

Real Time Tracking & Health Monitoring System of Remote Soldier

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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. I have designed a 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 bit arte sensor [1].

II. A COMPLETE 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 & Blood pressure.

A. System Architecture

It is composed of two parts

1) *Soldier unit*: This unit consists of two types of sensors such as temperature sensor, pulse rate sensor. These sensors are used to measure the signals from the human body such as heat signal, heart bit. 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 ARM 7 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 ARM7TDMI 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 VB s/w sorts the soldier'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 soldiers. Similarly, Army officer can also send reply to the corresponding soldier through VB screen in terms of SMS.

B. Block Diagram Description

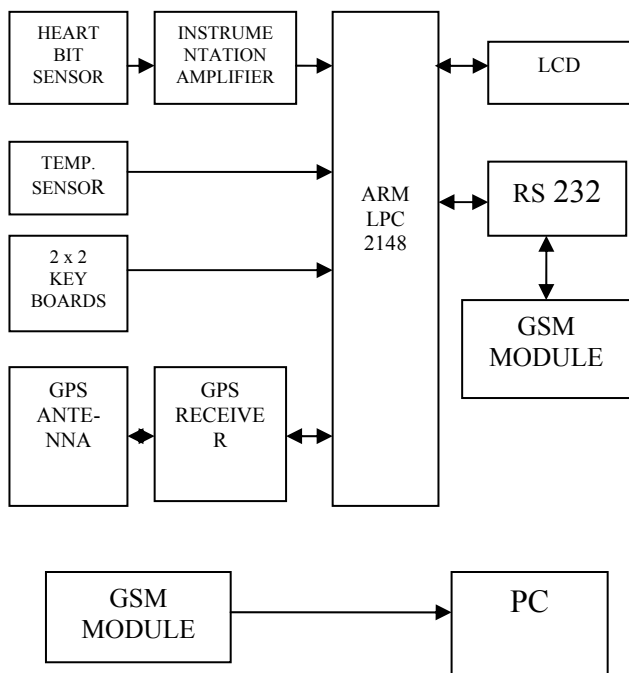


Fig. 1 Block Diagram of System

The above block diagram shows the overall co-ordination of the system. 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 placed on the soldier. It has mainly 3 parts: Biomedical sensors, Key keypad, GPS + GSM unit 2) Army unit: This unit consists PC with 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 we will use 'ARM' controller.

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. But ADC is 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.

- 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:

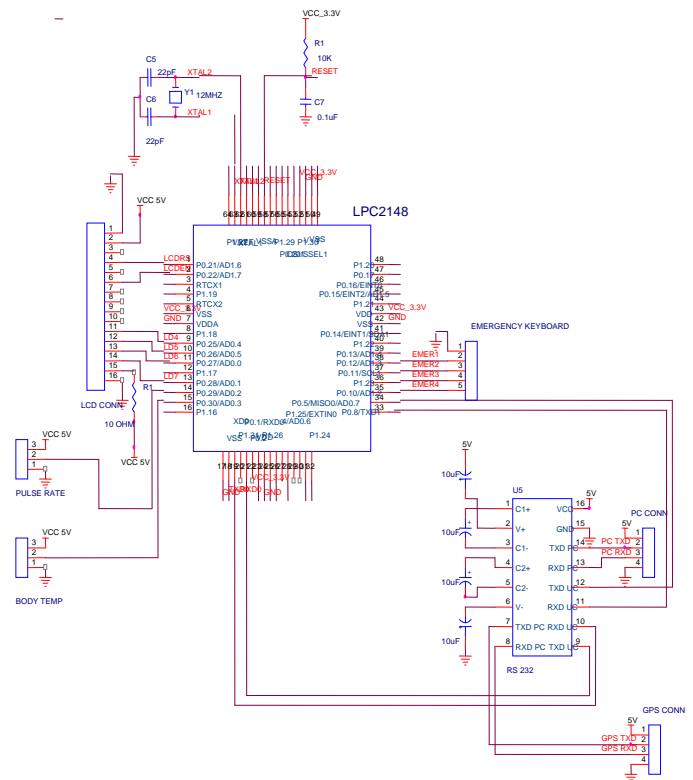
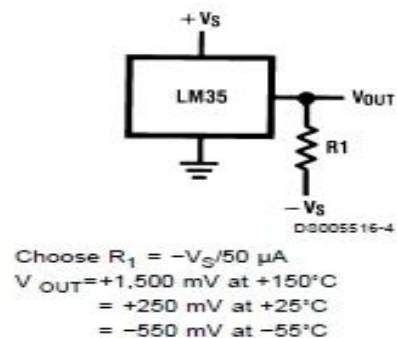


Fig. 2 Basic Circuit diagram of this proposed system

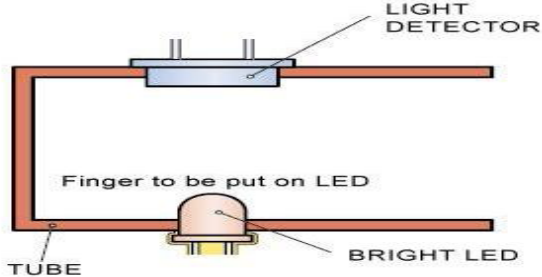
C. Temperature Sensor Lm35

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 $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 3/4^\circ\text{C}$ over a full -55 to $+150^\circ\text{C}$ temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only $60\ \mu\text{A}$ 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 $+150^\circ\text{C}$ temperature range, while the LM35C is rated for a -40° to $+110^\circ\text{C}$ range [8].



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 . Heart Beat Cavity Measurement System



ICLM358 is 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. The GPS receiver provides data in NMEA 0183format with a 1Hz update rate. 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 mobile vehicle will send it to the supervised center via SMS or GPRS service. The supervised center will receive the coordinate of the mobile vehicle then displays on the screen. The mother board on the mobile vehicle is equipped a GSM modem- GM862 and it is directed by a 32bits microcontroller ARM Cortex M3-LM3S2965. The microcontroller uses serial interface to communicate with GM862 by AT commands and send current position of the vehicle via SMS service by send the sequences commands below:

2) Commands:

- AT+CMGF=1<CR>
- AT+CMGS="0937856377"<CR>

- send SMS content : coordinate
- send the message issue Ctrl-Z char (0x1A) <CR>: carrier return character (0x0D hex)[4].



Fig:3 GPS Receiver

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.

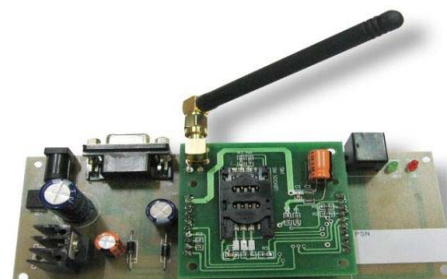


Fig. 4. GSM module

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

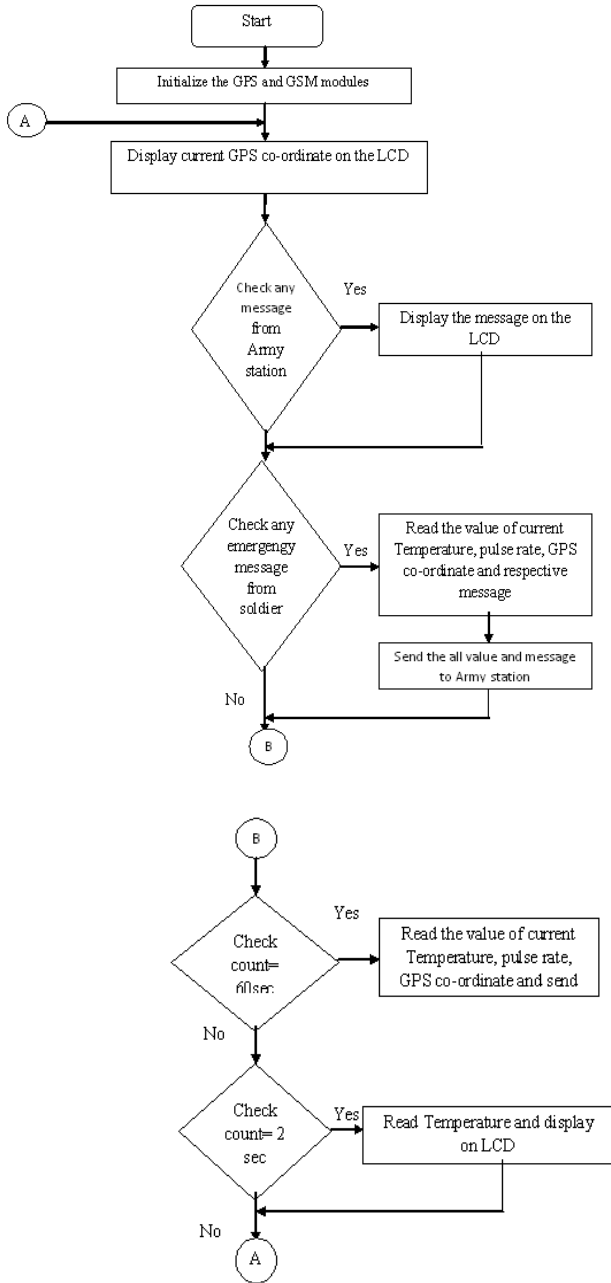


FIG. 5. FLOW CHART

V. ADVANTAGES OF 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.

VI. PERFORMANCE ANALYSIS

A. Performance characteristics of system

- Range of communication is unlimited due to the use of GPS and GSM communication systems.
- As I am using GPS as guider, soldier can be secure to use appropriate guidelines.
- Using GSM SMS facility, it is not necessary to transmit any audio signals. These SMS are depending upon the present condition of soldier.
- As my system is monitoring parameters regarding with the help of soldiers, it is bit easy to provide a medical services as per requirements.
- It is possible to get a resolution less than 100 meters by using super software that being used by foreign countries.
- As 3 stage pipelining used by ARM, execution speed of operation bit high.
- After each 60 seconds parameters regarding with the health of soldier will be send, so in time we can say a real time operating system.

B. Performance Analysis for temperature sensor LM35

TABLE I
 ANALYSIS OF COLLECTED DATA FOR LM 35 IN SPECIFIC
 CONDITION

| Sr. No. | Condition of set Temperature in °C | Readings from Thermometer | Output of LM 35 in °C on LCD |
|---------|---------------------------------------|---------------------------|------------------------------|
| 1. | Air Conditioner 25 | 23 | 24.6 |
| 2. | Normal Room at 33 | 31 | 32.8 |
| 3. | Open ground at 1:00 pm | 37 | 36.8 |
| 4. | By using Fire stick kept near to LM35 | 70 | 73.6 |
| 5. | Freezer bottle with water | 17 | 17.4 |

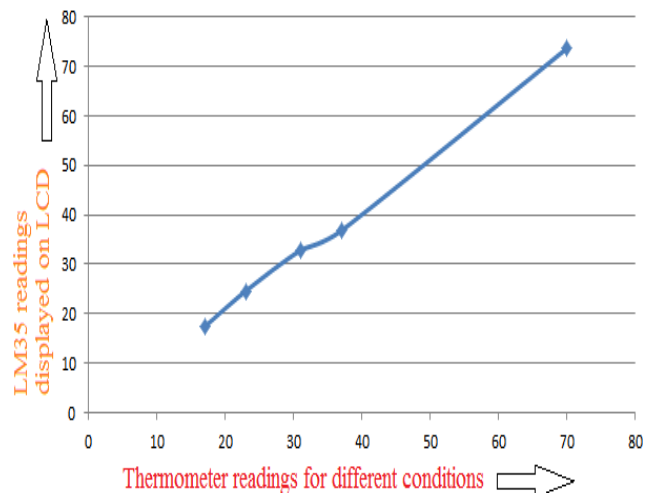


Fig.4 Comparison of LM 35 Readings on LCD with Thermometer readings.

C. Analysis for Pulse rate sensor

TABLE II
ANALYSIS OF SENSOR DATA FOR DIFFERENT SITUATION

| Sr. No. | Condition for reading | Output of sensor in terms of Pulses on LCD |
|---------|-----------------------------|--|
| 1. | Improper placement | INVALID FINGURE PRESS |
| 2. | Without finger | 006 |
| 3. | At normal | 78-88 |
| 4. | After running of 500 meters | 92-120 |

D. Check functionality of GPS module for different distance

TABLE III
ANALYSIS OF GPS MODULE FOR DIFFERENT DISTANCE

| Sr. No. | Distance in Meter | Name of location | GPS module Co-ordinates |
|---------|-------------------|------------------|---------------------------|
| 1. | Initial condition | Kopargaon | 1988.339 N 7448.339 E |
| 2. | 3000 | Computer Lab. | 1988.8390N 7548.0803E |
| 3. | 3000 | PG LAB | 1988.8390 N 7548.0803E |
| 4. | 3000 | At Hostel. | 1988.839 N 7548.080 E |

E. Checking GSM modem with respect to time

TABLE V
ANALYSIS OF GSM MODEM WITH RESPECT TO TIME

| Sr. No. | Parameters | Time required |
|---------|---------------------------|---|
| 1. | Initializations | 15-20 seconds after applying power. |
| 2. | NORMAL Message | 9-12 seconds to deliver after sending message |
| 3. | Emergency Message | 9-12 seconds to deliver after sending message |
| 4. | Message from Army station | 9-12 seconds to deliver after sending message |

VII. RESULTS

We continuously scan for various parameters of soldier, such as latitude, longitude temperature, pulse rate, and massages. The μ C stores all this data in the internal memory.

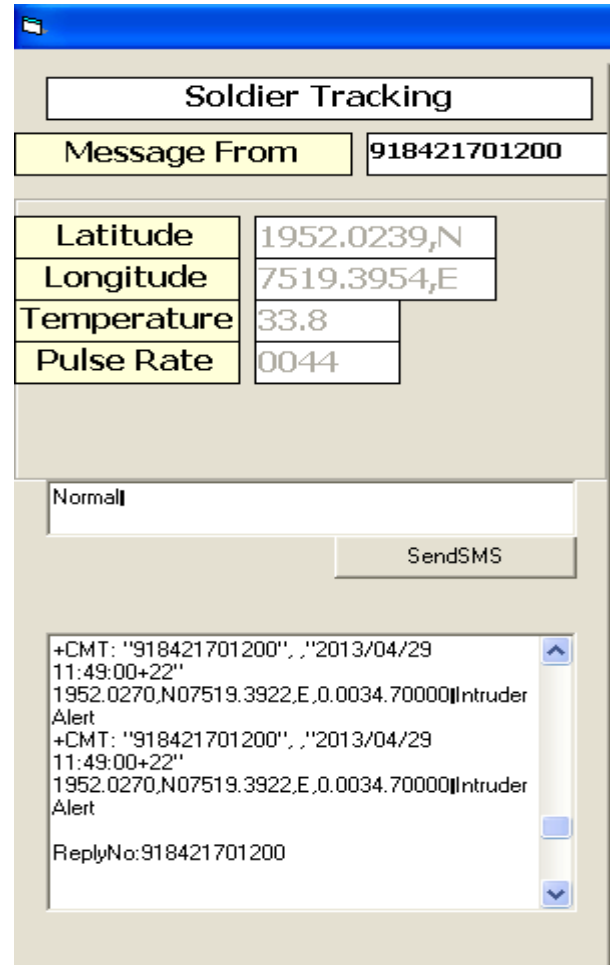


FIG. 6 PRACTICAL RESULTS

VII. CONCLUSIONS

From the above designed project I can conclude that we are able to transmit the data which is sensed from remote soldire to the server PC by using wireless transmission technology GPS. It is completely integrated so that it is possible to track anytime from anywhere. It has real-time capability, emerges in order to strengthen the relations among people. The accuracy of system is affected by some factors such as weather, environment around the mobile soldire unit, GPS receiver, compass sensor and the variation between True North Direction and Magnetic North Direction, etc. The future works include optimizing the hardware system, choosing a suitable GPS receiver and compass sensors. 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.

VIII . 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.

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