposes and implements a low cost object tracking system using GPS and GPRS. The system allows a user to view the present and the past positions recorded of a target object on Google Map through the internet. The system reads the current position of the object using GPS, the data is sent via GPRS service from the GSM network towards a web server using the POST method of the HTTP protocol. The object's position data is then stored in the database for live and past tracking. A web application is developed using PHP, JavaScript, Ajax and MySQL with the Google Map embedded. The existing live tracking systems that are available now a days use SMS for the communication to the server which turned out to be expensive. (SMS are used for communication to device). We have used the GPRS service which made our system a low cost tracking solution for localizing an object position and status. This system is very useful for car theft situations (alarm alert, engine starting, localizing), for adolescent drivers being watched and monitored by parents (speed limit exceeding, leaving a specific area), as well as for human and pet tracking. This paper presents a low cost tracking system using GPS and GPRS of GSM network, suitable for wide range of applications all over the world. The combination of the GPS and GPRS provides continuous and real time tracking. The cost is much lower compared to SMS based tracking systems. Free Google map and the use of HTTP protocol as data sending method reduces the monthly bundle cost for the individual user and also for the small business owner [5]. It is expected that the full implementation of the proposed system would ultimately replace the traditional and costly SMS based tracking systems.

Vehicle tracking system with GPS GSM Interface and Self-Created Map

This paper researched by Modi Nirav D from School of Department of Electronics, Bharati Vidyapeeth Deemed University, College of Engineering, and Pune has proposed project name "Vehicle Tracking system with GPS GSM Interface and Self-Created Map". (April 2014).

Safety and security of vehicle is primary thing for its owner. So, they always look for better mechanism for prevention. Also for company owner or manager it is necessary to know their language vehicle location. In any vehicle tracking unit, there are GPS receiver, controller and GSM module at transmitter side whereas at receiver side, there are GSM module and software system for locating the position of the vehicle. The map of every city is available on the map with co-ordinate of each place. Vehicle tracking technology allows us

to see our vehicles locations, speed of the vehicle and other features on the computer screen with a help of GPS (Global Positioning System) technology, GSM network, digital mapping and specialized tracking software. The GPS satellites transmit information like longitude, latitude, altitude, Universal time etc to the GPS receiver. For calculation of this information, at least three GPS satellites are needed. But main disadvantage of GPS is that it need direct line of sight. Its accuracy suffers at indoor locations. Once the receiver knows its position (only latitude and longitude not consider altitude) it is stored in the microcontroller's memory place in the vehicle. After predefined interval (in this paper interval=15sec), latest location of vehicle is sent to remote location using GSM network. At remote location, PC gets this information and placed on GOOGLE map using internet access whereas in our map internet access doesn't require. From this, location can be found in with less than 10m error in case of slow speed and clear environment. But in cloudy environment, error is higher. Also we get erroneous location in case of the indoor position or area in which more tall buildings are there.

GSM technology

GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands [6]. Some countries in the Americas (including Canada and the United States) use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

GSM has used a variety of voice codecs to squeeze 3.1 kHz audio into between 5.6 and 13 kbit/s. Originally, two codecs, named after the types of data channel they were allocated, were used, called Half Rate (5.6 kbit/s) and Full Rate (13 kbit/s). These used a system based upon linear predictive coding (LPC). In addition to being efficient with bitrates, these codecs also made it easier to identify more important parts of the audio, allowing the air interface layer to prioritize and better protect these parts of the signal. GSM was further enhanced in 1997 with the Enhanced Full Rate (EFR) codec, a 12.2 kbit/s codec that uses a full rate channel. Finally, with the development of UMTS, EFR was refactored into a variable-rate codec called AMRNarrowband, which is high quality and robust against interference when used on full rate channels, and less robust but still relatively high quality when used in good radio conditions on half-rate channels[7].

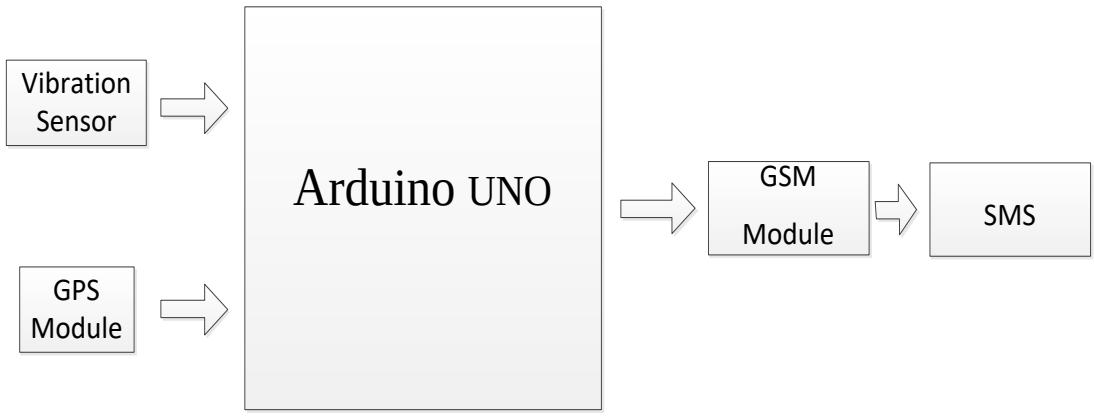
There are five different cell sizes in a GSM network, micro, pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells [8].

The modulation used in GSM is Gaussian minimum-shift keying (GMSK), a kind of continuous-phase frequency shift keying. In GMSK, the signal to be modulated onto the carrier is first smoothed with a Gaussian low-pass filter prior to being fed to a frequency modulator, which greatly reduces the interference to neighboring channels (adjacent channel interference).

PROPOSED SYSTEM

From figure below shows the main block diagram for overall system. The system consists of 2 inputs and 1 output. The input comes from vibration sensors detect the vibration and GPS module that reads the data of location, and one output GSM Module that send the SMS. All part is important to make the system working precisely and perfectly. The brain of this circuit is microcontroller which is as the main control of input and output.

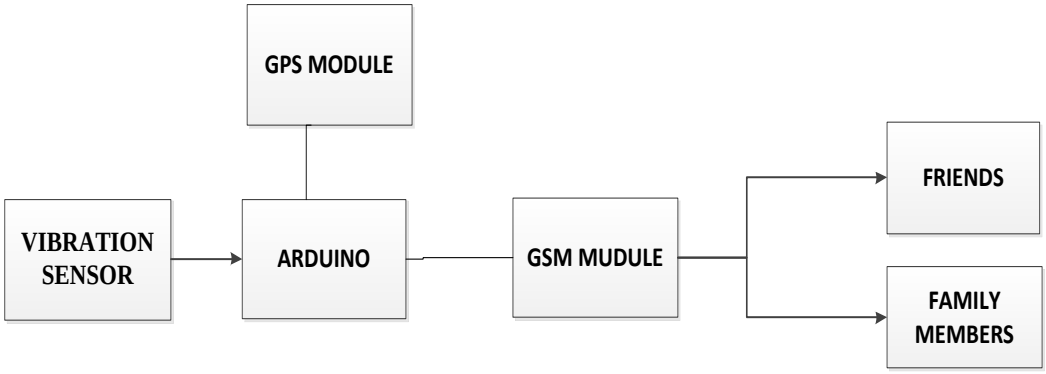
The block diagram of our proposed system is shown as follows:



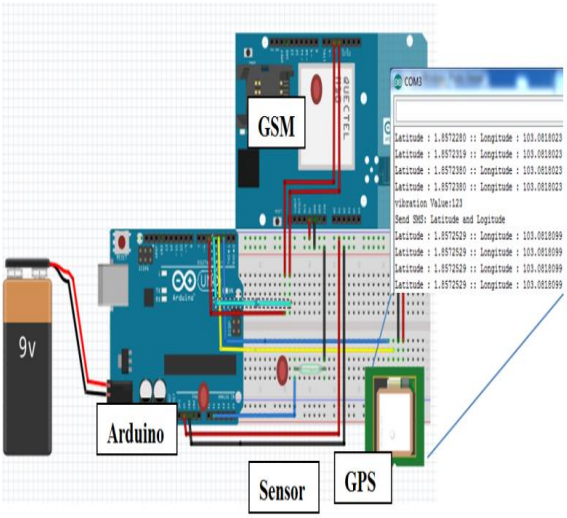
The idea of this project is to give information about the accident to the family members and friends, so GSM technology used to give the information by sending SMS. Sending SMS alone could not help the motorcyclist, if SMS sent and saying that accident had occurred where the ambulance come without knowing the location of the accident. So it need to include GPS location in the SMS that is sent so that the ambulance has perfect information about where and when the accident has occurred. GPS module use to extract the location of the accident, the GPS data is containing the latitude and longitude values that locate the accurate position of the accident place.

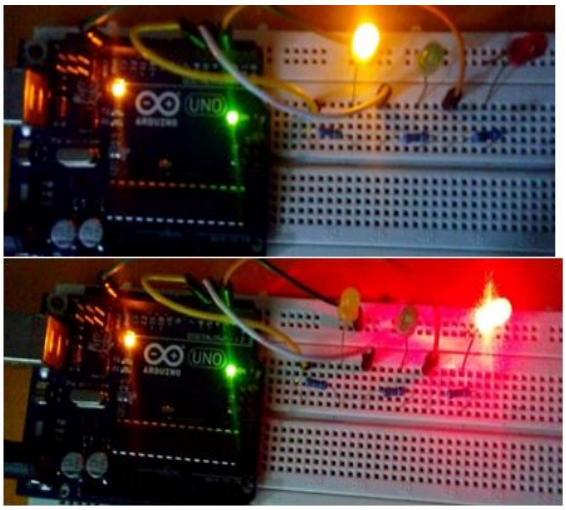
To run the GPS and GSM module, Arduino UNO board is used which has ATmega328 microcontroller. The Arduino is a very user friendly device which is easily interfaced with any sensors or modules and is very compact in size. The Arduino sent the SMS using the GSM module by keeping the GPS location in the SMS which is obtained from the GPS module. But when should all this is done? When accident occurs, how the Arduino detect the accident? We use a vibration sensor which is placed in the helmet. The vibration sensor is placed in the helmet such that it detects vibrations of the helmet. When the rider crashes, the helmet hits the ground and the vibration sensor detects the vibrations that are created when the helmet hits the ground and then the Arduino sent an SMS containing information about the accident and location of accident. General diagram of the project.

The general diagram of project process



SYSTEM STRUCTURE



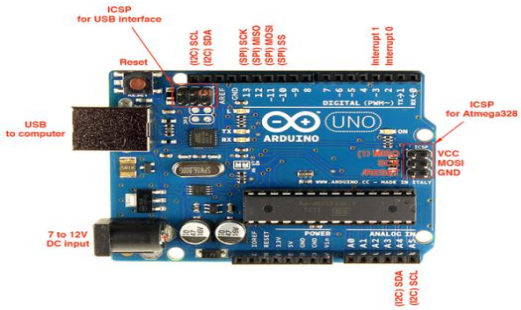


SYSTEM HARDWARE

Hardware description consist of briefly description about component used in this project based on serious consideration had been studied.

ARDUINO UNO R3 DEVELOPMENT BOARD USING ATMEL ATMEGA328 MICROCONTROLLER

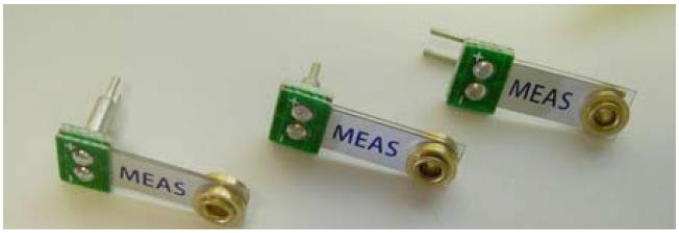
The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button [9]. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.



The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB to-serial converter.

VIBRATION SENSOR

The Mini sense 100 is a low-cost cantilever-type vibration sensor loaded by a mass to offer high sensitivity at low frequencies. The pins are designed for easy installation and are solder able. Horizontal and vertical mounting options are offered as well as a reduced height version. The active sensor area is shielded for improved RFI/EMI rejection. Rugged, flexible PVDF sensing element withstands high shock overload. Sensor has excellent linearity and dynamic range, and may be used for detecting either continuous vibration or impacts [10].



SKYLAB GPS MODULE

SKM53 Series with embedded GPS antenna. It is based on MediaTek3329 single-chip architecture [11]. As shown in figure SKM53is applied in a portable device and receiver like PND, GPS mouse, car holder, personal locator, speed camera detector and vehicle locator.

GSM MODULE SIM900 GSM/ GPRS SHIELD ICOMSAT

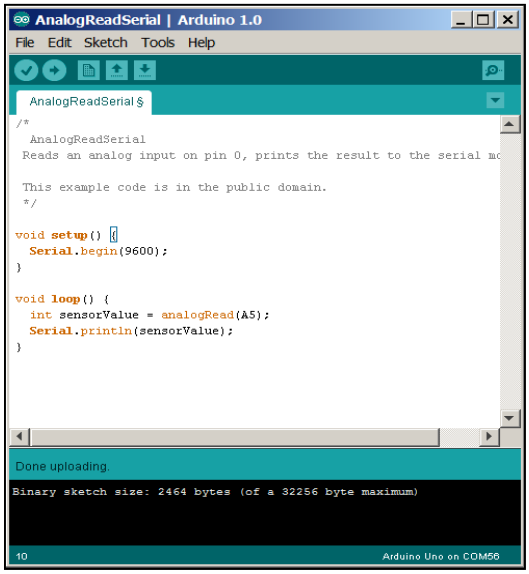
IComsat is a GSM/GPRS shield for Arduino and based on the SIM900 Quad-band GSM/GPRS module. It is controlled via AT commands and SIMCOM enhanced AT Commands [12].

SYSTEM SOFTWARE

Hardware development is one of the major parts in constructing the algorithm of the project. It includes the MicroC for the Arduino.

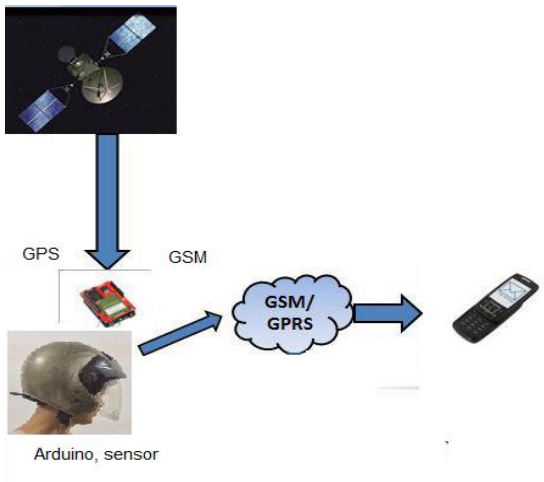
ARDUINO

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. The open-source Arduino environment as shown in figure 3.9 makes it easy to write code and upload it to the I/O board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, avr-gcc, and other open source software [13].



RESULT AND ANALYSIS

Discussing the results obtained from experiments and analysis of the result during the progression of this project.



Step1: Vibration Sensor

The MEAS vibration sensor has successfully detected vibration in on the helmet user. From the table 5.1 show the pulse generated from vibration sensor based from 3 type of range for MEAS sensor. From the table 5.2 indicates the vibration generated from MEAS sensor if the vibration is strong enough to represent an accident vibration.

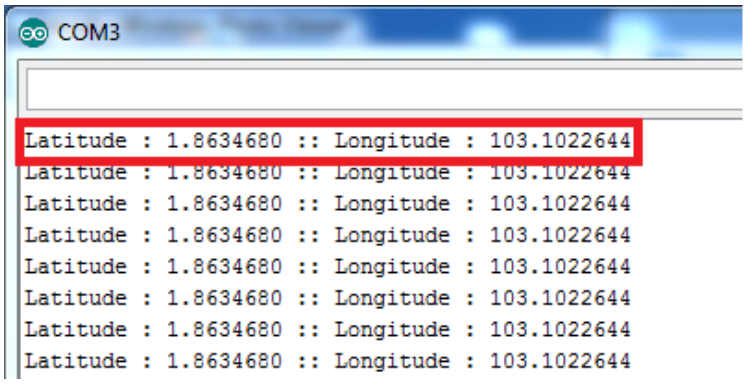
Range	**States**
pulse = 0	No vibration
pulse < 100 && pulse >0	Small vibration
pulse >=100	Real vibration

Range	**States**
pulse >=100	Real vibration

Step2: GPS Module

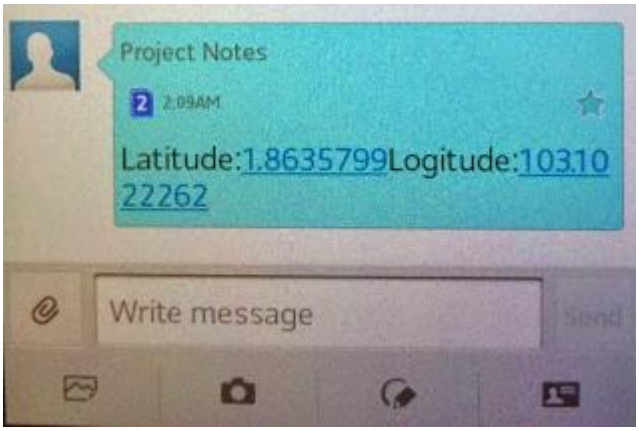
Global Positioning System tracking is a method of working out exactly the position of GPS sensor`s holder based on a simple mathematical principle called trilateration or triangulation. Trilateration falls into two categories: 2-D Trilateration and 3-D Trilateration, figure 5.3 it requires having at least four satellites transmitting coded signals from known positions. Three satellites are required to provide the three distance measurements, and the forth to remove receiver clock error.

GPS measurements are obtained in the GPS coordinate figure 5.4. Users should be aware that this position usually needs to be converted into the local coordinate system for the region. A GPS tracking system can work in various ways. Active and passive tracking. Passive tracking the position is usually stored in internal memory, while in the active tracking, also referred to as real time tracker, data is to be transmitted to central database via a modem within the GPS unit.



Step3: GPS MODEM

GSM modem also function successfully. When the GSM is ordered to be active the message is sent to family member as in figure 5.3. After that if the family member wants to know the position of the accident of the user.



Step3: ARDUINO BOARD (ALL SYSTEM)

The overall system of project finally functions successfully. Figure 5.4 shows the integration of the whole project consisting of Vibration sensor, GSM modem, GPS module and Arduino board. Figure 5.5 shows the result of project using arduino serial monitor

```
vibration Value:478
Send SMS: Latitude and Logitude
Latitude : 1.8573679 :: Longitude : 103.0820922
Latitude : 1.8573679 :: Longitude : 103.0820922
Latitude : 1.8573679 :: Longitude : 103.0820922
Latitude : 1.8573679 :: Longitude : 103.0820922
Latitude : 1.8573679 :: Longitude : 103.0820922
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CONCLUSION

The development of (HATS) Helmet Auto Tracking via SMS can be implemented using several methods of vibration detection. Knocking and vibration sensors are examples of sensors that suitable to the system. However vibration sensor is the most suitable sensor after several comparisons had been made. Saving lives needs both government and Drivers Corporation and commitment. Much efforts and money will be essential to accomplish and maintain a very good level of rider safety. The project were able to designed a GPS/GPRS based wireless, due to the wide spread of GSM network increasing the chance for applying this model in many areas around. The model that has been created hope to be able to achieve what is meant for, reducing the accident casualties with serious injuries, all this in favour of human life safety.

However there is constraint in this project, it is because GPS can't receive data from satellite while the motorcycle is in blocked areas like channels underground, the memory keeps the last reading before being. In conclusion, the project is successfully implemented and the objectives of the project are achieved.

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