International Journal of Recent Trends in Engineering & Research (IJRTER)
Conference on Electronics, Information and Communication Systems (CELICS'18)
Special Issue; March - 2018 [ISSN: 2455-1457]
DOI : 10.23883/IJRTER.CONF.02180328.017.8EL8O

Soldier Health Monitoring System

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Abstract— **Army has a determining part in nation's security, but there are many issues regarding the safety measures of the soldiers at warfare. We have come up with our project with a view to ceaselessly communicate the soldier's health status and location in war field to the military control room (base station). Soldier health status and his location are sent through GSM module to the base station. Biometric sensors and GPS keep track of health status and location of the soldier. Messages are transmitted through GSM module when the heartbeat rate goes down the critical value.**

Keywords— ***Arduino uno R3, GSM,GPS,TMP36,HEARTBEAT Sensor***

I. INTRODUCTION

One of the fundamental challenges in military operations lays in that the soldier not able to communicate with control room administrator. Major problems faced by the military are as follows:

1. Soldiers are unable to find their location.
2. They won't get timely medication in Warfield. In our project we mainly focused to enhance the communication with a specialized control room. We overcome the above issue as follows:

1. With the help of GPS, location of the soldiers can be found during critical condition.
2. As we know the location of the soldiers, the control room people can able to communicate with the soldiers and assist them using GSM.

Our paper is all about monitoring the health of the soldier using temperature and heartbeat sensors and sending information to the base station along with their location.

II. EXISTING TECHNOLOGIES

The idea for our project was taken from the following technologies:

1. Wrist watch for mountaineers which displays position, direction, surrounding temperature and it also act as altimeter.
2. Tracking of Tigers with GPRS (General packet radio service) used to track the movement of the animal.

In above technologies, we can find the location alone and we don't have any device to gather the medical status and passing it to the control room. Hence, using the biometric sensors and GSM we can make available the data to the control room.

III. PROPOSED SYSTEM

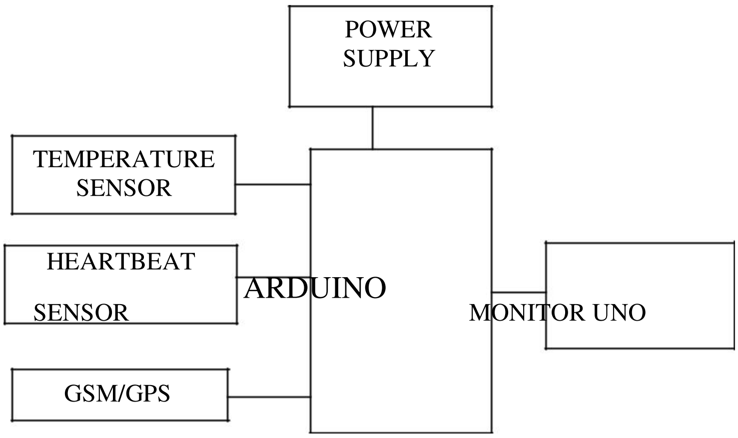

Fig 1: BLOCK DIAGRAM

In our proposed system, we have used Adriano Uno R3 and sensors to measure the temperature and heartbeat of a human body. When the measures vary from fixed value, message can be send to the control room using GSM along with the location of a person using GPS.

A.Arduino uno R3:

Adriano Uno R3 is the third and latest version of arguing Uno. It is a microcontroller board based on removable, dual-in-line package (DIP), ATmega328 AVR microcontroller. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button.

Adriano Uno R3 specification are ATmega328 microcontroller, operating voltage at 5V, input voltage 7 to 12V, input voltage limit up to 20V, digital I/O pins 14,

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analogs pins 6, DC current 40mA, flash memory 32KB including 0.5KB used by boot loader. SRAM of 2KB, EEPROM of 1KB and clock speed of 16MHz. Adriano Uno has a 2KB of SRAM and 1KB of EEPROM (Electrically Erasable Programmable Read Only Memory),USB controller chip is ATmega16U2(16k flash)\. The Uno differ from all preceding boards is that it does not use the FTDI USB-to-serial driver chip. Instead, it features an ATmega16U2 programmed as a USB-to-serial converter.

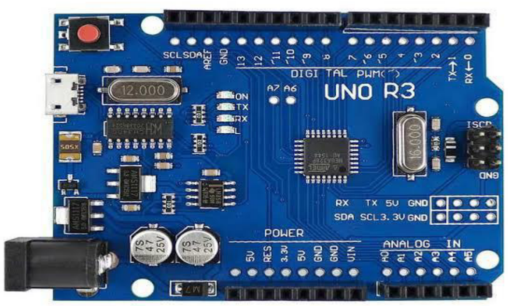

Fig 2: ARDUINO UNO R3

B.GSM:

SIM800 is a complete Quad-band GSM/GPRS solution in a SMT type which can be embedded in the customer applications.

SIM800 support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. With tiny size of 24*24*3mm, it can fit into slim and compact demands of customer design. Featuring Bluetooth and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

Fig 3: GSM MODULE

GSM (Global System for Mobile communication) is a wireless standard developed by European Telecommunications Standards Institute (ETSI) for mobile telephone system. A GSM/GPRS Module is used to enable communication between a microcontroller (and a microprocessor) and the GSM/GPRS network. GPRS or General Packet Radio Services is an extension of the GSM Network which provides an efficient way to transfer the data. . A GSM/GPRS Module is an IC or chip that connects to the GSM Network using a SIM (Subscriber Identity Module) and Radio Waves.

The access time in GPRS is very small and the main advantage is that it allows bursts of data to be transmitted the common radio frequencies in which a typical GSM Module operates are 850MHz, 900MHz, 1800MHz and 1900MHz.

It consists of the GSM/GPRS Module, slot for inserting a SIM Card, RS-232 Interface for connecting with computer or a microcontroller, signal status LED, power supply and a provision for connecting microphone and speaker.

Each GSM/GPRS Module is unique and it can be differentiated by its IMEI Number. IMEI or International Mobile Equipment Identity Number is a 15 – digit unique number associated with mobile phone, satellite phones and other GSM Network devices. With the help of this GSM/GPRS Module, we can make, receive or reject voice calls ;Send, receive or delete SMS messages in the SIM Card; Send and receive data to / from the GSM/GPRS Network through GPRS.

GSM network architecture:

1. Mobile station: It is the mobile phone which consists of the transceiver, the display and the processor and is controlled by a SIM card operating over the network.

2. Base station subsystem: It is the interface between mobile station and network subsystem. It contains base transceiver station which consists of radio transceiver and handles the protocol for communication with mobiles. There is a base station controller which acts as interface between the mobile station and mobile switching center.

3. Network subsystem: The basic part of the network subsystem is Mobile Service Switching Center which provides access to different networks like ISDN, PSTN. It also has Home Location Register and Visitors Location Register which provides call routing capabilities and roaming capabilities of GSM and holds the IMEI number.

GSM working:

GSM system was developed as a digital system using Time Division Multiple Access (TDMA) for communication purpose.

TDMA:

It is type of time-division multiplexing. It allows several users share same frequency channel by dividing the signal into different time slots. This allows safe inter frequency handovers than any other multiplexing techniques.

The SIM card mounted GSM modem upon receiving digit command by SMS from any cell phone send that data to the Microcontroller through serial communication. While the

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program is executed, the GSM modem receives command 'STOP' to develop an output at the Microcontroller, the contact point of which are used to disable the ignition switch. The command so sent by the user is based on an intimation received by him through the GSM modem 'ALERT' a programmed message only if the input is driven low.

AT commands:

AT Commands are parts of Hayes Command Set, which are defined originally for a modem. GSM Network also implements a similar AT like commands for its GSM Modules. The processor or controller, to which the GSM/GPRS Module is connected to, is responsible for sending the AT Commands to the module.

The AT commands consists of three parts: the prefix, the body or command, and the termination.

Types of AT commands are: Basic AT commands, S parameter AT commands and Extended AT commands.

Frequently used AT commands are:

1. AT – To check the communication between host and GSM module.
2. ATD- To make voice calls.
3. ATA- To answer the calls.
4. ATDL- To redial the last number.
5. ATH- To disconnect the call.
6. AT+CMGF- To set message mode to text mode.
7. AT+CMGS- To send the text message.

Features of GSM:

Improved spectrum efficiency
International roaming
Compatibility with integrated services digital network (ISDN)
Support for new services.
SIM phonebook management
Fixed dialing number (FDN)
Real time clock with alarm
management High-quality speech
Uses encryption to make phone calls more secure
Short message service (SMS)

C.GPS:

GPS stands for global positioning system which is a satellite-based radio-navigation system that provides relocation and time information to a GPS receiver anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites.

Structure:

The current GPS consists of three major segments.

Space segment:

It composed of 24 to 32 satellites in medium earth orbit and also includes payload adapters to the boosters required to launch them into orbit. It composed of the orbiting satellite, or space vehicles (SV) in GPS parlance. The GPS design originally called for 24SVs, eight each in three approximately circular orbits, but this was modified to six orbital planes with four satellites each.

The orbits are arranged so that atleast six satellites are always within line of sight from almost everywhere on the earth's surface.

Control segment:

This helps the entire system to work efficiently. It is essential that the transmission signals have to be updated and the satellites should be kept in appropriate position. It is composed of a master control station (MCS), an alternate master control station, four dedicated ground antennas, and six dedicated monitor stations.

User segment:

This segment includes military and civilian users. It comprises of sensitive receiver which can detect signals and a computer to convert the data into useful information.GPS receiver helps to locate your own position but disallows you being tracked by someone else.

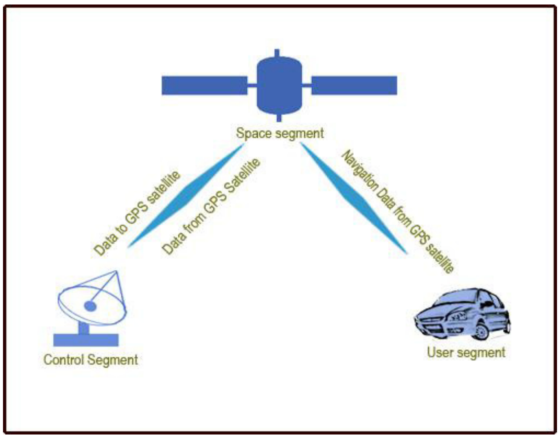

Fig 4: STRUCTURE OF GPS

Working:

It is based on time and known position of GPS specialized satellites. The satellite carries stable atomic clocks that are synchronized with one another and with the ground clocks. GPS receiver has clocks as well, but they are less stable and precise. GPS receiver monitors multiple satellites and solves equations to determine the precise position of the receiver and its deviation from true time.

Each satellite broadcast the message at two different frequencies 1.57542 GHz (L1 Signal) and 1.2276 GHz Signal). The satellite uses a CDMA (Code Division Multiple Access) spread-spectrum technique where the low bit rate message data is encoded with a high-rate pseudo-random (PRN) sequence that is different for each satellite. The receiver must be aware of PRN codes for each satellite to reconstruct the actual message data. The L1 frequencies are used by civilian users and L2 is for military purposes.

Demodulation and decoding:

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Demodulation of the signals is done by assigning each satellite a unique binary sequence known as a gold codes. These signals are decoded after demodulation using addition of the gold codes corresponding to the satellites monitored by the receiver.

If the almanac information has previously been acquired, the receiver picks the satellites to listen for by their PRNs, unique numbers in the range 1 through 32. If the almanac information is not in memory, the receiver enters a search mode until a lock is obtained on one of the satellites. To obtain a lock, it is necessary that there be an unobstructed line of sight from the receiver to the satellite. The receiver can then acquire the almanac and determine the satellites it should listen for. As it detects each satellite's signal, it identifies it by its distinct C/A code pattern. There can be a delay of up to 30 seconds before the first estimate of position because of the need to read the ephemeris data.Processing of the navigation message enables the determination of the time of transmission and the satellite position at this time

GPS signals and Message format:

Each GPS satellite continuously broadcasts a signal (carrier wave with modulation). It consists of pseudorandom code (sequence of ones and zeros) that is known to the receiver. Satellite continuously broadcast a navigation message on L1 (C/A and P/Y) and L2 (P/Y) frequencies at a rate of 50 bits per second. Each complete message takes 750 seconds to complete. The message has a basic format of a 1500-bit-long frame made up of five subframes, each subframes being 300 bits (6 seconds) long. Each subframe Consists of ten words, each 30 bits long.

Subframes	Description
1	Satellite clock, GOS time relationship
2-3	Ephemeris (precise satellite orbit)
4-5	Almanac component (satellite network synopsis, error correction)

Applications:

Civilian applications:

- Navigation
- Geotagging
- automated vehicle
- Astronomy

Military applications:

- Target tracking,
- Missile and projectile guidance, Search and rescue.

D. Temperature sensor(TMP36):

The TMP36 temperature sensor is an easy way to measure temperature using an Arduino. These sensors use a solid-state technique to determine the temperature. They don't use mercury (like old thermometers, bimetallic strips (like in some home thermometers or stoves), nor do they use thermistor (temperature sensitive resistors). Instead, they use the fact as temperature increases, the voltage across a diode increases at a known rate. By precisely amplifying the voltage change, it is easy to generate an analog signal that is directly proportional to temperature. The sensor can measure a fairly wide range of temperature (-50°C to 125°C), is fairly precise (0.1°C resolution), and is very low cost.

It's very similar to the LM35/TMP35 (Celsius output) and LM34/TMP34 (Farenheit output). The reason we went with the '36 instead of the '35 or '34 is that this sensor has a very wide range and doesn't require a negative voltage to read sub-zero temperatures. .

Specification:

Size: TO-92 package about 0.2" x 0.2" x0.2") with three leads
Temperature range: -40º C to 150º C/ -40 F to 302 F
Output range: 0.1 V (-40º) C to 2.0 V (150ºC) but accuracy decreases after 125 C.
Power supply: 2.7V to 5.5V only, 0.05 mA current draw.

Measuring the temperature:

Using the TMP36 is easy; simply connect the left pin to power (2.7-5.5V) and the right pin to ground. Then the middle pin will have an analog voltage that is directly proportional (linear) to the temperature. The analog voltage is independent of the power supply.
To convert the voltage to temperature, simply use the basic formula:

Temp in °C = [(Vout in mV) – 500]/ 10.

Advantages:

The TMP36 is a low voltage, precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. It also doesn't require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −40°C to +125°C temperature range. The output voltage can be converted to temperature easily using the scale factor of 10 mV/°C.

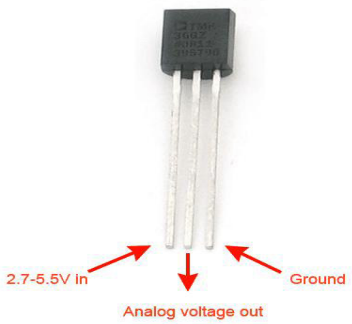

Fig 5: TMP36 (TEMPERATURE SENSOR)

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E.Heartbeat sensor:

The heartbeat sensor is based on the principle of photo phlethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important.

Working of a Heartbeat Sensor:

The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses causes a variation in the flow of blood to different regions of the body.When a tissue is illuminated with the light source(led), it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate.This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus the major requirement is to isolate that AC component as it is of prime importance.

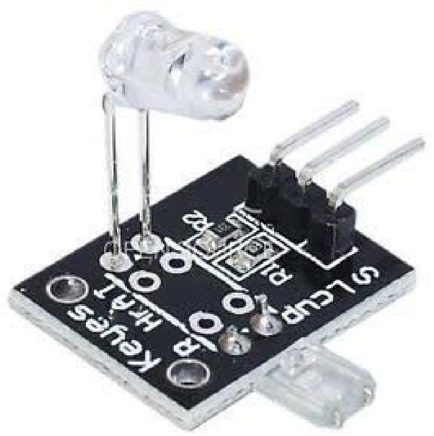

Fig 6: HEARTBEAT SENSOR MODULE

The digital pulses are given to a microcontroller for calculating the heat beat rate, given by the formula-

BPM (Beats per minute) = 60*f
where f is pulsating frequency.

IV. CONCLUSION:

Thus our system helps to monitor the health parameters of soldiers using heartbeat sensor to measure the heart beats and temperature sensor to measure body temperature of soldier. This system helps the soldier to get help from army base station during panic situation. Also this system provides the location information and health parameters of soldier to the army control room. Thus this system provides security and safety to our soldiers.

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