# Zigbee based Tracking and Rescue System

Ankit Singh
Department of Electronics and Telecommunication, SCOE, University of Mumbai, Maharashtra, India

Rahul Sharma
Department of Electronics and Telecommunication, SCOE, University of Mumbai, Maharashtra, India

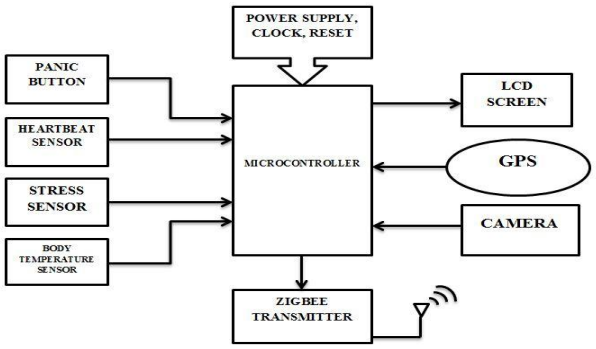
Rahul Saggam
Department of Electronics and Telecommunication, SCOE, University of Mumbai, Maharashtra, India

Anish Yadav
Department of Electronics and Telecommunication, SCOE, University of Mumbai, Maharashtra, India

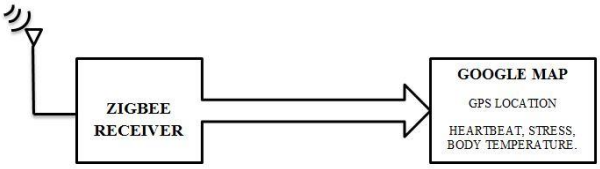
## ABSTRACT
This prototype is a wireless sensor network developed using ZigBee for tracking Individual (Travellers, Mountaineers, Soldiers, Enthusiasts, etc.). Sometimes Mountaineers, wildlife travellers put themselves in extreme situation where they get lost and mountaineer get trapped in avalanches their position is unknown and put their life in risk. The individual will be given mobile sensor unit that includes a GPS unit, a Microcontroller, Temperature, Heartbeat and Stress sensors, Transmitting antenna and a battery. Upon request or in real time, the sensor unit will transmits its UID number, GPS location, Health parameters status and time. The base station will receive this information and will display Location, Health status and time on Google map on monitor screen. The developed system can be used to track specific person as they will be given UID. Alternatively, any individual can request emergency help any time using the same system as it will be provided with panic button option in case of emergency. The location of the individual needing help will be identified on the map to make it easy for the help to reach in the most efficient way.

## Keywords
ZigBee, GPS, Heartbeat sensor, Stress sensor, Temperature sensor, location tracking device.

## 1. INTRODUCTION
People like Travelers, Mountaineers, wildlife enthusiasts put themselves in very adverse situation traveler me get lost, and mountaineers may get trapped in avalanches or people living in snow clad remote mountainous region may get trapped in avalanches. It becomes difficult to locate them as there are no details of their location. This may lead to many problems in their rescue operation. Also, Soldiers during patrolling remote location like mountains (area like Siachen)face extreme circumstances which cost them their lives.




**(a) Transmitter**




**(b)Receiver**

**Fig 1 System design of ZigBee based Tracking and Rescue System**

The diagram above display the overview of ZigBee based Tracking and Rescue System. This project suggests a ZigBee technology based Tracking and Rescue System that deals with tracking of user by sending their health and exact location status signals periodically or on requestusing wireless sensor networks which includes GPS, Microcontroller and other health monitoring sensors and acts accordingly for their rescue operation.

### 1.1 Panic Button
This is a small push button inside the controller connected to the full-on power and full off brake. Gives positive contact, and eliminates the resistance from the circuit. A very efficient way of handling power, even in the newer electronic controllers.

### 1.2 Heart Beat Sensor
Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller 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.

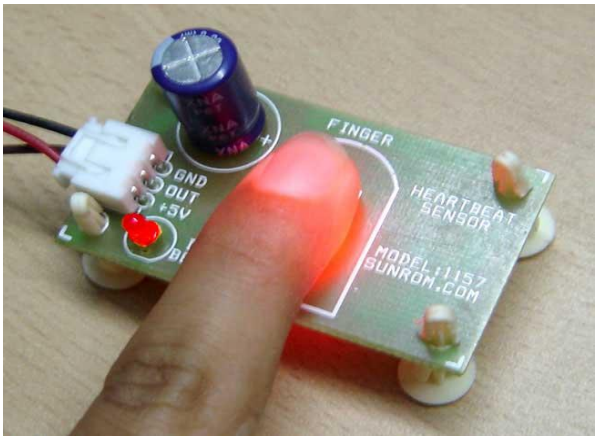



**Fig 2 Heart Beat Sensor module.**

Features:

- Microcontroller based SMD design.

- Heart beat indication by LED.
- Instant output digital signal for directly connecting to microcontroller.
- Compact Size.
- Working Voltage +5V DC.

## 1.3 Body Temperature Sensor

A thermistor is a type of resistor with resistance varying according to its temperature. Thermistors can be classified into two types depending on the sign of *k*. If *k* is positive, the resistance increases with increasing temperature, and the device is called a positive temperaturecoefficient (PTC) thermistor, or positron. If *k* is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (NTC) thermistor. Resistors that are not thermistors are designed to have a *k* as close to zero as possible, so that their resistance remains nearly constant over a wide temperature range.

$$\Delta R = k\Delta T$$

Where,

$\Delta R$ = change in resistance
$\Delta T$ = change in temperature
$k$ = temperature coefficient of resistance

## 1.4 Galvanic Skin Response Sensor (Stress Sensor)

Researchers define stress as a physical, mental, or emotional response to events that causes bodily or mental tension. Simply put, stress is any outside force or event that influences our body or mind.

Biologically, Galvanic skin response or skin stress is a change in the electrical resistance of the skin. By virtue of the galvanic skin response, autonomous nervous system activity causes a change in the skin's conductivity.

Depending on the stressors and the types of changes or events we are dealing with, stress can manifest itself physically, emotionally and/or mentally. Physical – this occurs when the body starts to suffer because of a stressful situation. Symptoms can manifest in a variety of ways and vary in their seriousness. The most common physical symptom is headaches because stress causes people to unconsciously tense their neck, forehead and shoulder muscles.

**Fig 3 Galvanic Skin Sensor.**

The Galvanic Skin Response Sensor (GSR - Sweating) allows you to measure the electrical conductance of the skin. It acts as an indicator of psychological or physiological arousal.

## 1.5 Microcontroller ATmega16

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing instructions in a single clock cycle, the Atmega16 achieves throughputs approaching 1MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.
Special Microcontroller Features:

- Various in-built peripherals like ADC, USART, Analog Comparator, SPI, and JTAG.
- Power-on Reset and Programmable Brown-out Detection.
- Internal Calibrated RC Oscillator.
- External and Internal Interrupt Sources.
- Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power- down, Standby and Extended Standby.
- 32 Programmable I/O Lines.
- 40-pin PDIP, 44-lead TQFP, 44-lead PLCC, and 44-pad QFN/MLF.

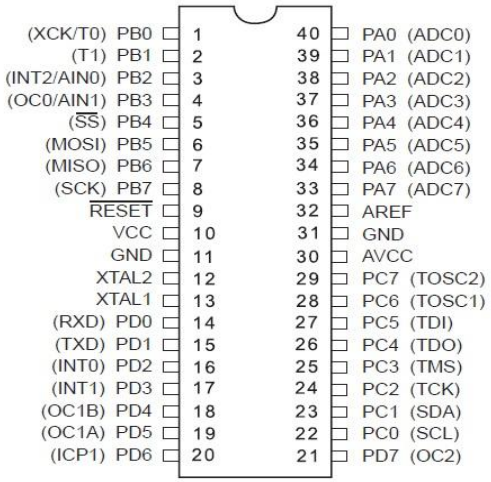



**Fig 4 A Tmega16 Microcontrollers.**

## 1.6 LCD Module

LCD (Liquid Crystal Display) screen is an electronic display module and it has a wide range of applications. A 16x2 LCDdisplay is very basic module and is very commonly used in various devices and circuits.

LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters unlike in seven segments, animations.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

- 16 Characters x 2 Lines.
- Built-in HD44780 Equivalent LCD Controller.
- Works directly with ATMEGA, ARDUINO, PIC and many other microcontrollers.
- 4 or 8-bit data I/O interface.
- Low power consumption.

## 1.7 GPS Module

This GPS receiver is low cost and contains POT (Patch Ceramic Antenna on Top). Its sensitivity is little less than our active Antenna models 1141 and 1216 but does well near windows or open sky and

where there is not much buildings around. Global Positioning System (GPS) satellites broadcast signals from space that GPS receivers, use to provide three-dimensional location(Latitude, longitude, and altitude) plus precise time. GPS receivers provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth. Sunroom's ultra-sensitive GPS receiver can acquire GPS signals from 65 channels of satellites and output position data with high accuracy in extremely challenging environments and under poor signal conditions due to its active antenna and high sensitivity. The GPS receiver's -160dBm tracking sensitivity allows continuous position coverage in nearly all application environments. The output is serial data of 9600 baud rate which is standard NMEA 0183 v3.0 protocol offering industry standard data messages and a command set for easy interface to mapping software and embedded devices.

**Fig 5 GPS Module**

## 1.8 ZigBee Transmitter Receiver Module

ZigBee protocol features:

- Low duty cycle - Provides long battery life.
- Low latency.
- Support for multiple network topologies: Static, dynamic, star and mesh.
- Direct Sequence Spread Spectrum (DSSS).
- 128-bit AES encryption – Provides secure connections between devices.
- Collision avoidance.
- Link quality indication.
- Clear channel assessment.
- Support for guaranteed time slots and packet freshness.

**Fig 6 Zigbee module.**

The ZigBee specification provides a security toolbox approach to ensuring reliable and secure networks. Access control lists, packet freshness timers and 128-bit encryption based on the NIST Certified Advanced Encryption Standard (AES) help protect transmitted data. Range specifically depends on the power used for transmission. More is the power, more is the range. Using high gain antenna with suitable RF radio module provides maximum range up to 65 miles.

## 2. ADVANTAGES

- System is very easy to use, secure and most preferable.
- System is very interacting, Digital and as many as sensors can be deployed.
- System is wireless.
- It gives instantly wireless data and GPS location.
- System can transmit data wirelessly from any geographical area.
- Do not require network, like in IoT, GSM to send data.
- Range can be further increased by using other RF radio module (XTEND 900 provides a range of 40 miles and XBee PRO 900 XSC provides range of 28 miles).

## 3. DISADVANTAGES

- Implementation cost is high.
- Power management.
- Physical size.

## 4. APPLICATIONS

This system can use any for-

- Tracking Wildlife animals.
- Travelers, forest/wildlife enthusiasts.
- Mountaineers.
- Soldiers.
- Company employs (Can prove useful tool for women).
- To keep an eye on the Kids by their working parents.

## 5. CONCLUSION

Tracking mobile target applications through wireless sensor networks is a critical and emerging field. GPS is not the ideal system in indoors environments for two reasons: inaccessibility and expensiveness. ZigBee networks benefit from having the ability to quickly attach information, detach, and go to sleep mode, which offers low power-consumption and extended battery life. In this paper, we explored the RF-based localization techniques, and other localization techniques which are based on measuring the weights to calculate the position of the target nodes.

One of the most important developments and improvements that should be added to research in the future is to improve the accuracy for tracking system. Involving weights in this research potentially leads to greater accuracy. Investigating involving end-device nodes in the tracking process to track the mobile target when the density of router nodes is very low is one of the priorities in the future. The proposed work involves tracking one mobile target. In the next step, we intend to track multiple mobile targets simultaneously, and increase the tracking area by involving a higher number of sensor nodes. Mobile targets will be looked at as possible routers to communicate with other routers in the ZigBee network.

To increase range of the system,RF radio module with high gain antenna can be used. RF module like XTEND 900 provides an outdoor LOS range of 40 miles whereasXBee PRO 900 XSC provides an outdoor LOS range of 28 miles and XBee PRO SX has maximum range of 65 miles.

Development can be done to improve its security features and safeguard it from hacking as it can be threat to the user. Various encryption methods need to be deployed at both the end in order to improve its security, so that only authorized person has the right to check the location.

A proper Network Management is required. As it can improve the system performance and energy efficiency Research can be done to improve tracking and Rescue system. Drones Copter have been developed that can carry humans. These Drones can be used for the rescue operation. In case, if an individual calls for immediate rescue, drones can be dispatched from the base station for their rescue.

Number of Sensors can be deployed to take many health and environment reading.

Cameras can be deployed in the system, so the actual situation can be seen and recorded by the rescue and response team.

System can be developed like a wearable gadget like watch, wrist band.

Further development can be done by installing microphone for voice data transmission and reception.

## 6. AKNOWLEDGMENT

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