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ARM 7 Based Accident Alert and Vehicle Tracking System

Salas K Jose, X. Anitha Mary, Namitha Mathew

Abstract*— Traffic accidents are one of the leading causes of fatalities. An important indicator of survival rates after an accident is the time between the accident and when emergency medical personnel are dispatched to the accident location. By eliminating the time between when an accident occurs and when the first responders are dispatched to the scene decreases mortality rates, we can save lives. One approach to eliminating the delay between accident occurrence and first responder dispatch is to use in-vehicle automatic accident detection and notification systems, which sense when a traffic accident is likely to occur and immediately notify emergency occurred. These in-vehicle systems, however, are not available in all cars and are unaffordable to retrofit in older vehicles. In this paper, such a system is described the main application of which is early accident detection. It can automatically detect traffic accidents using accelerometers and immediately notify a central emergency dispatch server after an accident, using GPS coordinates. Along with the data it will send the number of the vehicle too. This paper provides the following contributions to detecting traffic accidents via ARM7 controller. Here it is seen how arm controller, accelerometer, GSM connections, and GPS can be used to provide situational awareness responders. The codes are written and compiled in Keil ARMIDE.

***Index Terms*— Accident alert, accelerometer, GSM, GPS, i2c protocol, keil, UART, vehicle tracking.**

I. INTRODUCTION

When an auto crash occurs suddenly, the reaction of the emergency services now becomes a race between life and death. Today, wireless innovation has tilted the odds in favor of success like never before. This paper details about accident of automobile emergency alert situation. In this we are trying to program a GPS / GSM module incorporating an accelerometer to report occurrences of accident automatically via the GSM communication platform (using SMS messaging) to the nearest agencies such as hospitals, police stations, fire services and so on, giving the exact position of the point where the crash had occurred. This can provide early response and rescue of accident victims; saving properties and lives**.** The whole paper is based on arm controller. This controller is used to coordinate all the activities in the system. The components details are ARM 7(LPC 2378), Accelerometer (MMA7660FC), GPS module (MR 87), and GPS module (SIM 900)

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II. SYSTEM DESCRIPTION

The accelerometer is used to detect the acceleration. It is the main sensor used to detect accident. It can give the data to detect the accident. The data used to detect the accident. Once the accident is detected the GPS sensor. Then the GSM modem sends the GPS data and number of vehicle to a predefined mobile number.

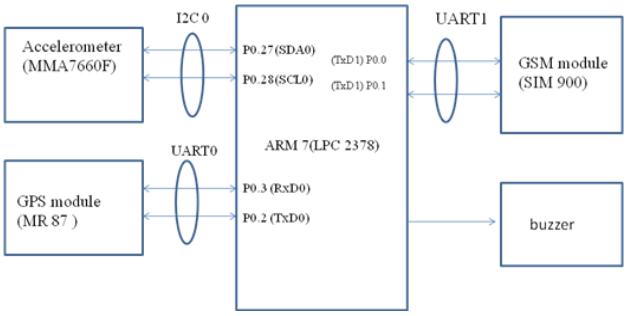

Fig 1: Block diagram of the paper

Here in our system can detect the accident using the accelerometer. This accelerometer is an I2C based one. A table to detect the acceleration value of the vehicle is provided. In case of accidents a large value of acceleration is obtained. But when the condition of breaking comes it is extremely difficult. So here an alarm is given on the buzzer. It will prolong for 30 seconds. Still if the driver does not press the reset button, then it will be interpreted as a serious accident. In this case the system will calculate the GPS coordinates and it will be messaged. GPS module used here is MR-87, a compact, high performance, and low power consumption GPS engine board. It can track up to 32 satellites at a time and perform fast calculations to low signal environments. This is a suitable one for portable electronic devices such as automotive, handheld navigation devices, mobile phones, Navigation devices, and other GPS applications. The GPS module that is used here is to detect the location of accident. In order to compute its location in three-dimensional space, a GPS receiver has to be able to lock onto signals from at least four different satellites. The receiver must maintain its lock on each satellite's signal for a period of time that is long enough to receive the information encoded in the transmission of the data. Achieving and maintaining a lock on more than three satellite signals can be impeded because each signal is transmitted at a frequency (1.575 GHz) that is high enough to bend around or pass through solid objects in the signals path. GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. Here in this system, it is used to send the data of accident to a station.

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There are five different cell sizes in a GSM network—femto, macro, Pico, micro and umbrella cells. The coverage area of each cell can be varied according to the implementation particular 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 than needed. Micro cell is a cell whose antenna height is under average roof top level. GSM networks operate in a number of different carrier frequency ranges separated into GSM frequency ranges for 2G and UMTS frequencies bands for 3G, with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were previously allocated, the 850 MHz and 1900 MHz bands can be used instead. In this case the frequency used is 9000 MHz.

III. METHODS AND MATERIALS

A. *ARM 7 LPC 2378 TDMI*

ARM7 is a series of ARM processor designs. This series has the Thumb 16-bit instruction set providing improved code density compared to previous designs. The commonly used ARM7 designs implement the ARMv4T architecture. All these designs are based on Von Neumann architecture, thus has versions comprising a cache that does not separate data and instruction caches. The LPC2378 microcontrollers are based on 32-bit ARM7TDMI-S CPU founded by NXP, with real-time emulation that combines the microcontroller with 512 kB of embedded high-speed flash memory. It has a 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at its maximum clock rate. So for critical performance in interrupt service routines and specific DSP algorithms, this increases performance up to 35 % over Thumb mode. The LPC2378 is suitable for multi-purpose serial communication applications. SB full speed device with 4 kB of endpoint RAM (LPC2378 only), two CAN channels, four UARTs, an SPI interface, three I2C-bus interfaces, an External Memory Controller (EMC) an I2C-bus interface, and two Synchronous Serial Ports (SSP),. This blend of serial communications interfaces combined with an on-chip 4 MHz internal oscillator 16 kB SRAM, SRAM of 32 kB, for Ethernet, together with 2 kB battery powered SRAM make this device suited for communication gateways 8 kB SRAM for USB and general purpose use, and protocol converters. Various 32-bit timers, an improved 10-bit ADC, PWM unit, CAN control unit 10-bit DAC, a, and up to 104 fast GPIO lines with up to 50 edges and up to four level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

B. *MMA 7660*

The MMA7660FC is a ±1.5 g 3-Axis Accelerometer with Digital Output (I2C). Low profile capacitive MEMS sensor featuring a low pass filter, compensation for 0g offset and has again errors. The device is used for product orientation, sensor data changes, and gesture detection through an interrupt pin (INT). The device is housed in a small 3mm x 3mm x 0.9mm DFN package. It can operate in different modes as follows. The sensor is having three power modes: first one is Off Mode, then Standby Mode, and finally Measurement Mode to offer the customer different power consumption choices. The sensor can only run in one of these modes at a time. Shake Detection, Orientation Detection, Tap Detection and/or Auto-Wake/Sleep Feature, Shake Detection and in this mode the digital analysis for any of these functions can be easily done.

C. *SIM 900 GSM modem*

SIM900 can be seen as a quad-band GSM/GPRS engine that works on many frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900 has features of GPRS multi-slot class 10/ class 8 (optional). It will also support the GPRS coding schemes such as CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24mm x 24mm x 3mm, SIM900 can meet almost many of the space requirements in many of applications, such as smart phone, M2M, PDA and other mobile devices. The physical interface to the mobile application is done as a 68-pin SMT pad, which can provide all hardware interfaces between the modules to customers' boards. Serial port and Debug port easily develop various applications. One audio channel includes a microphone as input and a speaker as output. The SIM900 equipped with power saving feature so that the current consumption is low as 1.5mA in SLEEP mode. The SIM900 is usually integrated with the TCP/IP protocol or extended TCP/IP. AT commands helps customers to use the TCP/IP protocol easily, and is very useful for those data transfer applications. Single supply voltage is in the range of 3.4V to 4.5V. Typical power consumption in SLEEP mode is seen as 1.5 mA. The frequency bands are set by AT command.

D. *GPS Modem*

In this paper a GPS MODEM of analog devices is used. Whichever the modem is used, it works based upon the NMEA 0183 protocol. This device has to be powered. It will give continuous data as output. The data can be taken in to the controller by using UART protocol. Then this data can be analyzed and we can find out the longitude and latitude of the current location

E. *The NMEA 0183 Standard*

The National Marine Electronics Association (NMEA) is a non-profit association of manufacturers, dealers, distributors, educational institutions, and others interested in different peripheral marine electronics occupations and so on. The NMEA 0183 standard defines an electrical interface and data protocol for communications between marine instrumentation.

F. *General Sentence Format*

All data can be transmitted as sentences. Only printable ASCII characters are permitted, then comes CR (carriage return) and then LF (line feed). Each sentence should starts with a "$" sign and must ends with <CR><LF>. There are three basic kinds of sentences, such as proprietary sentences, talker sentences, and query sentences. The general format for a talker sentence is $ttsss,d1,d2,....<CR><LF>. The first two letters following the „$" can be the talker identifier. The next three are the sentence identifier, these are followed by a number of data fields which are separated by commas, followed by an optional checksum, and finally terminated by carriage return/line feed. The data field is uniquely defined for each sentence type

G. *RMC Navigation Information*

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                                                11
        1          2        3 4         5 6 7  8    9  10 |  12 13  14   15
        |          |        | |         | | |  |    |  |  |  |  |   |    |
$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh
```

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxx,x.x,a*hh

3) Latitude
5) Longitude

H. I²C protocol

Whenever connecting any device to a microcontroller, the address and data lines of each device should be conventionally connected individually. But this would take up many precious pins on the microcontroller, as a result in a lot of traces on the PCB, and many require more components to connect everything together. This makes these systems to be expensive to produce and will be susceptible to interference and noise. In order to solve this problem, Philips Company developed I2C, in the 1980s. I2C is being a low-bandwidth and short distance protocol for on board communications. All devices can be easily connected through two wires. They are serial data (SDA) and serial clock (SCL).

I. UART protocol

A **Universal Asynchronous Receiver/Transmitter**, abbreviated **UART** is a type of synchronous receiver/transmitter, a piece of computer hardware that can translate data between parallel and serial forms. UART can be usually used in conjunction with different communication standards such as RS-422, RS-232 or RS-485. The universal designation shows that the data format and transmission speeds are configurable. These are typically handled by a special driver circuit external to the UART. A UART comes as an individual integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are included in microcontrollers also. External signals may be of many different forms. Every operations of the UART is controlled by a clock signal .The clock runs at a multiple of the data rate. The receiver will do testing on the state of the incoming signal on each clock pulse. It will be looking for the beginning of the start bit. If the required start bit lasts at least one-half of the bit time, it is valid and signals the start of a new character. Else, the spurious pulse may be ignored. After waiting a further bit time, the state of the line again gets sampled. The resulting level clocked into a shift register. After the required number of bit periods for the character length have elapsed. The contents of the shift register are ready to be given to the receiving system. The UART then sets a flag to indicate new data is readily available. It will also generate a processor interrupt to request that the host processor transfers the received data. Transmission operation is a simpler one. It will be under the control of a particular transmitting system. Whenever the data is deposited in the shift register after completion of previous character, the UART hardware generate a start bit, shifts the required number of data bits out to the line, generates and appends the parity bit (if used), and appends the stop bits. Transmission of a single character can take a long time relative to CPU speeds. So the UART may maintain a flag indicating busy status so that the host system will not put a new character for transmission until the previous one get completed. This can also be done using an interrupt.

IV. RESULTS

Here the various results obtained in different stages of the work can be. As it is a combination of different modules, they have been checked individually. And the results are as shown below. On checking the accelerometer, it shown different values on the HyperTerminal for various shake. For the GPS modem, the values ware extracted using controller and the values ware displayed on the HyperTerminal. The GSM modem was given set of AT commands. It was able to send the messages. Finally it was tested for the interface of all modules. Here the accelerometer detected a higher value of threshold then the alarm started to ring. If the reset was not pressed even after 30 seconds then the message was send. If the switch is pressed then the sending action is cancelled.

A. Results of GPS module

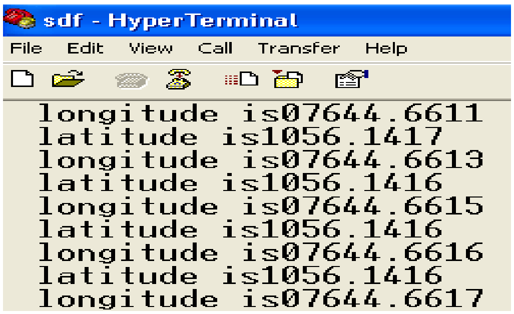

Fig 3: The isolated value of longitude and latitude using MNEA protocol, displayed on hyper terminal

B. Result of accelerometer module

Fig 4: Values obtained as results of shaking motion

C. Together interface of all modules

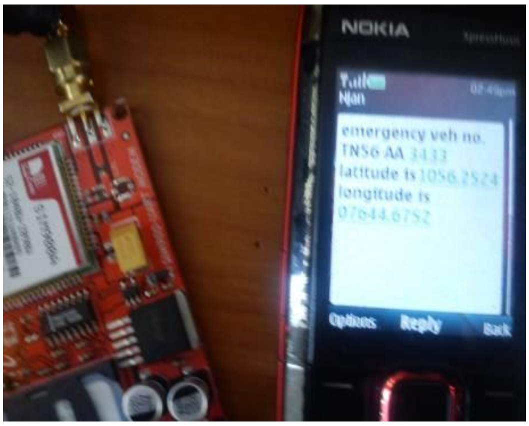

Fig 5: Messages send on accident detection

D. Final outputs

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Fig 5: final result

V. CONCLUSION AND FUTURE WORK

This vehicle accident detection and alert systems provide emergency responders with crucial information at the earliest possible time. Reducing the time between when an accident takes place and when it is detected can reduce mortality rates. Conventional in-vehicle accident detection and notification systems, such as On Star, are effective in reducing the time gap before first responders are sent to the scene. These systems, however, are expensive and not available in all vehicles. To further increase the usage of automatic accident detection and notification systems, this system can be used to indirectly detect accidents through sensors, such as accelerometers. In future we can interface different sensors with this paper, such as alcohol detector, drowsiness detector, heart rate detector, etc. In terms of these we can really prevent accident and save life. Security sensors to identify theft can also be added. It can be reprogrammed to switch off vehicle and track the vehicle in theft.

VI. ACKNOLEDGEMENT

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