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GSM & GPS Integrated With ARM Based Event Data Recorder for Accident Detection

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Abstract—Main concentration of this project is to find out the vehicle which is met with an accident by using MEMS sensor and GPS, GSM.Vehicle tracking system is one of the hot topics in embedded systems industry. In this project ARM controller communicates with LCD, GPS module and GSM modem. This system will be placed in a moving vehicle. The ARM controller will poll GPS module in prefixed intervals and sends the vehicle location information (Latitude & Longitude) to central station over GSM network. Whenever any accident occurs MEMS sensor detects the vibration of the vehicle and sends mechanical force, to ARM, by using GPS, we will get particular location where accident occurs, and then GSM sends message to authorized members & 108.One more best feature is whenever any authorized people gives message to GSM at accident location then it sends back the message of the accident location longitude and latitude values.

Keywords- - ARM7 TMI-S, MEMS Accelerometer, GPS, GSM, LPC2148, APR9600, Wireless monitoring station, µc/OS-II.

I. INTRODUCTION

In today's world as the population increases day by day the numbers of vehicles also increases on the roads and highways. This result in more accident that interns leads to the traffic jams and public get help instantaneously. 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 [2].A server computer at the (remote) monitoring station, that is continuously waiting for data from the system, should record the actions of the vehicle into a database. 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[4].We areintended to made this monitoring wireless using ARM7 hardware platform ported with real time operating system µc/OS-II.

Key feature of this design include:

a. Vehicle real-time monitoring by sending "its" information regarding velocity, Position (longitude, latitude) to the monitoring station and to the user/owners mobile that should help them to get medical help if accident or the theft.

b. Display that information on GUI and also at the same time these information are stored in the database.

c. User/owner has an access to get real-time position of a vehicle in real time.

d. Also in case of theft vehicle should be stop at the same time where this system is ported on the mobile vehicle.

e. It includes a temperature sensor that gives temperature in degree Celsius for monitoring the environmental conditions around the goods or other stuff in the transport vehicle.

Hardware of Vehicular System

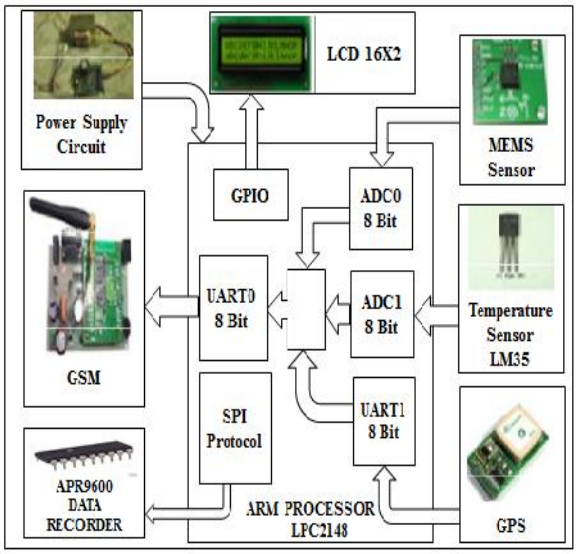

Figure 1: vehicular system block diagram

The complete block diagram is as shows in figure 1.

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 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.The system includes APR9600 which is used to datarecorder system. The APR9600 Data recorder is interfaced to an ARM processor using SPI (Serial Peripheral Interface). All this information are shown on LCD that is interfaced with a GPIO0 and send it to a monitoring station (receiver side) by GSM module wirelessly that is interfaced with UART0 of ARM processor. 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. The detail descriptions of all modules are as follows.

A. GSM MODULE:

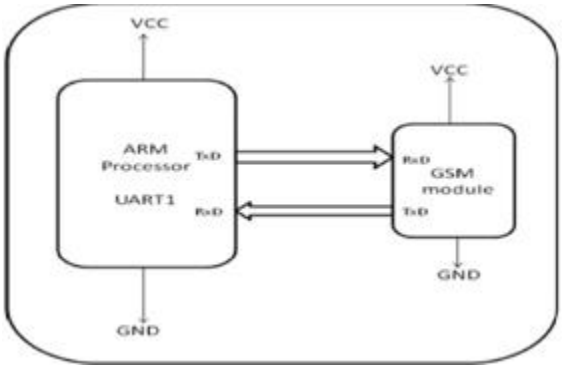

Figure 2: Interfacing of GSM module with ARM Processor on UART1

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 Transceiver pin of ARM processor is connected to Received 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 on Hyper-Terminal and as per the connection shown in fig 2 the same data is send to a specified mobile number and monitoring station as shown in figure3.

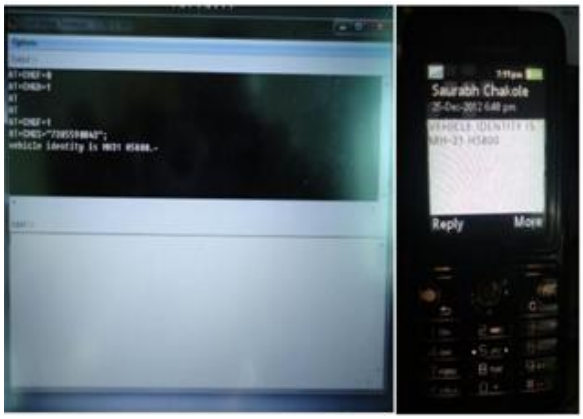

Figure 3: Identity of a vehicle on mobile and on HyperTerminal

B. 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 that have an active patch antenna from Cirocomm. 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.

The detail NMEA protocol:

1: GPGGA - Global Positioning System Fix Data

2: GPGSA - GPS DOP and active satellites

3: GPGSV - GPS Satellites in view

4: GPRMC: Recommended minimum specific GPS/Transit data Speed.

5: GPVTG: Track Made Good and Ground

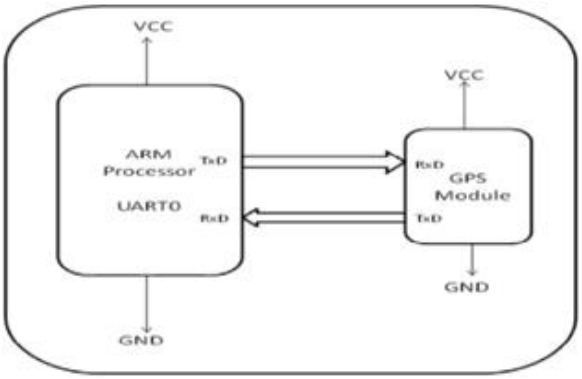

Figure4: Interfacing of GPS module with ARM Processor on UART1

Figure 4 shows interfacing of GPS module with ARM Processor on UART1where Transceiver pin of ARM processor is connected to Receiver pin of GPS module and vice versa. The data from GPS receiver in NMEA format is received on ARM processor using UART1 protocol which contains information about Vehicle position (longitude, latitude) and speed. This information can be check on HyperTerminal of a computer using USB to serial convertor. per the connection shown in figure 4, the same data is send to a specified mobile number and monitoring station as shown in figure5.

Figure 5: Position and speed of a vehicle on HyperTerminal and Mobile.

C. MEMS 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 at 4.5MHz clock from system peripheral clock. 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.

D. 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 bitARM7 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.

E. APR9600

The system includes APR9600 data recorder which is used to datarecorder system. We can play back after the incident whenever we require. We can playback capability for 40 to 60 seconds.Each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion. TheAPR9600 data recorder provision is implemented using Serial Peripheral Interface (SPI) protocol supported by the LPC2148 ARM7 processor.

II. RECEIVER/MONITORING SECTION:

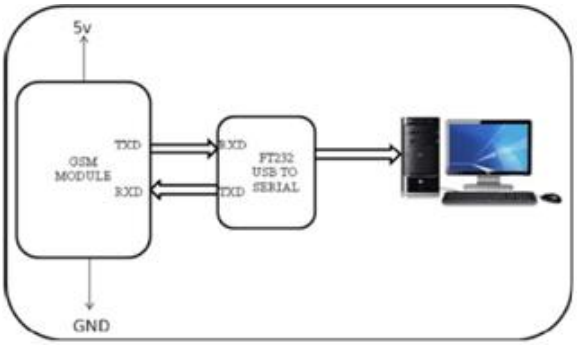

Figure 6: Interfacing of GSM module with PC

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 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.

III. SOFTWARE USED:

A. Kiel µvision4 IDE:

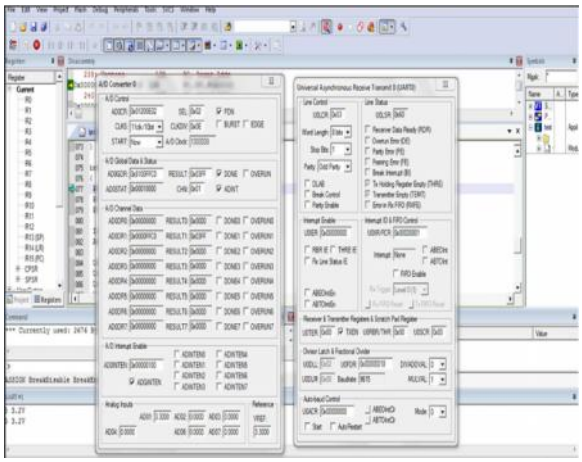

Figure 7: Simulation result of configured ADC0 and UART1 on keilµVision4 of LPC2148.

KeilµVision4 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 or enhanced 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. Figure 7 shows simulation result of ADC0 with UART1 collectively on KeilµVision4 software.

B. GUI

The GUI for the proposed system is designed on Visual Studio 2010. C # is a simple, modern, object-oriented, and type-safe programming language. Microsoft's C# compiler for the .NET Framework is a conforming implementation of both of these standards. Exception handling provides a structured and extensible approach to error detection and recovery. Also this language is compatible with all Microsoft applications.

C. µc/OS-II

µC/OS-II is a real time operating system that is portable, romable, scalable, preemptive, real-time deterministic multitasking kernel for microprocessors, microcontrollers and DSPs. µC/OS-II manages up to 250 application tasks(6). RTOS can be ported to ARM hardware, and then the system can deal with much more complicated tasks. Real-Time (RT) indicates an expectant response or reaction to an event on the instant of its evolution. And Operating System (OS) is a system program that provides an interface between hardware and application programs.The µc/OS-II is used for timing constraints.

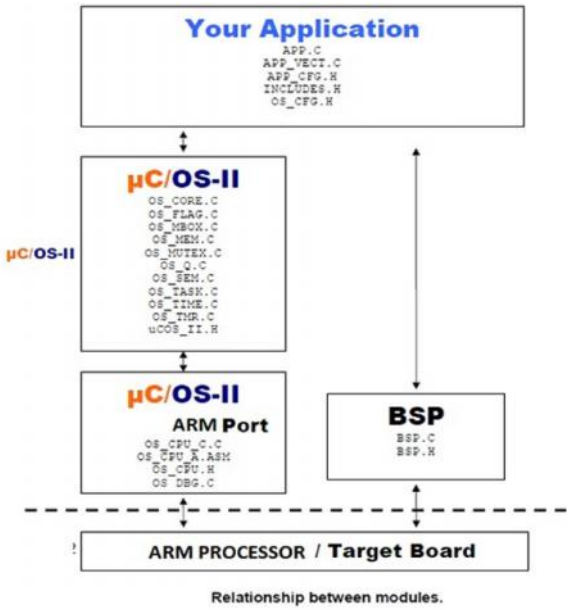

Figure 8:µc/OS-II RTOS Kernel

IV. 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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