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ARM Hardware Platform For Vehicular

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ABSTRACT:
In today's world as the population increases day by day the numbers of vehicles also increases on the roads and highways. This module provides information about the accident to the hospital and police station. As a result sudden help public life may save and the traffic jams are reduced. To improve the level of supervision and management for cargo transport vehicles, especially trucks carrying coal it is important to develop transport vehicles remote monitoring module .A server computer at the (remote) monitoring station, This contains the information regarding Vehicle velocity, position, identity and temperature in two fashions. The information given to monitoring station is in continuous manner and when the accident occurs. The development of vehicular design brings public many convenience in life but also brings many problems at the same time, for example, traffic congestion, difficulty in monitoring dispersive vehicle, theft and other series of problems.

Index Terms— ARM7 TMI-S, MEMS Accelerometer, GPS, GSM, LPC2148, Wireless monitoring station.

1. INTRODUCTION:

Mankind has always reacted to problems with strong determination aimed at providing better solutions to difficulties. From the use of celestial navigation to the use of compass man has always searched for a means of accurately locating his position on the globe with precision and accuracy necessary to avoid tragedy and to reach his intended destination. One could also want to locate a specific place in a locality familiar to him. This could be a shopping mall, a petrol station, a hotel, or even an office. The Global Positioning System (GPS), is a popular satellite navigation system which makes use of a constellation of more than two dozen GPS satellites to transmit precise radio wave signals in any weather, day or night, anywhere on Earth. This allows a GPS receiver in an unobstructed line of view to synchronize with the satellite to determine its current horizontal location to the nearest 15 meters radius in latitude, longitude and altitude by connecting to just four satellites in its horizon. It provides accurate three-dimensional position (latitude, longitude, and altitude), velocity and precise time traceable to Coordinated Universal Time (UTC). To make the device user friendly, the information from the GPS is translated to information that can be understood via a map [3]. The aim of this work is to integrate readily available materials with the implementation of the knowledge of software engineering and basic electrical and electronics to build an easy to use, computerized navigation/tracking system capable of tracking the movements of a remote target.. Because of the tracking capabilities of the device it can easily be used to monitor the movements of a vehicle as well as for vehicle recovery [3].

With the development of GPS technologies and the improvement of 3G wireless communication network, the communication mode of GSM/GPRS-based

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positioning and monitoring system is constantly changing as well as its developing technology [5], aiming to build an efficient, reliable and wide range covered system by integrating the latest communications technology and the newest wireless network environment. The traditional positioning and monitoring system consists of three parts: the GPS terminals, wireless communication network and control center as shown in Fig.1.

Fig 1: Positioning and monitoring system architecture

2. METHODOLOGY:

Methodology of Detection

The signal processing goal is to classify the original data into two classes, fall and not fall. In this system, the input data from 3 axis accelerometer was kept and processed in real-time with sampling rate of 60 Hz or higher. The signal from MEMs accelerometer was converted by 10 bits ADC into integer range between 0 and 1023. The sensor was embedded in a motorcycle seat to fix the accelerometers axis so that the response of acceleration data is well defined. The classification of the fall detection utilized the 3-axis acceleration signal from MEMs accelerometer and the ground speed from GPS module. In general, motorcycle fall can be classified as linear fall and non-linear fall. The linear fall is concerned about fall without external force, which is free falling condition that only z-axis acceleration changes. In this case, the non-linear fall data from accelerometer and the ground speed from GPS module is considered. To determine the accelerometer output, two frames of acceleration data, which include 3-axis acceleration at present time (t) and prior time (t-1), are used for analysis. For a linear fall, the z-axis acceleration follows free falling condition which is given by,

$|Az| \geq 9.7$ m/s2 (1)

where the Az is the z-axis acceleration [4].

In a non-linear fall, two frames of acceleration data are used. From non-linear fall experiments under most likely situations, the change of acceleration between two consecutive frames should be more than 15.5 m/s2. Thus, the non-linear fall condition is given by,

$| An, t -- | An, t-1 | \geq 15.5$ m/s2 (2)

Where the A n, t is acceleration from x, y or z coordinate at the present time frame and An, t-l is acceleration parameter from x, y or z coordinate in the previous time frame. From equation, if the difference of acceleration in two time frames is more than 15. 5 mls2, the first condition of non-linear fall accident of motorcycle is met. The ground speed from GPS module then used to decide whether actual non-linear fall accident occurs. If ground speed becomes zero after detection of large acceleration change as indicated in equation (2), non-linear fall detection in motorcycle is detected and fall alert message will be sent. However, false detection may occur in case of a severe brake because data are not kept and processed over a long time frame [4].

Accident Detection Flowchart

The following flowchart describes how the system detects type of fall and detecting accident by sending alarm.

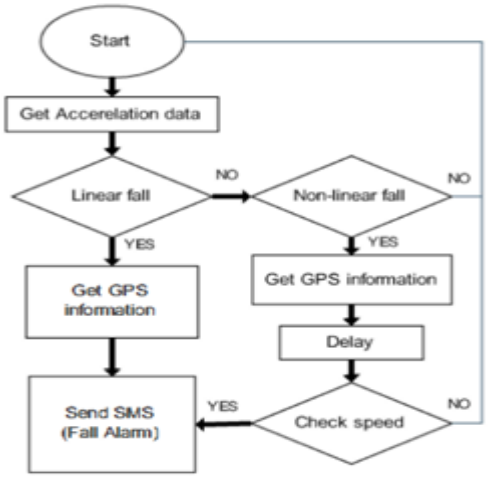

Fig 3: Accident Detection Flowchart

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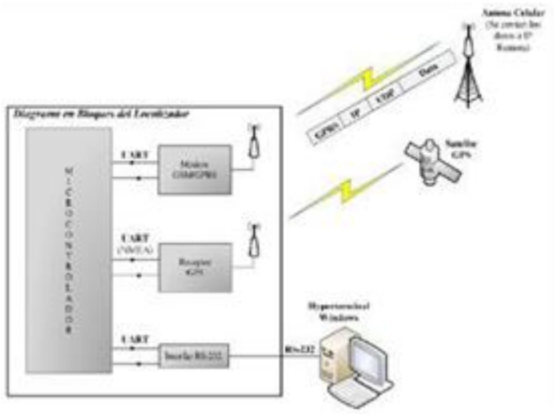
3. Proposed System Architecture System Description

The system consists of cooperative components of an accelerometer, microcontroller unit (MCU), GPS device and GSM module for sending a short massage. An accelerometer is applied for awareness and fall detection indicating an accident. The speed of motorcycle and threshold algorithm are used to decide a fall or accident in real-time. Mobile short massage containing position from GPS (latitude, longitude) will be sent when motorcycle accident is detected. The robust package design is implemented so that it is safe from water's spray and dust in environment. The module is aimed to be installed under the motorcycle seat. A high performance 16 bits MCU is used to process and store real-time signal from the accelerometer. Thus, this device is analogous to a black box in airplane. The police and insurance examiner can obtain accident history to investigate accident situation from data-logger in this device. The device keeps data log of track and acceleration data for 1 minute before and after an accident. Moreover, this device can be used to track motorcycle after it was stolen in real-time by the use of Google Map in a terminal used in the remote control location The system consists of cooperative components of an accelerometer, microcontroller unit (MCU), GPS device and GSM module for sending a short massage. An accelerometer is applied for awareness and fall detection indicating an accident. The speed of motorcycle and threshold algorithm are used to decide a fall or accident in real-time. Mobile short massage containing position from GPS (latitude, longitude) will be sent when motorcycle accident is detected. The robust package design is implemented so that it is safe from water's spray and dust in environment. The module is aimed to be installed under the motorcycle seat. A high performance 16 bits MCU is used to process and store real-time signal from the accelerometer. Thus, this device is analogous to a black box in airplane. The police and insurance examiner can obtain accident history to investigate accident situation from data-logger in this device. The device keeps data log of track and acceleration data for 1 minute before and after an accident. Moreover, this device can be used to track motorcycle after it was stolen in real-time by the use of Google Map in a terminal used in the remote control location The system consists of cooperative components of an accelerometer, microcontroller unit (MCU), GPS device and GSM module for sending a short massage. An accelerometer is applied for awareness and fall detection indicating an accident. The speed of motorcycle and threshold algorithm are used to decide a fall or accident in real-time. Mobile short massage containing position from GPS (latitude, longitude) will be sent when motorcycle accident is detected. The robust package design is implemented so that it is safe from water's spray and dust in environment. The module is aimed to be installed under the motorcycle seat. A high performance 16 bits MCU is used to process and store real-time signal from the accelerometer. Thus, this device is analogous to a black box in airplane. The police and insurance examiner can obtain accident history to investigate accident situation from data-logger in this device. The device keeps data log of track and acceleration data for 1 minute before and after an accident. Moreover, this device can be used to track motorcycle after it was stolen in real-time by the use of Google Map in a terminal used in the remote control location



System Block Diagrams Vehicular Unit

The complete block diagram of vehicle unit is as shows in figure 4.The vehicular system [VS] includes hardware that consists of an ARM 7 TDMI core processor, Accelerometer, GPS module, GSM module, SD memory card, l6x2 LCD, and temperature sensor. The whole VS works on a 5V or 9V dc regulated

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power supply. The GPS receiver module interfaced with UART1 of ARM processor provides speed and location information. The identity of a vehicle is fixed that is saved in a flash memory of a processor. The temperature sensor provides temperature per degree Celsius to an ARM processor. The temperature sensor is interfaced to an ADC1 of ARM processor. Vehicular speed, position and temperature are stored in a SD card. The SD card is interfaced to an ARM processor using SPI (Serial Peripheral Interface). All this information are shown on LCD that is interfaced with a GPIO 0 and send it to a monitoring station(receiver side) by GSM module wirelessly that is interfaced with UART0 of ARM processor [1].

Fig 4: System Block Diagram – The Vehicular Unit
Also the same information is given to a concern person to get that information anywhere anytime. The module requires GSM SIM (Subscriber Identity Module). As per the definite event stored in a program and when collision/accident occurs that is sense by an Accelerometer which is interfaced to ADC0 of ARM processor.

4. DISCUSSION

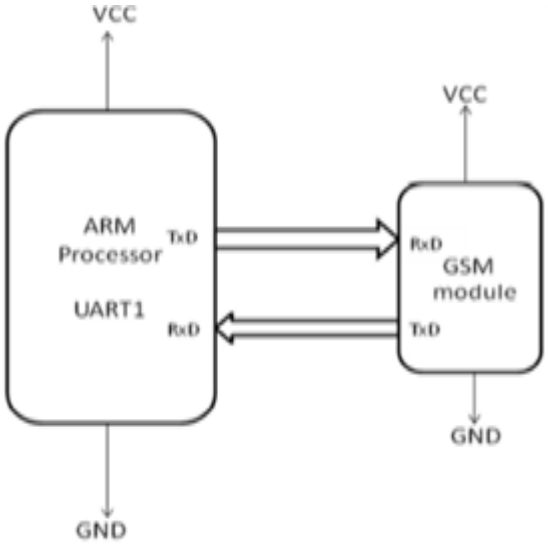

Fig 5: Interfacing of GSM module on UART1
Global System for Mobile communications (GSM) is the almost popular wireless standard for mobile phones in the world. GSM module allows transmission of Short message service (SMS) in TEXT mode and PDU mode. The proposed design uses SIM 300 GSM module in text mode.

This design uses SIM300 GSM module that provide 900/1800/1900MHz Tri-band for VOICE, SMS, DATA, and FAX. This module operates on AT command over TTL interface. AT command is an abbreviation for Attention command that is recognized by GSM Module. This abbreviation is always used to start a command line to be send from TE (Terminal Equipment) to TA (Terminal Adaptor).The information contains information speed, position (longitude, latitude), identity and temperature of a vehicle that is transmitted to the monitoring station by the SMS through the GSM network.. SIM 300 Module works on 12V, 2A power supply. The module is configured at 9600 baud rate. Figure 2 shows interfacing of GSM module with ARM
Processor on UART1where TxD pin of ARM processor is connected to RxD pin of GSM module and vice versa. The transmitted data from ARM processor using UART1 module contains information about Vehicle Identity that may be checked and displayed.

GPS MODULE:

Global Position System (GPS) is a space-based satellite navigation that provides location and time information in all weather conditions, anywhere on or near the Earth.GPS Receiver MT3318 Module is used. The GPS receiver tracks 51 satellites simultaneously. The module is mounted on the PCB along with the 3.3V low drop voltage regulator, transmit, receive and power indication LEDs, Schmitt trigger based buffer for 5V to 3.3V logic level conversion. This GPS receiver gives data output in standard National marine electronics association (NMEA) format. The GPS receiver gives -157dBm tracking sensitivity. The module is configured at 9600 baud rate. Module requires a 5V supply and can be interfaced with the 5V TTL / CMOS logic. Fig 6: Interfacing of GPS Module

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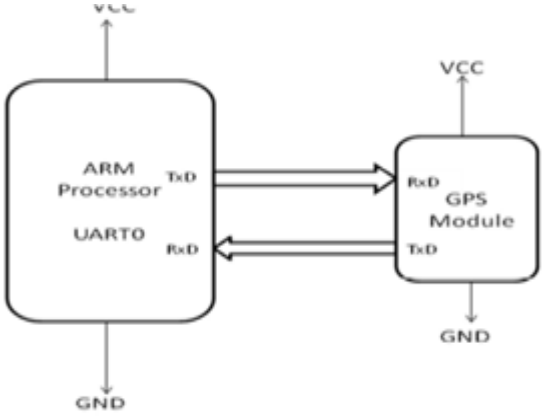


ACCELEROMETER:

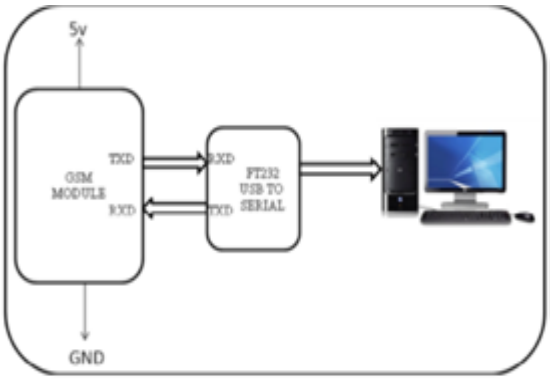
An accelerometer measures acceleration. Acceleration is a measure of how quickly speed changes. Accelerometer sensor is used to measure static (earth Gravity) or dynamic acceleration in all three axes, forward/backward, left/right and up/down. The output of accelerometer provides 1.65V to 3.3V in positive direction and in negative direction the voltage drop from 1.65V to 0V. The output of accelerometer is in analogue form with three different output voltages each representing X, Y and Z direction of motion. These three voltage signal are processed through ADC0 on three different Channels available on ARM. The 8 bit digital output from ADC0 is fed to UART1 of ARM. Accelerometer is used in this design for the collision detection. The maximum output voltage of accelerator module is 3.3V that is a CMOS voltage of the processor.

ARM7 PROCESSOR:

The conventional 8 and 16bit Microcontrollers has its deficiencies when compared with 32bit microcontroller. This proposed system design uses the ARM processor. 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. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. The Philips LPC2148 which is based on 32 bit ARM7 TDMI core supporting real time simulation. When ARM processor combined with RTOS with timing constraint can be realized for the data acquisition and transmission of data with high precision [1].

DATA STORAGE:

The system includes memory card which is used to store data. The data contains vehicle ‘ID’, ‘Position’ (Longitude’, 'Latitude)', date, time and velocity of a vehicle. The memory card can be expanded depending upon the purpose. The data storage provision is implemented using Serial Peripheral Interface (SPI) protocol supported by the LPC2148 ARM7 processor. This stored data can be access any time for monitoring (speed of a vehicle, correct path, collision etc.), comparison, and traffic analysis purpose etc. GSM module provides information in text mode. The information is given to a computer by interfacing of GSM module to computer by use of USB to SERIAL convertor. Most of the laptops are not having serial port and also in certain PC. As the size of the laptop are shrinking so the serial port are removed. The Location, Velocity and Identity of a vehicle can be display to the GUI and stored in a database. Figure 6 shows interfacing of GSM module with the PC using USB to serial convertor. The data received from GSM module is stored in data base and also it can be show on GUI. In case of accident occur the position of vehicle can be easily track by the use of use of Google map software. The monitoring station uses a single GSM module which can communicate with number of modules at run time which is a high real time need. This information can also be sending to the nearest hospital/police station to get help easily .This will certainly save the lives.



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Software Used

Kiel µvision IDE:

KeilµVision IDE (Integrated Development Environment) is a Windows based front end for the C Compiler and assembler. KeilµVision4 is used for writing embedded C programs. Embedded C is a high level language, which includes many aspects of the ANSI (American National Standard Institute) C programming language. Standard libraries are altered orenhanced to address the peculiarities of an embedded target processor [7].The signal from accelerometer module is processed by the processor. The analog signal from this module is applied to the on-chip peripheral ADC0. This ADC0 is configured as a 10-bit output data which gives high precision compared to the 8-bit microprocessors. This digital data is transmitted through UART1. UART1 transmits the data 8-bit at a time. These digital values are transmitted to GSM module through UART1.

CONCLUSION

The Vehicular System provides information of a vehicle like velocity, position, through a GPS module and identity of a vehicle to a monitoring station and to a mobile phone according to a definite event stored in a program or a query from a monitoring station. Accelerometer senses the collision of the vehicle and sends this information in real time to a hospital/police station. The monitoring station display these information on GUI also stored these information in database for further process according to a program. The system is useful in much application such as surveillance, security, tracking, which may be installed in cargo trucks, cars, motorcycle, and boat. The system can be used in many applications

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