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GPS Based Advanced Soldier Tracking With Emergency Messages & Communication System

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Abstract: ***In today's world enemy warfare is an important factor in any nation's security. The national security mainly depends on army (ground), navy (sea), air-force (air).The important and vital role is played by the army soldier's. There are many concerns regarding the safety of these soldiers. As soon as any soldier enters the enemy lines it is very vital for the army base station to know the location as well as the health status of all soldiers. In our project, the soldier can ask for directions to the army base unit in case he feels that he is lost. By using the location sent by the GPS, the base station can guide soldier to safe area & GSM will help to communicate the Soldier unit with Base unit. By getting the exact location of soldiers it will help the Soldiers to discuss about their war strategies and take guidance from Base unit. The various Health Sensors such as Temperature sensor, Heart rate sensors, Humidity sensors, Gas detection sensors will help to decide the health status of that particular soldier.***

Keywords: Tracking, GPS, Sensors, Navigation.

I. INTRODUCTION

The infantry soldier of tomorrow promises to be one of the most technologically advanced modern warfare has ever The challenge was to integrate these piecemeal components into a lightweight package that could achieve the desired result without being too bulky and cumbersome or requiring too much power. It is necessary for the base station to guide the soldier on correct path if he is lost in the battlefield, around the world, various research programs are currently being conducted, such as the United States'. One of the fundamental challenges in military operations lies that the soldier's are not able to communicate with control room station. In addition, the proper navigation between soldier's organizations plays important role for careful planning and co-ordination. So in this paper we focus on tracking the location of soldier from GPS, which is useful for control room station to know the exact location of soldier and accordingly they will guide them. Also High -speed, short-range, soldier-to-soldier wireless communications to relay information on situational awareness, GPS navigation, Bio-medical sensors and Wireless communi. With large amount of data & we have to copy this data into another flash drive then it can be possible using this small device which can be handled easily. As shown in the figure the user can transfer the data from source to destination. We can also able to select which folder is to be transfer with the help of user interface LCD with Up- Down arrows & option & select buttons. Thus it makes the device more flexible. By addition of some extra software part it may be possible to the functions like delete, copy single file or folder to the base system. This device able to operate on batteries as well as on the AC mains power supply so that user can choose any alternative for his use depending upon the situations. As shown in the figure the user can transfer the data from source to destination. We can also able to select which folder is to be transfer with the help of user interface LCD with Up- Down arrows & option & select buttons. Thus it makes the device more flexible. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver. The GPS is used to log the longitude and the latitude of

soldier, which is stored in the µc memory. The Block Diagram of system is described below which mainly consists of two units listed & described below- Soldier unit & Base unit.

II. SYSTEM BLOCK DIAGRAM

I. Soldier Unit

II. Base Unit

I. SOLDIER UNIT:

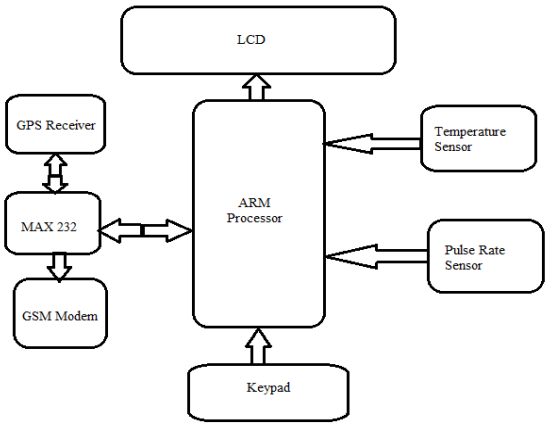


Fig 1. Soldier Unit

In this module, we have come up with an idea of tracking the soldier as well as to give the health status of the soldier during the war, which enables the army personnel to plan the war strategies. Also the soldier can ask for directions to the army base unit in case he feels that he is lost. By using the location sent by the GPS the base station can guide the soldier to safe area.

This unit is placed on the soldier. It has mainly 4 parts:

- Biomedical sensors
- Key pad
- GPS Receiver
- GSM Modem

Biomedical sensors

Here to find the health status of soldier we are using a body temp sensor as well as pulse rate sensor. These sensors will measure the body temperature and the pulse rate of soldier and will be stored in µc memory. These signals, travelling at the speed of light, are intercepted by your GPS receiver, which calculates how far away each satellite is based on how long it took for the messages to arrive. These sensors will help to sense physical parameters & informs to Base Station through GSM.

4 x1 Keypad

Here we are giving a 4 keys as a facility to the soldier where he can ask 4 pre determined questions to the base camp.

GPS Receiver and GSM Modem

The GPS is used to log the longitude and the latitude of soldier, which is stored in the µc memory. The GSM unit sends the SMS to the army base camp containing the health parameters and the location of soldier.

GPS (Global Positioning System)

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more

GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

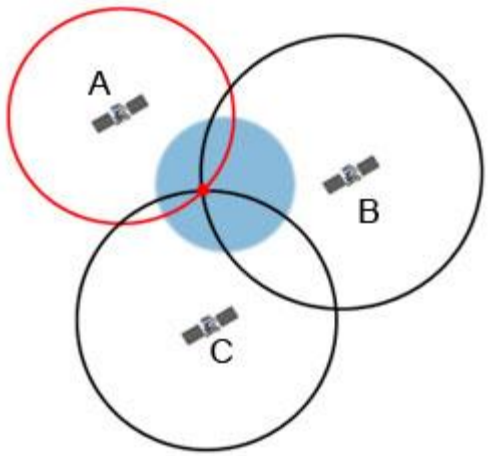
Wherever you are on the planet, at least four GPS satellites are 'visible' at any time. The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Each one transmits information about its position and the current time at regular intervals. These signals, travelling at the speed of light, are intercepted by your GPS receiver, which calculates how far away each satellite is based on how long it took for the messages to arrive. time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

Range of GPS :-

The approximate range for working of GPS is bout 4 -5 Kms over which it can give accurate results. These signals, travelling at the speed of light, are intercepted by your GPS receiver, which calculates how far away each satellite is based on how long it took for the messages to arrive. . These signals, travelling at the speed of light, are intercepted by your GPS receiver and transmitted to base station. . These signals, travelling at the speed of light, are intercepted by your GPS receiver. The range of GPS is about Ten meters which can be increased according to applications. This GPS works on trilateration method which is described later on in this paper.

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions.

Trilateration:-



If you do the same for satellites B and C, you can work out your location by seeing where the three circles intersect. This is just what your GPS receiver does, although it uses overlapping spheres rather than circles. The more satellites there are above the horizon the more accurately your GPS unit can determine where you are at exact location on the earth.

How Position is Determined ?

A GPS receiver "knows" the location of the satellites because that information is included in the transmitted *Ephemeris* data (see below). By estimating how far away a satellite is, the receiver also "knows" it is located somewhere on the surface of an imaginary sphere centered at the satellite. It then determines the sizes of several spheres, one for each satellite and therefore knows the receiver is located where these spheres intersect.

GPS Accuracy:-

The accuracy of a position determined with GPS depends on the type of receiver. Most consumer GPS units have an accuracy of about +/-10m. Other types of receivers use a method called Differential GPS (DGPS) to obtain much higher accuracy. DGPS requires an additional receiver fixed at a known location nearby. Observations made by the stationary receiver are used to correct positions recorded by the roving units, producing an accuracy greater than 1 meter.

How Is The Signal Timed?

All GPS satellites have several atomic clocks. The signal that is sent out is a random sequence, each part of which is different from every other, called pseudo-random code. This random sequence is repeated continuously. All GPS receivers know this sequence and repeat it internally. Therefore, satellites and the receivers must be in synch. The receiver picks up the satellite's transmission and compares the incoming signal to its own internal signal. By comparing how much the satellite signal is lagging, the travel time becomes known.

What does the signal consist of?

The navigational signals transmitted by GPS satellites encode a variety of information including satellite positions, the state of the internal clocks, and the health of the network. These signals are transmitted on two separate carrier frequencies that are common to all satellites in the network. Two different encodings are used: a public encoding that enables lower resolution navigation, and an encrypted encoding used by the U.S. military.

GPS satellites transmit two radio signals. These are designated as L1 and L2. A Civilian GPS uses the L1 signal frequency (1575.42 MHz) in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass, plastic etc but will not travel through solid objects such as buildings and mountains.

The GPS signal contains three different bits of information — a pseudo random code, almanac data and ephemeris data.

GSM (Global System For Mobile Communication i.e. Groupe Special Mobile)

It is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It became the de facto global standard for mobile communications with over 80% market share.

The GSM standard was developed as a replacement for first generation (1G) analog cellular networks, and originally described a digital, circuit-switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit-switched transport, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).Subsequently, the 3GPP developed third generation (3G) UMTS standards followed by fourth generation (4G) LTE Advanced standards, which are not part of the ETSI GSM standard.

Network structure:-

The network is structured into a number of discrete sections:

1) Base Station Subsystem :– the base stations and their controllers explained.

2) Network and Switching Subsystem :– the part of the network most similar to a fixed network, sometimes just called the "core network"

3) GPRS Core Network :– the optional part which allows packet-based Internet connections.

Operations support system (OSS) :– network maintenance.

GSM Carrier Frequencies Bands :-

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

Most 3G networks in Europe operate in the 2100 MHz frequency band. For more information on worldwide GSM frequency usage, see GSM frequency bands. Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots (or burst periods) are grouped into a TDMA frame. Half-rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270.833 kbit/s, and frame duration is 4.615 ms.

Inspired by the making of 32 bit processors by some undergraduates at Berkeley and a one man design center Western Design Center, Phoenix, Steve Furber and Sophie Wilson of Acorn Ltd. set out to make their own processors. Sophie developed the instruction set and simulated it on the BBC Basic which convinced many in the company that it was not just anything half hearted shot aimed in darkness.

Acorn floated a new company Advanced RISC Machines Ltd. solely dedicated for ARM core development. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots (or burst periods) are grouped into a TDMA frame. Half-rate channels use alternate frames in the same timeslot. In 1992, Acorn won the Queen's Award for Technology for the ARM. Apple and ARM collaborated to develop the ARM6 cores on which the Apple Newton PDAs were based. Later, the technology was also transferred to Intel over a settlement of lawsuit. Intel further modified it and developed its own high performance line XScale, now sold to Marvell. ARM Inc. is involved with developing cores primarily while its licensees make microcontroller and processors, the most popular being the ARM7TDMI machines. Some prominent licensees of ARM machines are Alcatel Lucent, Apple, Atmel, Cirrus Logic, Freescale, DEC, Intel, LG, Marvell, Microsoft, Nvidia, Qualcomm, Samsung, Sharp, ST microelectronics, Symbios Logic, Texas Instruments, VLSI Technology, Yamaha, Zilabs etc.

Basics of ARM Processors :-

ARM is a a 32-bit RISC processor architecture currently being developed by the ARM corporation. The business model behind ARM is based on licensing the ARM architecture to companies that want to manufacture ARM-based CPU's or system-on-a-chip products. The two main types of licenses are the Implementation license and the Architecture license. The Implementation license provides complete information required to design and manufacture integrated circuits containing an ARM processor core. ARM licenses two types of cores: soft cores and hard cores. A hard core is optimised for a specific manufacturing process, while a soft core can be used in any process but is less optimised.

The architecture license enables the licensee to develop their own processors compliant with the ARM ISA. ARM processors possess a unique combination of features that makes ARM the most popular embedded architecture today. First, ARM cores are very simple compared to most other general-purpose processors, which means that they can be manufactured using a comparatively small number of transistors, leaving plenty of space on the chip for application-specific macrocells. A typical ARM chip can contain several peripheral controllers, a digital signal processor, and some amount of on-chip memory, along with an ARM core. Second, both ARM ISA and pipeline design are aimed at minimising energy consumption — a critical requirement in mobile embedded systems.

Third, the ARM architecture is highly modular: the only mandatory component of an ARM processor is the integer pipeline; all other components, including caches, MMU, floating point and other co-processors are optional. The business model

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III. BASE UNIT

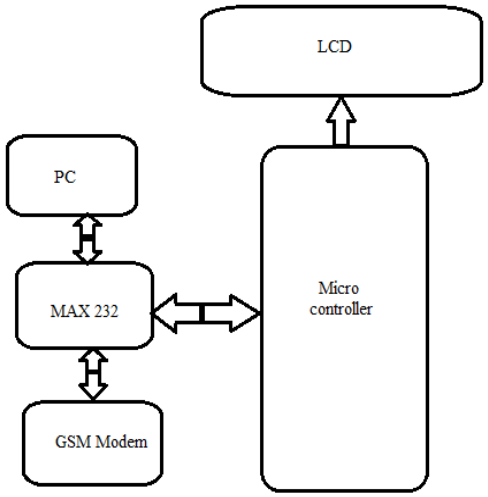


Fig 1. Base Unit

In this unit upon receiving the SMS, the VB s/w shows the solder's location on Google maps 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.

IV. MODULES DESCRIPTION

1) ARM (LPC2138)

The microprocessor that has been used for this project is a 32 bit ARM7,. It has two 8 channel ADC ,single 10 bit DAC, two 32 bit timer/counter ,multiple serial interfaces including two UART ,two fast I2C, Capture, compare and PWM module.

2) GPS (SR87)

SR-87 series GPS modules incorporates high sensitivity, high performance design.

3) RF Transceiver(CC2500)

This is an FSK transceiver module, which is designed using Chipcon IC(cc2500).it is true single-chip transceiver, it is based on 3 wire digital serial interface and an entire phase-locked loop for precise local oscillator generation .it can be used in 2400-2483.5GHz ISM/SRD band system. it is high performance and low cost module.

4) Graphical LCD:

The **Graphical LCDs** are used to display customized characters and images. The Graphical LCDs used in many applications; they are used in video games, mobile phones, lifts etc. as display units. This LCD has a display format of **128x64**

dots and has yellow-green colour backlight. Here it is used to display all details of soldier such as speed, distance height and also their health parameter's.

5) Pulse Rate Sensor:

Pulse rate sensor gives digital output of heart beat when finger is placed on it. it works on the principle of light modulation by blood flow through finger at each pulse.

V. SIMULATION RESULTS

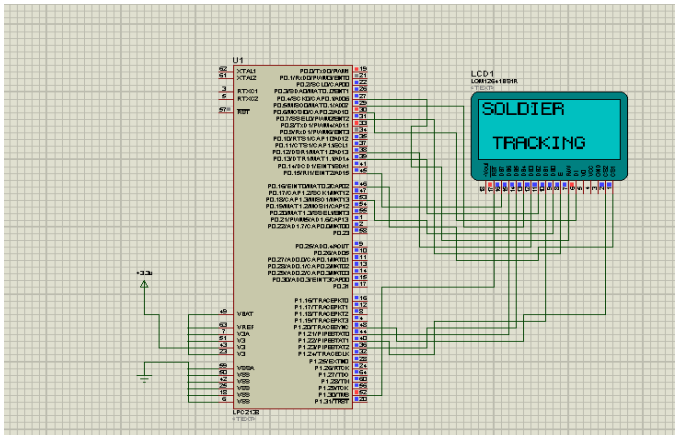
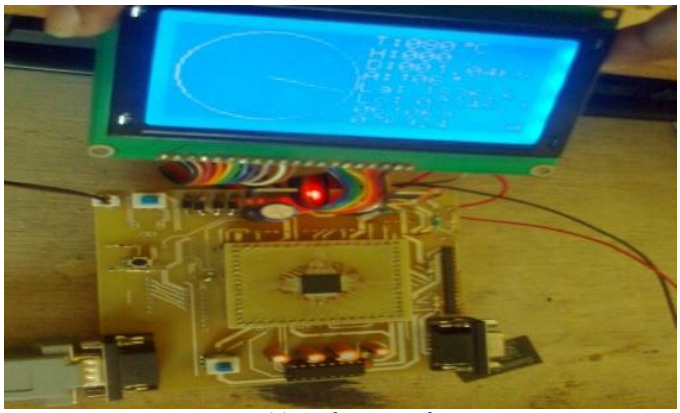


Fig (1) Displaying text on graphical LCD

Above fig. shows interfacing of Graphical LCD with ARM processor. To perform this we have written code in keil software and proteus is used for simulation results.



Fig(2) Hardware Result

Above fig. shows the hardware result one entire soldier unit including with ARM processor, graphical lcd. Two Power supply of 5v and 3.3V.5V power supply for peripherals such as GPS, graphical lcd, Rf module, sensors. ARM processor requires 3.3Vsupply.Soldiers latitude, longitude speed, distance, height these all things will be displayed on graphical LCD.

For Example:- **$GPGLL,4717.115,N,00833.912,E,130305.0,A*32<CR><LF>**

Field	Example	Unit	Notes
Message ID	$GPGLL		GLL protocol header.
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south.
Longitude	12158.3416		dddmm.mmmm
E/W indicator	W		E=east or W=west.
UTC Time	161229.487		hhmmss.sss
Status	A		A: Data valid or V: Data invalid.
Mode	*A*		*A=Autonomous, D=DGPS, E=DR (Only present in NMEA version 3.00).*
Checksum	*41		
<CR><LF>			Message terminator.

VI. CONCLUSION

Following conclusion can be retrieved from above implementation are:

- Security and safety for soldiers: GPS tracks position of soldier anywhere on globe and also health system monitors soldier's vital health parameters Which provides security and safety for soldiers.
- Continuous Communication is Possible: Soldiers can communicate anywhere using RF,DS- SS,FH-SS which can help soldier to communicate among their squad members whenever in need.
- Less complex circuit and power consumption. Use of ARM processor and low power requiring peripherals reduce overall power usage of system. Modules used are smaller in size and also lightweight so that they can be carried around.

So in this way concept of tracking and navigation system is very useful for soldiers when they are on military field war. And also for base station so that they can get real-time view of soldier's on field displayed on PC.

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