ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

Development of Wireless Black Box Using MEMS Technology for Accident Prevention

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ABSTRACT: Transportation require to carry out things from one place to another. With mean time , transportation also faces many problems such as accidents, traffic and air pollution. This paper is designed in the vision of preventing accidents. A prior intimation is given to the driver about the obstacles present in the roads such as, temporary work on progress, if the vehicle is very nearer to the reference vehicle etc. The main purpose is to develop a prototype (Black Box Implementation) for vehicle diagnosis that can be installed into any vehicle. This module can be designed with minimum number of functional requirements as per the user. The eye blink sensor will sense the reflections of eye, if the person is drowsy or sleepy automatically it leads to decrease the fuel flow consumption and the buzzer will be on to make the person awake.

KEYWORDS: Black box, Eye blink sensor , Buzzer, Accelerometer .

I.INTRODUCTION

The entire designed system is beneficial for the avoidance of accident causing, which involves various applications as mentioned below. In the event of accident, this wireless device will send mobile phone short message indicating the position of vehicle by GSM/ GPS system to family member, emergency medical service (EMS). If the distance between two vehicles is very less then automatically the fuel flow will be reduced. In case of rash driving, logging of data from accelerometer into the SD card so as for reference in future and also stops the vehicle if obstacle is ahead. If the person is drowsy or sleepy automatically it leads to decrease the fuel flow consumption and the buzzer will be on to make the person awake. This can contribute to construct safer vehicles movements to save the life of the human, improving the treatment for crash victims enhancing road status in order to decrease the death rate.

II .LITERATURE SURVEY

In the paper [1] , Usually this types of facilities available in aircraft. If any crashes occur in between two aircrafts or any problem occur in an aircraft we can identify it by information stored in black box. By using this concept we can implement it on vehicles. So by collecting the information from two vehicles one can judge which person committed mistake. This module has been placed in each vehicle. Once accident has been occurred it will store all the information that is the state about that vehicle in that particular time in black box. So this will be useful for forensic purpose.

In [2], Car black box is a device to record driving history which can be used for car forensics in case of car accident or crimes. Car black box stores video clips that could be critical clues for investigating car-related accidents or crimes. These video clips can be collected to police server via 3G phones where smart phones are very useful for this purpose. This module shows the whole process to collect video proofs using smart phones through Bluetooth. Some of the cryptographic mechanisms were used to provide privacy and video integrity .

In [3] ,The main purpose of the paper is to develop a prototype of Black Box for vehicle diagnosis that can be installed into any vehicle. This module can be designed with minimum number of circuits, which will help to

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ISSN (Print): 2320-9798

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construct safer vehicles and it improves the treatment for crash victims, helping insurance companies to investigate for their vehicle crash and enhancing road status in order to decrease the death rate.

This paper has presented a new vision for the vehicles industry, where the Black Box system used for vehicles. A full and detailed description was made for every part of this system. This paper offered a user friendly embedded program to analyze the data of the accident.

The Black Box module developed can be implemented in all vehicles system. As soon as the driver runs the motor, this system will begin saving the data events of the corresponding vehicle. The data are always saved in the EEPROM of the Black Box, and in case of accidents, an additional 10 seconds of events after this accident will be saved. The data saved can be retrieved after the accident for privacy purposes and it is display to the user using serial transmission and the EEPROM. A detailed report will be given to the user containing the recorded data in the memory.

In [4] , wireless black box using MEMS accelerometer and GPS tracking system is developed for monitoring the accidents. The system consists of components such as an accelerometer, microcontroller unit, GSM module and GPS device. When accident occur , this wireless device will send mobile phone short massage indicating the position of vehicle by GPS system to family member, Emergency medical service (EMS) and nearest hospital, So the threshold algorithm and speed of vehicle are used to determine accident in real-time. The test results for vehicle may be linear fall, non-linear fall and with high accuracy.

An innovative wireless black box using MEMS accelerometer and GPS tracking system has been developed for accidental monitoring. The system can detect type of accident (linear and nonlinear fall) from accelerometer using algorithm for threshold, posture after crashing of vehicle and GPS ground speed. After detecting accident, short alarm massage data (alarm massage and position of accident) will be sent through GSM network. The system been tested in real world applications using bicycles. The test results shows that linear fall, non-linear fall and normal ride with no false alarm.

III.ARCHITECTURE OF GPS TRACKING AND GSM MODULES

The proposed system [5] consists GSM modems (stationary and in -vehicle), of in- vehicle GPS receiver and embedded controller. The users of this application can monitor the location graphically on Google Earth, and they can also view other relevant information of each automobile in the fleet.

The implemented tracking system can be used to monitor various parameters related to emergency services, safety and engine stall. This paper shows an implementation of several modern technologies to achieve a desirable goal of fleet monitoring and management.

Fig. 1: The block diagram of GPS tracking system

IV. HARDWARE REQUIREMENTS

Arduino ATmega328
Zigbee
GPS Module
Microcontroller-8052
Fuel flow device
Ultrasonic sensor HC-SR304
Eye blink sensor
GSM Modem
SD card

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A. ARDUINO

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), a 16 MHz crystal oscillator, 6 analog inputs, a power jack, a USB connection, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. This differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead of that it features the Atmega8U2 programmed as a USB-to-serial converter.

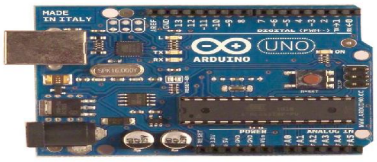

Fig. 2: Arduino Microcontroller

PURPOSE OF USING ARDUINO

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50.

Cross-platform - The Arduino software runs on Macintosh OSX, Windows, and Linux OS. Most microcontroller systems are limited to Windows OS.

Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, and also it is flexible enough for advanced users to take advantage of as well. It is conveniently based on the Processing programming environment for teachers, so students will also be familiar with the Arduino.

Open source and extensible software- The Arduino software is published as open source tools which available for extension by experienced programmers. The language can be extended through C++ libraries, and people wants to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based.

Open source and extensible hardware - The Arduino is based on Atmel's TMEGA8 and ATMEGA168 microcontrollers. The modules are published under a Creative Commons license, so experienced designers can make their own version of the module, extend and improve it. Even relatively inexperienced users can build the breadboard version of the module in order to understand working and save money.

B.ULTRASONIC SENSOR

Ultra sonic sensor is mainly used to measure the distance between two vehicles.

This sensor consists of four PINS

1.Vcc----------connect to 5V dc
2.Trigger----------pulse input that triggers the sensor
3.Echo----------indicates the reception of echo from the target
4.Gnd----------ground final.

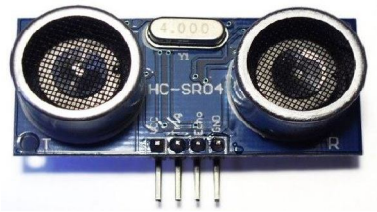

Fig. 3: Ultra Sonic Sensor(HC-SR04)

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ISSN (Print): 2320-9798

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C.GPS

A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a person, vehicle, or other asset to which it is attached and to record the position of the asset at regular intervals. The recorded data location can be stored in the tracking unit, or it will be transmitted to a central location data base, using a cellular (GPRS or SMS), or internet-connected computer, radio, satellite modem embedded in the unit. This allows the location to be displayed against a map backdrop either in real time using **GPS tracking software**. Data tracking software is available for smart phones with GPS capability.

Fig.4: GPS(SKG13C)

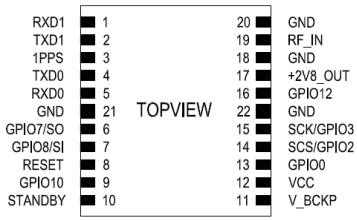

Fig. 5: Pin configuration

Features

- Ultra high sensitivity: -165dBm
- Extremely fast TTFF (Time To First Fix) at low signal level
- Low power consumption: Typical 45mA@3.3V
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage: 3.0V to 4.2V
- Operating temperature range: -40 to 85℃
- SMD type with stamp holes
- Small form factor: 15x13x2.7mm
- RoHS compliant (Lead-free)

D.GSM

The average values of the Bluetooth frequency with and without the security layer are 4.83 Hz and 5.01 Hz, respectively. The security layer introduces a delay because the terms ΔTd and ΔTe which are decryption time and encryption time respectively are significant . On the other hand, the size of the message sent through Bluetooth is 40% larger if the security layer is enabled, and different payload sizes introduce different behaviours. In general, the increased size of the message decreases the Bluetooth frequency due to the low-level mechanisms implemented in the Bluetooth stack. Despite this slight decrease of sending frequency, the performance of the closed-loop system is not affected by the security routines when the high-level control strategies equipped with this additional layer are tested.

Fig . 6: GSM MODEM

Features

- Highly Reliable for 24x7 operation with Matched Antenna
- Status of Modem Indicated by LED
- Simple to Use & Low Cost

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- Quad Band Modem supports all GSM operator SIM cards

E .EYEBLINK SENSOR

Senses eye blink using IR sensor, potentiometer and comparator. Location of iris is detected by one IR sensor and output is given to one comparator. An Infra-red LED emits the light of particular intensity which is received by an Infra-red Photodiode which is connected at the input of the operational amplifier, and its output is proportional to intensity of light falling on it. As the output of IR detector is connected to the inverting terminal of Op-Amp, the input voltage of Op-Amp varies as per the intensity of light falling on IR detector. Hence the output of Op-Amp varies accordingly. While driving, the IR emitter will continuously emit the light, which falls on the driver‘s eye and this light will be reflected. from the driver‘s eye and detected by the IR detector. When the eye is open, maximum amount of light will be reflected from the eye, as our eye is transparent.

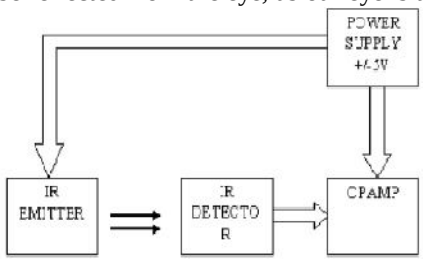

Fig. 7: Circuit Diagram Of EYEBLINK SENSOR

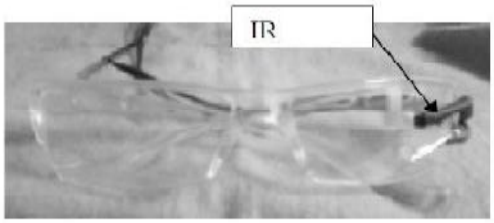

Fig .8: EBM GOGGLE

The sensor part of the EBM system is implemented in the form of a goggle. The goggle used is a simple , in which IR LED and IR photo diode are placed in such a way that light emitted by the IR LED falls on the eyeball and the reflected light is collected by the IR photo diode. The goggle receives the power from +5V power supply and it sends the signal to the input of Op-Amp. The goggle is to be worn by the driver while driving. The sensors are implemented in such a way that it won‘t obstruct the sight.

F. ZIGBEE

Tarang modules were designed with low to medium transmit power and for high reliability wireless networks. The modules require minimum power and provide reliable delivery of data between devices. The interface is provided with the module help to directly fit into many industrial applications. The modules operate within the ISM 2.4 to 2.4835 GHz frequency band IEE 802.15.4 baseband.

Fig .9: ZIGBEE TARANG F4

Features

- Range-outdoor line of sight: upto 50km with directional
- Transmit power: upto 1watt /30 dBm nominal
- Receiver sensitivity upto -107dBm
- Command Modes for configuring Module parameters
- Allocated Direct sequence spread spectrum technology
- Analog to digital conversion and I/O lines support

G. ACCELEROMETER

The ADXL335 is a thin , small, low power, complete 3-axis accelerometer with signal conditioned voltage outputs and the product measures acceleration with a minimum full-scale range of ±3 *g*. It can measure the static

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ISSN (Print): 2320-9798

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acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

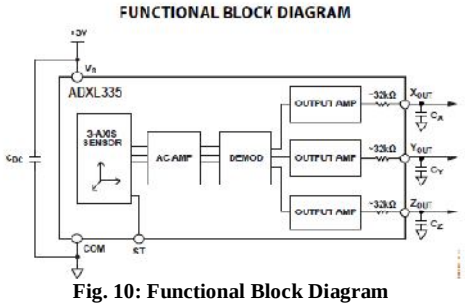

Fig. 10: Functional Block Diagram

Features

- 3-axis sensing
- Small, low profile package
- 4 mm × 1.45 mm LFCSP
- Low power : 350 µA (typical)
- Single-supply operation: 1.8 V to 3.6 V
- 10,000 *g* shock survival
- Excellent temperature stability
- Bandwidth adjustment with a single capacitor per axis .
- RoHS/WEEE lead-free compliant

H. FUEL FLOW DEVICE

If the distance between two vehicles will be less then automatically the fuel flow will be reduced and also if the person is sleepy or drowsy that is sensed by eye blink sensor even at this point of time fuel flow will be reduced automatically.

Fig. 11: Fuel Flow Device

The Fuel Flow Meter uses proven solid-state ultrasonic flow measurement technology to detect directional fuel flow rate up to 8000ml/min and the fuel flow meter is capable of monitoring both steady and transient fuel flow, fuel flow direction, temperature and cumulative fuel usage.

I.POWER SUPPLY

A power supply is a device that supplies electric power to one or more electric loads where such term is most commonly applied to devices that convert one form of electrical energy to another. A regulated power supply is one that controls the output voltage or current to a specific value; the controlled value is held nearly constant despite variations in either load current or the voltage supplied by the power supply's energy source. Every power supply must obtain the energy , as well as any energy performing that task, from an energy source.

V. SOFTWARE REQUIREMENTS

ARDUINO PROGRAMMING LANGUAGE

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling motors, lights and other actuators. The microcontroller on the board is programmed using the Arduino

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programming language and the Arduino development environment. This projects can be stand-alone or they can communicate with software on running on a computer.

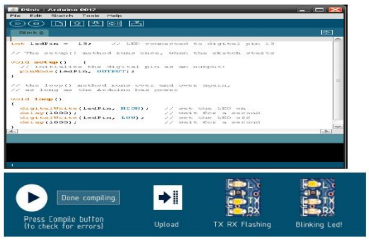

Fig.12 : Arduino software

MICROCONTROLLER-8052

Here demonstration of KEIL IDE is shown. Here we will show creation of project in KEIL and will build it and generate the HEX file.

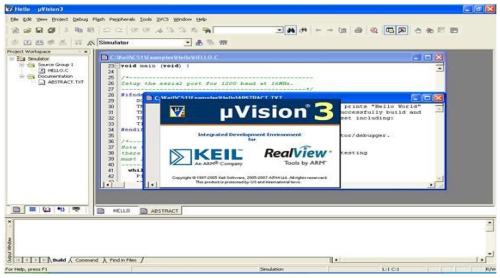

Fig.13 : Keil microvision

That hex file can be downloaded into target processor by either programmer or if your processor support ISP then we can download code via serial port.

VI. BLOCK DIAGRAM & WORKING

The Block diagram includes the Arduino as the main heart of the controlling system which is used to control the speed and minimum distance between the vehicles the interface of HCSR 04 Ultrasonic sensor is connected to PIN 8 and 9, Echo and Trigger Pin of the Sensor to microcontroller which is used to calculate the distance and reduces the speed of vehicle and Controllers the Flow of fuel. The Eye Blink sensor which consists of comparator LM358 compares the light intensity falling on the eye ball and has the difference in voltage at comparator when eye is closed as there by in turn generates either high or low voltage as digital output and fed to the microcontroller to raise the alarm to wake up. This not only monitor the parameters by also log the data such as accelerometer data for the vehicle tilting and stored in SD card which is interface with Arduino Uno. The Motor which is used cannot be driven by microcontroller hence motor driver is attached to increase the current and drive the motor depending the controls of microcontroller. The GPS data logging and SMS service for emergency is done by Enabling the Tx and Rx by using Panic button which is connected to PIN 7 and 5 from Arduino Microcontroller.

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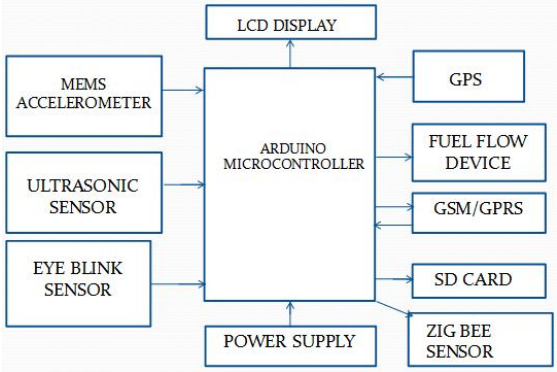

Fig.14: Block Schematic Of The Proposed System

VII. RESULTS

If any zone is not nearby then automatically the zone detection unit is displayed on LCD as in fig15 . In case if any zone like hospital zone, school zone etc detects then this kind of zone will be displayed as in fig 16.

Fig .15: Dispaly Of Zone Detection

Fig.16: Display of Single zone

If there is only one way ahead then it will display the message as single lane zone on LCD as in fig 17. Usually more number of passengers will be there in bus stops so accident occurrence in this type of places will be more, so in order to avoid accidents driver will get the information regarding the presence of bus stop before itself so he can take precautions to avoid accidents by slowing down the vehicle as in fig 18.

Fig. 17: Display of Bus Stop

Fig .18 . Display Of Hospital Zone

User will get the information before itself indicating the presence of hospital zone ahead he can take precautions to avoid accidents. The below fig 19 shows the hardware connections and fig20 shows the message from black box .

Fig. 19: Hardware Connections

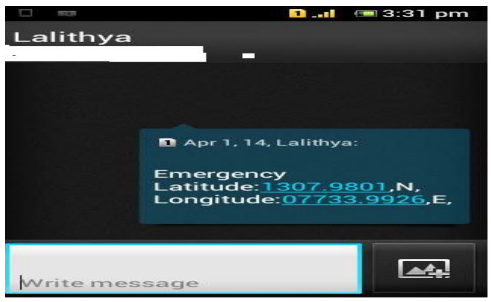

Fig .20: Message From Black Box

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

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VIII . CONCLUSION AND FUTURE WORK

The proposed system successfully exhibits itself the vision of preventing accidents. The paper is concluding that an implementation of a system designed with multiple functionality such as Ultrasonic sensor, Accelerometer, Zone detection system, Eye Blink Sensor, Location estimation and SMS service for emergency situation. This system is designed as prototype black box function for logging the status of accelerometer which is used in future for investigation purpose when met with an accident. This designed system is not only use for logging of data but also used for prevention of various accident causes such as drowsiness, rash driving, unknown of obstacle ahead and zone identification for speed reduction. The various sensor implemented in the system will avoid all the causes mentioned above so as to avoid accident occur and save the life of the human.

With the help of GPS we will be able to get the information about latitude and the longitude of the location where accident has taken place but we won't be able to find the exact location name. For that we require Google map and also satellite links. If a speed of a vehicle is increased, the message will be sent to the server system. It gets updated and penalty will be charged to the driver. The state of the vehicle should be indicated in case of abnormal driving. For example the particular health state of the driver should be displayed.

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