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Safety using Road Automated Wireless Communicating Smart Helmet Application (SURACSHA)

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Abstract*—As human life is of utmost importance, timely help is more important than a helping hand. It has been found through surveys that knowing the condition of the patient pre arrival to Hospital ameliorate the chances of survival in case of fatal accident. This project is one among those which enhance the chances of saving human life with timely support. There are three main modules discussed in the project. When a biker meets with an accident an automatic detection system is triggered and an SMS consisting of the GPS location in descriptive terms through map plotting along with the current heart rate and the body temperature of the patient is sent to a specified phone number. The sensor network consists of gyroscope, GSM, GPS, Temperature sensors and Heart rate sensor. The system consists of two subsystems the master and the slave. The slave system situated onto the person's helmet detects the occurrence of an accident and triggers the rescuing mechanism. *Here the GSM is used to send the text message and the GPS is used to track the exact coordinates of the vehicle. The communication between subsystems is carried out by Zigbee modules between the Microcontroller (Atmega 128), GSM and GPS module. The systems is a distributed system. A learning Algorithm is applied to the system to improve the efficiency of the system over time.

Keywords— ***Accident monitoring and response, GPS (global positioning system), GSM (global system for mobile Communication), accident detection, Safety. SMS (short message service), Hospitalization, electrical signal characteristics.***

I. INTRODUCTION

In the present growing population of India, the country also faces the uprising of accident rate. In India majority of the private transport is done on two-wheelers. So naturally number of accidents have risen. These accident have resulted into deaths of casualties. Many solutions were practiced for minimizing and preventing the accident rate. Safety has also become a major factor that is to be taken care of which numbers of accidents have rapidly increased day by day, many lives are lost due to improper post-accident signaling and tracing out the exact location. Our project provides solution for the above stated problem which involves notifying the pre specified number about the occurrence of an accident using GSM and GPS based technology. In addition to it our project also includes the work of intimating the concerned people with graphical description of the exact location. This project also involves conveying information about the heart rate and body temperature upon impact detection by the system. Post-accident signaling can be given in form of text message with the exact location using GPS and GSM based technology. Here the GSM is used in order to alert the prior person through a text message and the GPS is used to track the exact coordinates of the vehicle which is also included to the text message.

II. EXISTING SYSTEM

There are a lot of personal health security notification systems developed present day for the safety of a person who meets with an accident. Some of them have to be triggered manually and some of them are automatic. But nowadays these automatic systems are facing many problems such as faulty detection system, low working speed, etc. If a person meets with an accident he will be unable to press the switch in order to trigger the notification system. In such cases manual stimulation system will be useless. Present day's automatic systems are capable of detecting the situation of the accident and condition of victim and thereby sending a notification to some specified number in the form of text containing the casualties' GPS location in the form of latitude and longitude. But these systems are found wanting for their faulty condition detection, large size of the device and more importantly high cost. Further such systems are prone to physical damage upon impact and could be rendered obsolete. The system conveys the data in the form of latitude and longitude but to a layman this may prove to be insufficient, so it is mandatory to have a descriptive platform or a software which will automatically interpret the received data and generate the location and directional route in the form of map. The system should also be able to send the location to emergency hospital services. Now the system needs to develop up to an extent at which it will be able to detect the heart rate, body temperature and respiration rate of the victim and transmit data to the doctors at the hospitals, which will enable them to prepare for emergency care. Here, the sensors and actuators should be comfortable to the person, so the attachments should be on-person wearable type of gears. Additionally, the system should be error free and should have higher accuracy. Further it should be a distributed system so that each module of the system can perform its function independently of the other as

the connection may be broken off during impact. Finally, the whole system should be a robust and a cost efficient system.

III. PROPOSED SYSTEM

As the system needs to be perfect for the safety of a person, it needs to be developed to tackle the shortcomings faced by the preceding systems. For perfect detection of Accidental conditions the vibrational sensors and Gyroscope should be used. As the whole system will be embedded inside the helmet, it will be easier to detect the occurrence of an accident. The vibrational sensors will be helpful in detection of impact in the form of G-force. The vibrational sensors will be fitted on the helmet as well as on the vehicle. So combining the results from the vibrational sensors and the gyroscope readings, the CPU will take decision. Additional feature in the system is the real time health monitoring facility which will include data such as heart rate, body temperature and respiration rate. This will facilitate the doctors from the emergency hospital services to take consequential decisions about the treatment. Here all sensors will be tangible making the user feel comfortable. From the point of making the whole system distributed, the main CPU will be fixed inside the vehicle for safety purposes. We will consider this CPU as the master board. All the sensor interfaces and a small processor will be embedded in the slave board. Both the master board and slave board will be powered by small power sources, such as battery. Both the boards will communicate with each other using ZigBee XBee modules without any wired connection between them. Thus the slave board can be easily fixed inside the helmet. Therefore this distributed system will be able to work even if the slave part of the system is damaged. The master part of the system will decide about sending the longitude and latitude of the location to the predefined number using GSM module. Once the computer receives the GPS location through short messaging service (SMS), the software in the computer will generate a descriptive platform containing the directions to the scene, the heart rate and the body temperature. Most important feature of the proposed system will be accurate detection of accident condition by applying learning technique on gyroscope values and EEPROM tolerance checking

Figure 1: Complete SURACSHA system

IV. COMPONENTS OF THE SYSTEM

1. *SLAVE PART*

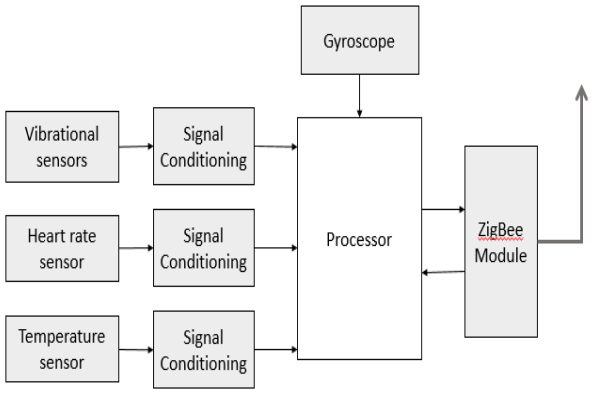

Figure 2: Block diagram of slave system.

This part of the system is mounted on the helmet as it is small in size and has low weight. The slave part contains the interface to several sensors such as vibrational sensors, heart rate sensors and temperature sensor.

Continuous monitoring of flag bits associated with each sensor surrounded to the helmet helps to determine the incident of accident. This protocol consists of transmission and reception of sensor outputs after signal conditioning through Transmitter module.

Each sensor has a data bit associated with it which is continuously transmitted by slave circuitry, which is received and processed by the master. Also one flag bit for each sensor serves the purpose of detection of completion of reception of particular sensor data and ready state for reception of next sensor data.

If flag bit of the vibration sensor in slave circuit gets toggled to high then all sensor data gets transmitted to master assembly for processing of gyroscope readings and slave sensor readings.

Vibration Sensor	Heart Rate Sensor	Temperature Sensor	Transmission Enable
0	X	X	0
0	X	X	0
0	X	X	0
1	X	X	0

Figure 3: Truth table for proposed communication protocol

i. Vibration Sensor:

A vibration sensor is piezoelectric material placed on the helmet in order to detect event of an accident. Vibrations produced by accidents are generally very huge of the order of 9G (G is force against gravity). The data bit associated with the vibration sensor gets toggled to high after crossing a particular threshold value and is transmitted to master part of system.

ii. Heart rate sensor:

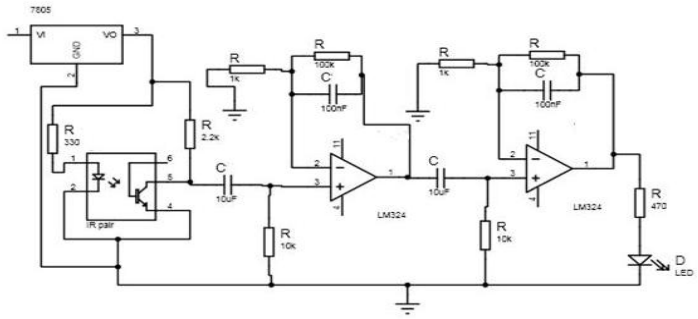

Figure 4: Complete circuit diagram for heart rate detection.

Assembly for real time heart rate detection sensor includes a photodiode and an IR diode pair to detect change in density of flow of blood in artery or vein for a time period 't' which is then processed to calculate the heart rate per minute.
In circumstance of an accident, the driver gets into tachycardia in which heart beats more than 100 times per minute thus exceeding the normal rate of 60bpm to 100bpm. If the doctors are informed about heart rate beforehand they will be well prepared for the treatment and could avoid severe consequences.

iii. Temperature Sensor:

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling and also rated for full −55°C to +150°C.
Detection in aberrant body temperature may support event of an accident along with other sensor data.

2. MASTER PART-Main CPU

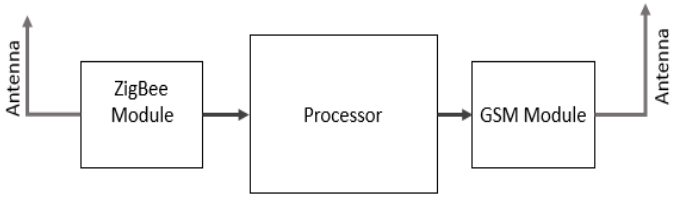

Figure 5: Block diagram of Master system.

This main CPU is responsible for decision making based on the received data through the ZigBee module. The master initiates the whole system only when the slave starts to transmit the data to the master. In order to take the appropriate decisions, the processors is coded with learning technique which will enable the processor to determine the event of an accident. The module XBee wireless communication which uses ZigBee protocol is used for wireless communication. The module used for sending the text message, containing latitude and longitude, to the receiver is SIM900 GSM module. The module is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. More important element of the system is the Atmega128 by Atmel which is actually responsible for processing and decision making. The UART (Universal asynchronous receiver/transmitter) protocol is used for communication between the ZigBee module and GSM module.
Learning technique for determination of accident condition using Gyroscope values:

A .General approach (GA)

This approach contains the general decision making algorithm. The processor checks the data sent by the slave board of the gyroscope angles with respect to X-axis, Y-axis, Z-axis and status of vibration sensor flag. The output from the gyroscope is in the form of angular velocity. This output is converted to the angles by the slave board and sent to the master board. We will name those angles as X-angle, Y-angle and Z-angle with respect to the three axes. So the angular values will be checked for some predefined safe threshold limits. If those angular values exceed the limit, the master will simultaneously check if the status bit of vibration sensor flag is set. Processor will detect the occurrence of an accident only if both the conditions of gyroscope detection and sensor flag status are met simultaneously.

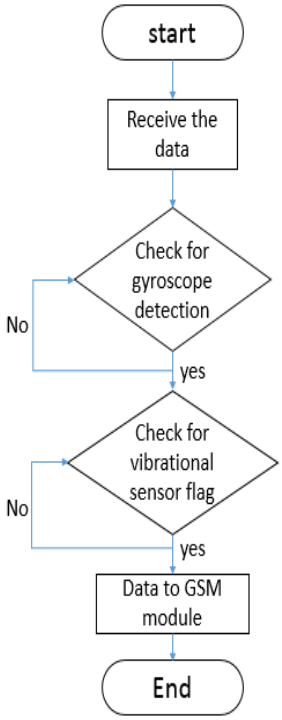

Figure 6: flowchart for detection of accident condition using GA approach.

B. Approach with tilting approximation (ATA)

This approach is focused mainly on the estimating tilting of the helmet. Based on the gyroscope readings with respect to on axis reaching towards higher limit or lower limit tilting of helmet is determined. If tilting reading exceeds the limits then accident condition is made true. Here, in this approach the processor takes sample of tilting angle data received from the gyroscope at equal interval of time. Each time the processor samples the data the difference of each angle from the

respective limits is observed. The processor will determine the tilting based on the shifting sampled angle towards limits or exceeding it. Tilting of the helmet in any direction beyond the limits will determine possibility of the accident condition.

C. General approach combined with learning techniques (GLT)

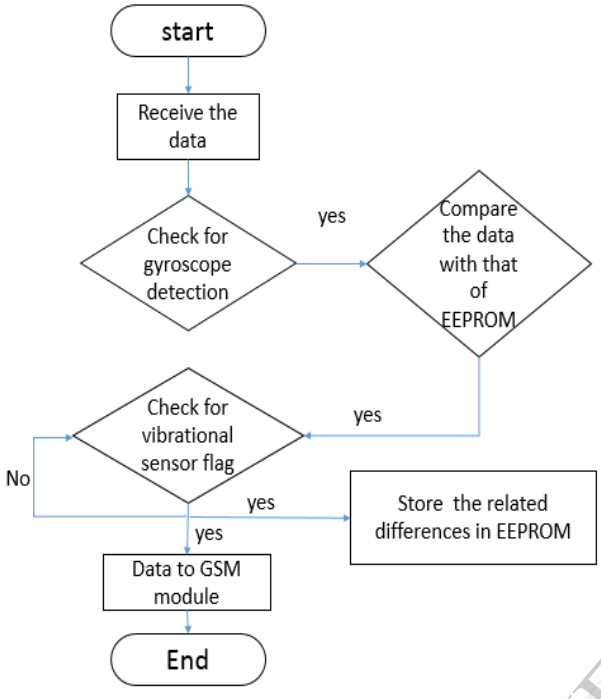

Figure 7: Flow chart of the algorithm used by GLT approach to determine the accident condition.

This approach primarily takes decision by general fuzzy logic approach as well as by checking using learning technique. In this method the processor takes the decision based on the general approach method, then the processor compares the angle differences from respective limits to the data stored in the EEPROM. The EEPROM is initially loaded with number of data values of differences. The processor then compares for each angle whether they are within the tolerance of predefined data or not. One more feature of this approach is that when both of conditions stated in the general approach are true then related differences of the angles will be stored in the EEPROM of processor. This will enable the processor to detect the accident in case of malfunction of the vibrational sensor.

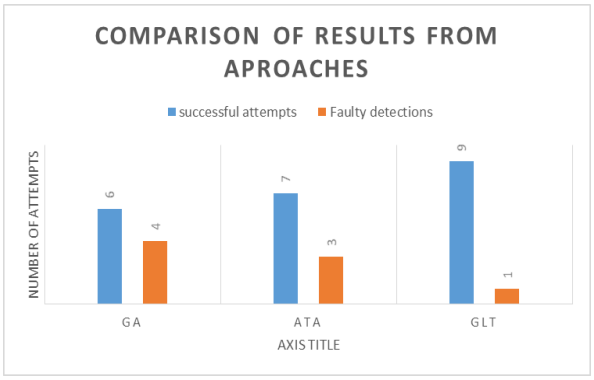

Figure 8: Statistical comparison of discussed approaches to detect the accident condition.

3. RECEIVER PART

The data about the location of accident is in the form of longitude and latitude values. This is interpreted into user friendly interface by visualizing the location on maps along with the supplementary data.

Case 1. When a person start ignition of the vehicle then a message is sent to main receiver by master

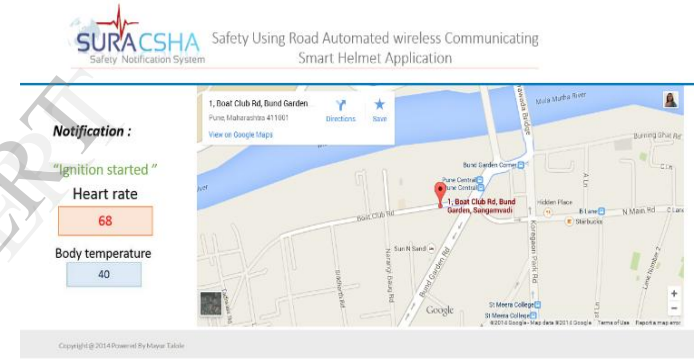

Figure 9: Image of the notification containing heart rate, body temperature and location of the person when ignition is applied to the vehicle.

Case 2. When the person met with an accident then text containing all the data will be sent by master board. The display shows the location of victim and directions to get to him. Also the display will update the data related to heart rate and body temperature.

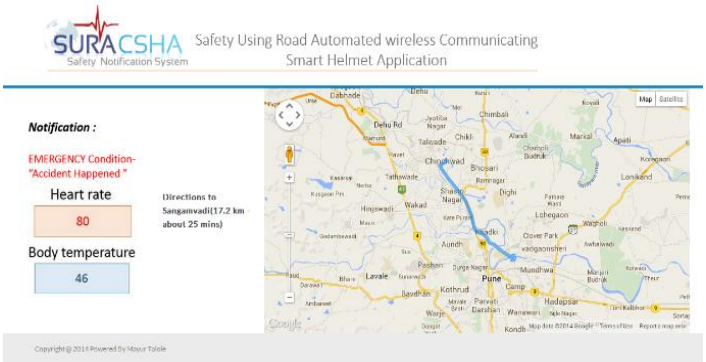

Figure 9: Image of the notification containing heart rate, body temperature and location of the person when the accident condition is detected

V. CONCLUSION

From the above study over the system, it is concluded that the system implemented is very useful and advantageous application for two wheelers or with some modification even cars. Implementation of this system by manufactures or by individuals will decrease the deaths ratio from accidents. The medical staff will be well prepared than an emergency case and will efficiently treat the casualty. Hence it can be inferred that the SURACSHA is a flexible system to operate and remarkable improve the life expectance of the victim.

VI. FUTURE SCOPE

The system could be useful for tracking one's locations. The system could be developed to an android application which will be even more useful for real time location detection. The data related to blood pressure can also be added to the data containing heart rate and body temperature. This will help doctors to prepare an emergency treatment for the patient.

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