Real Time Tracking & Health Monitoring System of Remote Soldier Using Arm7

P. S. Kurhe[1], S. S. Agrawal[2]
Electronics and Telecommunication Department,
Government College of Engineering,
Aurangabad, (M.S.) India-431005

***Abstract*— Every year Soldiers become lost or injured. This project gives the ability to track where Soldiers are at any given moment. Search and rescue efforts become minimized in time and resources. Additionally, with alert feature Soldiers will be able to communicate their distress with GPS coordinate information. Location tracking has been of great importance since World War II, when military planners realized its usefulness for targeting, fleet management, positioning, and navigation. This is a system which is reliable, energy efficient remote soldier monitoring system. It is able to send parameters of soldier in real time. It enables the army station to monitor soldier's parameters (temp, heartbeat, location) in real time. Here the parameters of soldiers are measured continuously (temp, heartbeat, location) and wirelessly transmitted using GSM.**

***Keywords*— ARM, GSM, GPS, Sensors, LCD.**

I. INTRODUCTION

Nowadays Defence services are rapidly growing towards new innovation with advance implementation. Soldier's health is more important because they are the defenders who protect our country [1]. The system is composed of two parts, which are portable remote soldier unit and the monitoring centre. The portable remote soldier unit consists of Advanced RISC Machines (ARM) with the embedded operating system, GPS and a GSM, temperature sensor and heart beat sensor.

II. PROPOSED SYSTEM

The proposed work of this project is to develop a system that can be supplemented with real-time wireless monitoring systems which are designed and implemented through GPS network and are able to record and transmit bio-signals of soldiers. The aim of this project is to provide a medical monitoring for the soldier at any time and any place and to design a soldier tracking system using GSM and GPS to provide wireless system for monitoring the parameters of soldier are as – Body temperature & heart beat.

A. System Architecture

It is composed of two parts

1) Soldier unit: This unit consists of two types of sensors such as temperature sensor, heart beat sensor. These sensors are used to measure the signals from the human body such as heat signal, heart beat. After measurement, these analog signals are converted into digital signals and compared with the actual signals. If any discrepancy occurs between the measured signals and the actual signals, then it is considered as an emergency. The ARM7 LPC2148 processor plays an important role in controlling all the devices. It has an inbuilt A\D convertor.

GSM transmitter is used to transmit the signals from the sensors which are controlled by the ARM7 microprocessor. GPS system is used to locate the position of the soldier. It is very helpful for the army station to rescue the soldier as soon as the emergency signal is received. The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power sensitive applications, the ARM7TDM solution provides the low power consumption, small size, and high performance needed in portable, embedded applications [1].The ARM7TDMI-S core is the synthesizable version of the ARM7TDMI core, available in both VERILOG and VHDL, ready for compilation into processes supported by in-house or commercially available synthesis libraries. Optimized for flexibility and featuring an identical feature set to the hard macro cell, it improves time-to-market by reducing development time while allowing for increased design flexibility, and enabling >>98% fault coverage. The ARM720T hard macro cell contains the ARM7TDMI core, 8kb unified cache, and a Memory Management Unit (MMU) that allows the use of protected execution spaces and virtual memory. This macro cell is compatible with leading operating systems including Windows CE, Linux, palm OS, and SYMBIAN OS [1].

2) Army unit: Upon receiving the SMS, the visual basic software sorts the solder's location based on the GPS co-ordinates also the health status is displayed. In this way the army official's can keep a track of all their solders.

B. Block Diagram Description

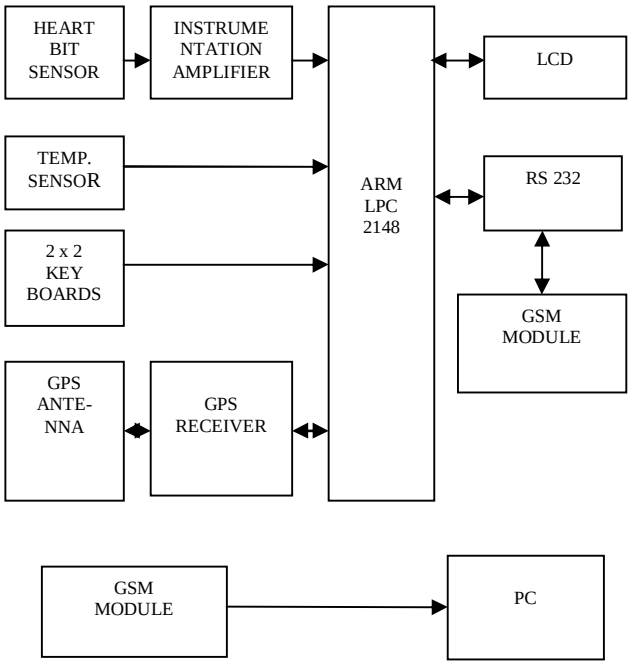


Fig. 1 Block Diagram of System

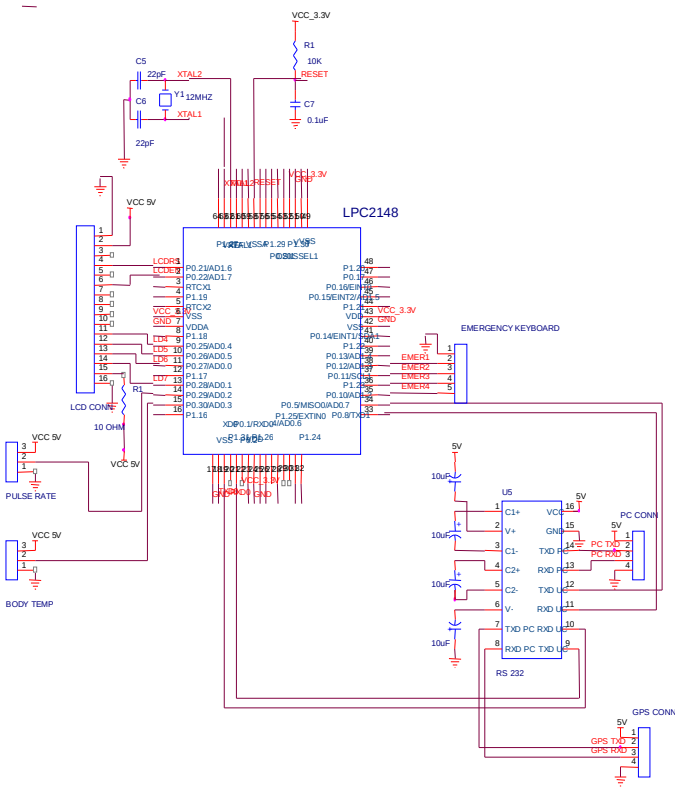


Fig .2 Basic Circuit diagram of this proposed system

In fig. 1, block diagram of overall sustem is shown. It shows how the concept is implemented as the real time application.Here there are 2 units under hardware design part:
1) Soldier unit: This unit is with the soldier. It has mainly 3 parts:Biomedical sensors, Key keypad, GPS + GSM unit.
2) Army unit: This unit consists of PC and GSM module.

III. Design Description

All the design of proposed system are described in the following.The figure 2 shows the basic circuit diagram of this proposed system.

A. Hardware Description

The heart of system is microcontroller which will access the data. In our project 'ARM' controller is used.

To measure temperature of soldier there will be a temperature sensor. To convert the output of sensor into electrical form we will use signal conditioning (transducer). As controller operates only on digital data, so this analog data is to be converted into digital form by using ADC inbuilt in ARM processor. So the output of the signal conditioner circuit is directly connected to ARM processor.

B. ARM 7- LPC 2148

The ARM7EJ-S processor is a synthesizable core that provides all the benefits of the ARM7TDMI – low power consumption, small size, and the thumb instruction set – while also incorporating ARM's latest DSP extensions and Jazelle technology, enabling acceleration of java-based applications. Compatible with the ARM9™, ARM9E™, and ARM10™ families, and Strong-Arm® architecture software written for the ARM7TDMI processor is 100% binary-compatible with other members of the ARM7 family and forwards-compatible with the ARM9, ARM9E, and ARM10 families, as well as products in Intel's Strong ARM architectures. This gives designers a choice of software-compatible processors with strong price performance points. Support for the ARM architecture today includes:

• Operating systems such as Windows CE, Linux, palm OS and SYMBIAN OS.

• More than 40 real-time operating systems, Including qnx, Wind River's vx works.

LPC2148 Micro controller:

LPC2148 Microcontroller Architecture.TheARM7 is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The 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 (CISC). This simplicity *results* in a high instruction throughput and impressive real-

time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super reduced instruction set. Essentially, the ARM7TDMIS processor has two instruction sets:

• The standard 32-bit ARM set.
• A 16-bit Thumb set.

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM processor connected to a 16-bit memory system [7].

1) Fast general purpose parallel I/O (GPIO): Device pins that are not connected to a specific peripheral function are controlled by the GPIO registers. Pins may be dynamically configured as inputs or outputs. The value of the output register may be read back, as well as the current state of the port pins. LPC2148 introduce accelerated GPIO functions over prior LPC2000 devices:

• GPIO registers are relocated to the ARM local bus for the fastest possible I/O timing.
• Mask registers allow treating sets of port bits as a group, leaving other bits unchanged.
• All GPIO registers are byte addressable.
• Entire port value can be written in one instruction.
• Bit-level set and clear registers allow a single instruction set or clear of any number of bits in one port.
• Direction control of individual bits.
• Separate control of output set and clear.
• All I/O default to inputs after reset.

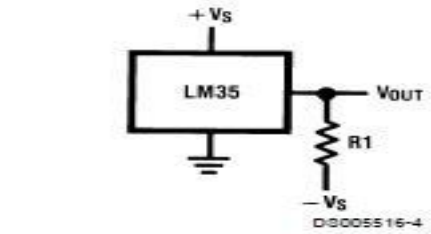
2) 10-bit ADC: The LPC2148 contains two analog to digital converters. These converters are single 10-bit successive approximation analog to digital converters. While ADC0 has six channels, ADC1 has eight channels. Therefore, total number of available ADC inputs for LPC2148 is 14.

3) ADC Features: 10 bit successive approximation analog to digital converter.

• Measurement range of 0 V to VREF.
• Each converter capable of performing more than 400000 10-bit samples per second.
• Every analog input has a dedicated result register to reduce interrupt overhead.
• Optional conversion on transition on input pin or timer match signal.
• Global Start command for both converters [9].

C. Temperature Sensor LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling [8]. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range [8].



Choose $R_1 = -V_S/50\ \mu A$
V_{OUT} = +1,500 mV at +150°C
= +250 mV at +25°C
= −550 mV at −55°C

D. Heart Beat Sensor

Heart beat sensor is designed to give digital output of heart beat when a finger is placed inside it. This digital output can be connected to ARM directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

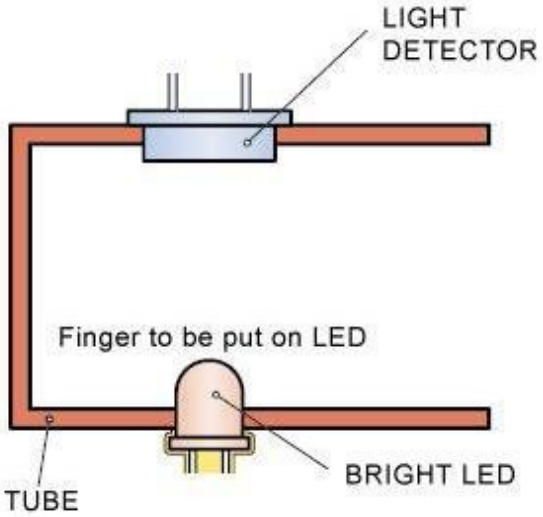


Fig .3 Heart Beat Cavity Measurement System

ICLM358is used for Heart Beat Sensor. Its dual low power operational amplifier consists of a super bright red LED and light detector. One will act as amplifiers and another will be used as comparator. LED needs to be super bright as the light must pass through finger and detected at other end. When

heart pumps a pulse of blood through blood vessels, finger becomes slightly more opaque so less light reached at the detector. With each heart pulse detector signal varies this variation is converted to electrical pulse [2].

E .GPS Receiver: GPS Module

The GPS smart receiver features the 16 channels .Ultra low power GPS architecture. This complete enabled GPS receiver provides high position, velocity and time accuracy performances as well as high sensitivity and tracking capabilities. The hardware interfaces for GPS units are designed to meet NMEA requirements. Generally message received by GPS is in NMEA [National Marine Electronics Association] message format and NMEA protocol which is most commonly used is NMEA0183 protocol. GPS sentences beginning with the following specifications:$GPGGA, $GPGSA, $GPGSV, $GPRMC, and $GPVTG. And sentences also begins with $GPMSS, $GPZDA as shown in [table 1].

1) *The Method of Tracking:* The tracking method is based on the process of collecting continuously the coordinate (latitude, longitude) of mobile vehicle that could get from GPS receiver. After getting the coordinate, the remote soldier unit will send it to the army unit via GSM. The army unit will receive the coordinate of the soldier then displays on the screen [4].

Fig. 4 GPS Receiver

TABLE I

FORMATS OF NMEA MESSAGES

Sentence ID	**Description**
$GPGGA	GPS Fix Date
$ GPGSA	GPS Dilution of Precision
$GPGSV	GPS Satellite in view
$GPRMC	Recommended minimum specific GPS/Transit Data
$GPVTG	Track made good and ground speed
$GPMSS	Beacon Receiver status
$GPZDA	UTC Date/Time and Local time Zone
	Offset

3) *Specifications:*

- 16-channels GPS search engine.
- Ultra low power design (38mA, typical).
- Compact size.
- Built-in low noise, high gain active antenna.
- Super-cohesive magnetic for installation.
- High sensitivity (up to -152dBm typ).
- Apply to host devices with USB or RS232.

4) *Applications*:

- Automotive
- Personal/Portable Navigation (PDA)
- Geographic Surveying
- Sports and Recreation

5) *Benefits to User:*

- Ultra low power consumption
- Easy and fast to install
- Superior urban canyon performance
- Low cost with high performance

F. GSM HARDWARE

The core of data communication about this system lies in wireless communication control terminals that uses GSM Modules to transfer long-distance data extensively and reliably. It Support instructions of AT commands. SIM300 can be integrated with a wide range of applications. SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz SIM300 provides GPRS multi-slot class 10 capabilities and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 40mm x 33mm x 2.85 mm, SIM300 can fit almost all the space requirement in our application. Therefore, the MCU can connect with GSM modules very expediently through serial interfaces.

Fig. 5 GSM Module.

IV. Software Design

This includes the coding of ARM 7 processor and coding for downloading of data and for GUI (Graphical User Interface) on server side.
For ARM 7 :Embedded c using Keil software.
For GUI :VB.Net

V. Advantages Of Proposed System

- Provides high level safety to human life.
- Suitable for Indian conditions.
- Easy retrieval of data for the cause of incidents.
- low cost and less complex system for installing and application.

IV. Conclusions

From the above designed project it can be concluded that we are able to transmit the data which is sensed from remote soldier to the server PC by using wireless transmission technology GSM. It is completely integrated so that it is possible to track anytime from anywhere. It has real-time capability. The accuracy of system is affected by some factors such as weather, environment around the mobile soldier unit, GPS receiver. The future works include optimizing the hardware system, choosing a suitable GPS receiver. Improving the routing algorithm can be improved by neural network. This system has many advantages such as large capability, wide areas range, low operation costs, effective, strong expandability and easy to use. Upgrading this setup is very easy which makes it open to future a requirement which also makes it more efficient.

VII . Future enhancement

There is always chance to improve any system as research & development is an endless process. The following measurements can be done in future: Pulseoximetry and, Galvanic-Skin Resistance Amenia.
1. Soldier Voice Recognition system: IC HM2007 can be used to recognize the voice samples of the soldier, for better security purpose.
2. A Camera can be fitted into the system so as to enable the base station to get a real time view of the battlefield.
3. Automatic Surveillance Robot: A Robot with all the medical features as well as advanced features like ammunition can be build.

References

[1] Ushasree.K, Hameed Pasha, "*Protection system for VIP'S with GPRS & Remote monitoring*", International Journal of Computer Trends and Technology- volume2Issue2- 2011.

[2] Rubina.A.Shaikh, "*Real Time Health Monitoring System Of Remote Patient Using Arm7*", International Journal of Instrumentation, Control and Automation (IJICA) ISSN: 2231-1890, Vol-1 Iss-3,4, 2012.

[3] N. Lakshmi Kanthan & V. Babu, "*MCEP Based Intelligent Vehicle with Multitask Management*", ISSN (Print): 2278-8948, Volume-1, Issue-2, 2012 .

[4] Abid khan, Ravi Mishra, "*GPS – GSM Based Tracking System*", International Journal of Engineering Trends and Technology Volume3 Issue2- 2012.

[5] Pooja Sathe, "*Gprs Based Routing & Tracking Of Mobile Vehicles Using Arm*", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue4, July-August 2012, pp.1088-1090.

[6] Ya-lin Miao†, Xiang-lin Miao, Zheng-Zhong Bian , Yong-jie Zhan "*Design and Application of Embedded System Based on ARM7 LPC2104 Processor in Telemedicine*", Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference Shanghai, China, September 1-4, 2005.

[7] UM10139 Volume 1: *LPC214x User Manual*, Rev. 01 -15 August 2005, Philips Semiconductors.

[8] LM35 datsheet, National Semiconductor Corporation DS005516, http://www.national.com.

[9] LPC2141/42/44/46/48, Rev.5-12 August 2011, http://www.nxp.com.

[10] Hui Hu, Lian Fang "*Design and Implementation of Vehicle Monitoring System Based on GPS/GSM/GIS*" Third International Symposium on Intelligent Information Technology Application ,School of Information Engineering, East China Jiao Tong University, Nanchang, Jiangxi, China in 2009. Pages 278-279.

[11] Thuong Le-Tien, Vu Phung-The "*Routing and Tracking System for mobile Vehicles in Large Area*", Fifth IEEE International Symposium on Electronic Design, Test & Applications Dept. of Electrical Electronics Engineering, HCM University of Technology, Vietnam in 2010.

[12] Umar Farooq, Tanveer ul Haq, Muhammad Amar, Muhammad Usman Asad, Asim Iqbal "*GPS-GSM Integration for Enhancing Public Transportation Management Services*" Second International Conference on Computer Engineering and Applications, Department of Electrical Engineering University of The Punjab Lahore-54590, in 2010.