LORA BASED SOLDIER TRACKING AND HEALTH MONITORING DEVICE

Kruthikaran V[1], Nandhu S[2], Sakthi Krishnan K[3], Sajan P Philip[4]

[1]Student, Mechatronics, Bannari amman institute of technology, Tamilnadu, India
[2]Student, Electronics and communication engineering Bannari amman institute of technology, Tamilnadu, India
[3]Student, Electronics and communication engineering, Bannari amman institute of technology, Tamilnadu, India
[4]Professor, Electronics and communication engineering, Bannari amman institute of technology, Tamilnadu, India

---***---

Abstract - *A country's military might is determined by its ability to field men on land, at sea, and in the air. A compact and effective approach is suggested for monitoring these soldiers. The soldier can mount this device, which keeps track of the soldier's whereabouts and health indicators. The strength of a nation is derived from its military might, which consists of land troops, air forces, and naval forces. To maintain tabs on these soldiers, a quick and efficient method is offered. This gadget, which the soldier can mount, monitors the soldier's health indicators and whereabouts. A few other parts of this system are beneficial to warriors. Low-data-rate, long-distance signal transmission from the soldier to the control device is made possible by Long Range (LoRa) technology. We can design a system that uses less power while still transmitting at a high pace with the aid of LoRa. The health monitoring system consists of heart rate, pulse, temperature, and motion detection. Determine a soldier's level of fatigue in a battle situation with the use of motion detection. The soldier's chance of survival is increased by the ability of these gadget combinations to track the soldier in the field and their parameters. Motion detection assists in determining a soldier's level of weariness in a combat situation.*

Key Words: **LoRa, Arduino, Monitoring, SOS, Assisting, Soldier.**

1. INTRODUCTION

In the current global environment, a nation's security is of the utmost importance, and that security is dependent on the army force. It would be practically impossible to safeguard a country without the army. The creation of wearable technology is necessary because it is not large and uses very little power in the defense industry, allowing for the real-time tracking of a soldier's position and key health indicators while he is engaged in combat. The base station may direct the soldier to their location using this navigation system for soldiers. Hence, this paper focuses on monitoring the location of soldiers using GPS, which is important for control room stations to know the precise location of soldiers and accordingly they switch lead them. Moreover, high-speed, short-range wireless connection between soldiers is used to transmit data on situational awareness, including information from biological sensors, GPS, and wireless communication. Temperature and heartbeat sensors make up the biosensor.

This project's key selling point is that it is Internet of Things (IoT) based. IoT systems are made up of connected machinery (mechanical or digital), computer tools, living things, humans, and other things with special functions. Their data may be moved through a network using the IoT without the involvement of human beings or computers from one location to another. The use of IoT in soldier navigation and health monitoring systems is in the immediate transmission to the base station, without the need for the soldier to input any data, of the soldier's position and health parameters in real time while they are on the battlefield.

Problem Definition

The soldier's equipment includes a buzzer, panic button, body temperature sensor, oxygen level detector, LCD display, GPS receiver, and Wi-Fi module. They have used Arduino to link all of the sensors, a GPS receiver, a wi-fi module, a buzzer, and a panic button in the above picture. It has been made clear that either a soldier unit or a base unit can use the system. Due to the fact that Arduino is connection-oriented and has a USB connector, they have not specified how communication between the client and server sides is achieved. So, we may draw the conclusion that the current system has some weaknesses that can be fixed by altering a unit or component. We are attempting to fix those issues in the suggested system by completely redesigning it.

Proposed System

The project demonstrates an efficient system that can track troops' vital signs while simultaneously recording their location using the required sensors. Wireless RF modules are then used to transfer the sensor data to the following level of the hierarchy. This technology enables the control room unit to use the wireless body sensor network and the RF receiver at regular intervals to continuously track the position and monitor the troops' vital signs. As part of the suggested architecture, an ESP8266 connected to the control room continuously checks the data received from the various subsystems and issues an alert if any values go over or below predetermined thresholds. If any abnormalities are discovered in the values received to the control unit node, they make sure that assistance is sent from the control unit node or the squadron leader's node within a short period of time. Live health monitoring and position tracking of the soldiers will ensure their safety on the battlefield.

LITERATURE SURVEY

1. Jasvinder Singh, et al., [1] proposed Global Positioning System (GPS) and Internet of Things (IoT) based soldier positioning and health signal system in 2019.Communication may go on forever. Soldiers may communicate from any location, which makes it possible for them to contact one another in an emergency. The overall power consumption of the module is reduced through the use of an ARM CPU, a simple circuit, and peripherals with minimal power requirements. Smaller and lighter peripherals are employed so that warriors may transport them in safety and securely. Soldier safety and security is provided by the health system, which also tracks a soldier's whereabouts anywhere on the planet via GPS.

2. Niket Patil, et al.,[2] proposed a health monitoring and tracking system in 2018. This study produced a system for tracking and monitoring troop health that is IoT-based. This suggested module might be mounted on a soldier's body and use GPS to determine their current location and state of health. IoT will be used to send this data to the base station. With the help of the demonstrated module, a low-cost circuit may be implemented to protect soldiers' lives on the battlefield.

3. William Walker A L, et al., [3] proposed mobile health monitoring in 2018. The authors talked about several wearable, portable, light-weight, and compact biosensors that have been created for keeping track of soldiers' health. For real-time monitoring of a soldier's health conditions, the BSN is made up of sensors that may be worn on the body, including heart rate, temperature, and gas sensors. The strategy for creating a network of connected BSNs that can monitor troops' health in real time is suggested in this research.

4. Akshay Gondalic, et al., [4] designed an IoT Based Healthcare Monitoring System for War Soldiers using Machine Learning in 2018. Using GPS, temperature sensors, heartbeat sensors, and other devices, this system enables an army base station to monitor the health of soldiers and track their whereabouts. ZigBee technology will be used to wirelessly communicate with the other soldiers the information from sensors and GPS readings. Moreover, the deployment of the LoRaWAN network system in conflict zones where cellular network coverage is either nonexistent or prohibits data transfer has been recommended. The data will be uploaded to the cloud for further data analysis and forecasting using the K means clustering technique.

5. Afef Mdhaffar, et al., [5] proposed a work on IoT Based Health Monitoring via LoRaWAN in 2017 in Using low-cost, low-power, and secure communication utilizing a LoRaWAN network architecture, the acquired bio sensor data is delivered to the analysis module. In remote places where cellular network coverage is either nonexistent or does not enable data transfer, heart rate, temperature, and blood sugar levels have been measured. The typical area covered by LoRaWAN is around 33 km2, and when the LoRaWAN gateway is installed outdoors at a height of 12 meters, it is stated that the power consumption of this monitoring module is ten times lower than that of other long-range cellular solutions like GPRS/3G/4G.

Soldier Node

A temperature sensor and a pulse sensor are part of this node's body sensor networks (BSN). The soldiers' vital signs are monitored by these devices. The temperature of the soldier and his surroundings are monitored by a temperature sensor, while the pulse sensor (RC-A-4015) measures the troops' pulse rate in beats per minute (BPM). An urgency is judged to exist if there is any difference between the detected values and the threshold values that have been established.

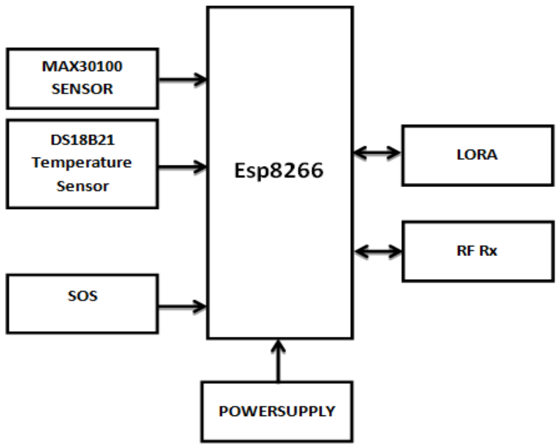


Figure 1 : Block diagram of soldier node

The BSN and an RF receiver are both attached to the node in order to find and monitor the soldier's Zone. The micro controller processes and stores all the data coming in from the sensors before sending it to the next node through the wireless LORA transceiver module. As the distance between the soldier's node and the node is just a few kilometers , LoRA is the RF module that is utilized in the soldier's node.

Control Node

This node has an SX1278 wireless RF LoRa module, which is where it gets data from other nodes. This node's only purpose is to track, archive, and analyze the information received from the node. The ThingSpeak web application is also used to connect this node to the internet. We can link this node to the internet with the use of a USB and a laptop. When this node is online, data from the sensors is delivered to the ThingSpeak cloud and simultaneously sent to the dashboard designed to communicate with the project through the cloud.

Objectives

We can see today that many troops were impacted by health problems. As a result, our suggested system can identify the circumstance when users are in any urgent situations or conditions outside of networked regions.

Methodology

Wireless RF modules are then used to transfer the data gathered from the sensors (current position) to the following level of the hierarchy. This technology enables the control room unit to use the wireless body sensor network and the RF receiver at regular intervals to continuously track the position and monitor the troops' vital signs. As part of the suggested architecture, an ESP8266 connected to the control room continuously checks the data received from the various subsystems and issues an alert if any values go over or below predetermined thresholds. The soldiers' whereabouts and live health status are tracked to guarantee their safety on the battlefield, and if any irregularities are discovered in the values supplied to the control unit node, they make sure that help is delivered from that node or the squadron leaders node as soon as possible.

LORA unit

LoRa is a "Long Range" low power wireless standard created to offer a communications network with low data rates similar to those seen in cellular technology.

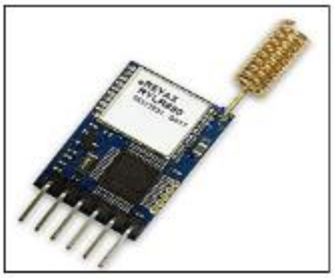


Figure 2 : Lora module

LoRa, which targets the M2M and IoT markets, is excellent at delivering sporadic low data rate connectivity across considerable distances. Even low power transmissions can be picked up over long distances because of the radio interface's ability to pick up extremely low signal levels. The radio interface and LoRa modulation have been created and optimized to deliver precisely the kind of communications required for remote M2M and IoT nodes.

LORA Technology

The LoRa technology has numerous important components. Its salient characteristics include the following.

1. Long range: 15 - 20 km.
2. Millions of nodes
3. Long battery life: in excess of ten years

The general functionality and connection of the system are provided by a variety of LoRa technology components:

1. LoRa PHY/RF interface: The system's proper operation depends on the LoRa physical layer, or PHY. It controls the RF signal characteristics that are sent between the nodes or endpoints, such as the sensors and the LoRa gateway where signals are received. The physical layer, also known as the radio interface, controls the signal's frequencies, modulation type, power levels, signaling between the sending and receiving components, among other things.

2. LoRa protocol stack: In addition to defining the open protocol stack, the LoRa Alliance has also defined the LoRa physical layer. The development of the open source stack has made it possible for the idea of LoRa to develop because all the various companies involved in its development, use, and deployment have been able to collaborate to produce an affordable, simple-to-use solution for connecting all kinds of connected IoT devices.

3. LoRa network architecture (LoRaWAN): In addition to the radio frequency (RF) components of the LoRa wireless system, there are additional components of the network architecture, such as the overall system architecture, backhaul, server, and application computers. LoRaWAN is a common name for the whole architecture.

LORA Frequency Bands

The unlicensed frequencies that are accessible everywhere are what the LoRa wireless system uses. The most popular bands and frequencies are:

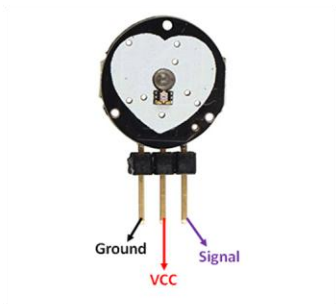
1. Europe: 868 MHz

2. North America: 915 MHz
3. Asia: 433 MHz

The LoRa wireless modules and devices can achieve significantly greater coverage by operating at lower frequencies than the 2.4 or 5.8 GHz ISM bands, especially when the nodes are within buildings. While often operating in the sub-1GHz ISM bands, the technology is fundamentally frequency agnostic and can operate on a wide range of frequencies without much modification.

Pulse Sensor

A well-designed plug-and-play heart-rate sensor for Arduino is available as Pulse Sensor. It may be utilized by academics, creatives, athletes, makers, game developers, and mobile app developers that wish to quickly incorporate real heart rate data into their works. The sensor connects directly into Arduino and is attached to a fingertip or earlobe. A free monitoring app that displays your pulse in real time on a graph is also included.



Working

The pulse/heart beat sensor is really easy to use. The sensor has two sides, one of which includes an LED and an ambient light sensor, and the other of which has circuitry. The amplification and noise canceling functions are carried out by this circuitry. Our body's veins are covered by the LED on the sensor's front side. Either the tip of your finger or the tip of your ear should be used, but it must be positioned exactly over a vein. As of right now, the LED is emitting light directly into the vein. Only when the heart is pumping will blood flow through the veins, therefore by tracking blood flow, we can also track heartbeats. When blood flow is detected, the ambient light sensor will detect more light since blood will reflect it. This slight difference in light received is analyzed over time to estimate our heart rate.

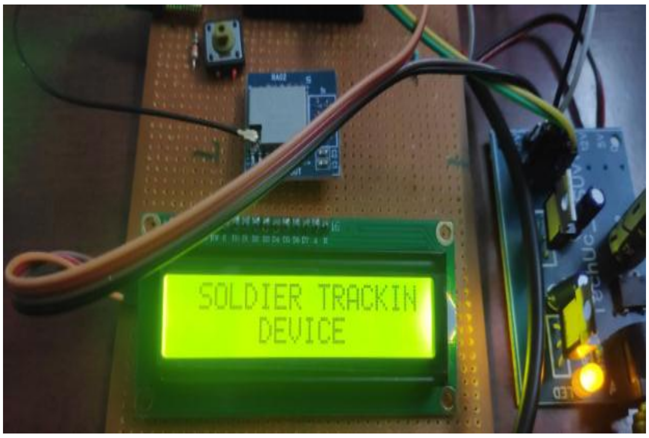
Usage of Pulse Sensor

The pulse sensor is simple to use, but placing it correctly is crucial. The sensor should also be covered with hot glue, vinyl tape, or other non-conductive materials because all of the electronics on it are immediately visible. Also, it is not advisable to use moist hands when using these sensors. The sensor's flat side should be put on top of the vein with a light pressure applied; often, clips or Velcro tapes are used to provide this pressure. The sensor may function at +5V or 3.3V systems; to use it, simply supply power to it via the Vcc and ground pins. Once the microcontroller is switched on, connect the Signal pin to the ADC pin to track changes in output voltage. The easily available code will greatly simplify things if you're working with a development board like Arduino. For further details on connecting the sensor to Arduino and mounting it, see the datasheet at the bottom of the page. You may get the sensor, code, and processing schematics from the Sparkfun product website.

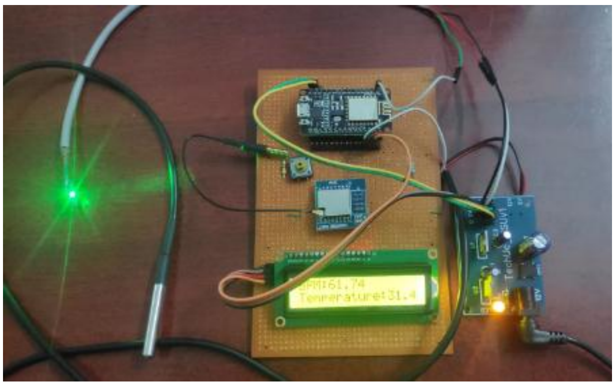
Applications

1. Sleep Tracking
2. Anxiety monitoring
3. Remote patient monitoring/alarm system
4. Health bands
5. Advanced gaming consoles

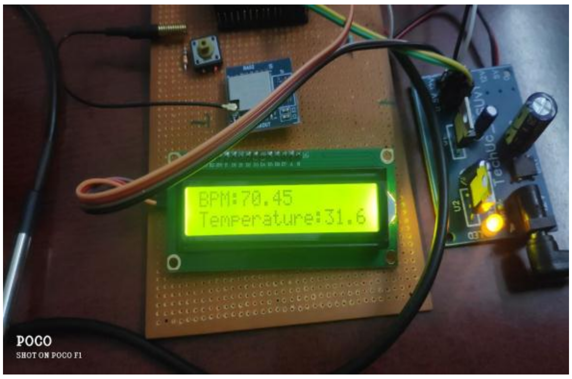
RESULTS AND OUTPUTS



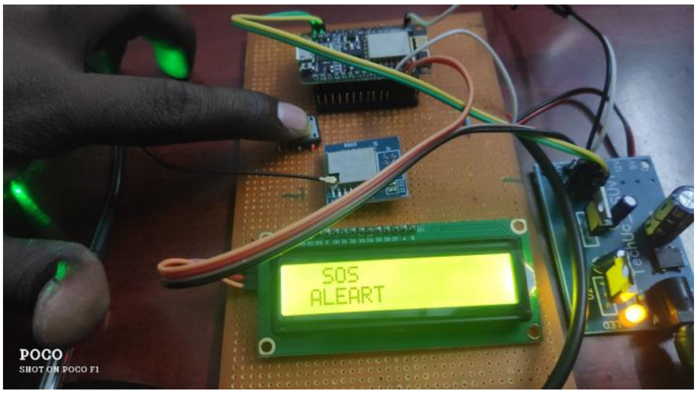
Soldier activates the soldier node when they enter the deep woodland or SOS regions.



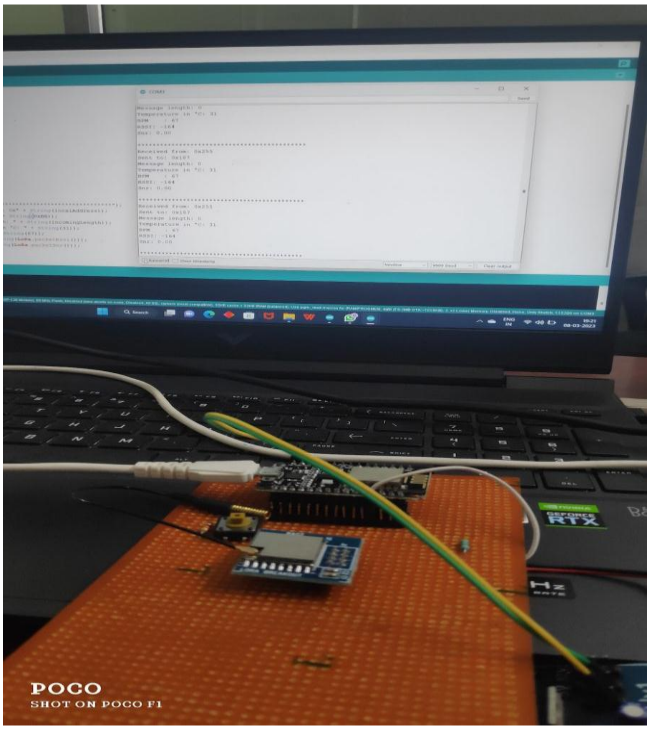
The soldier's heart rate and temperature are shown on a display that is fixed to the soldier.



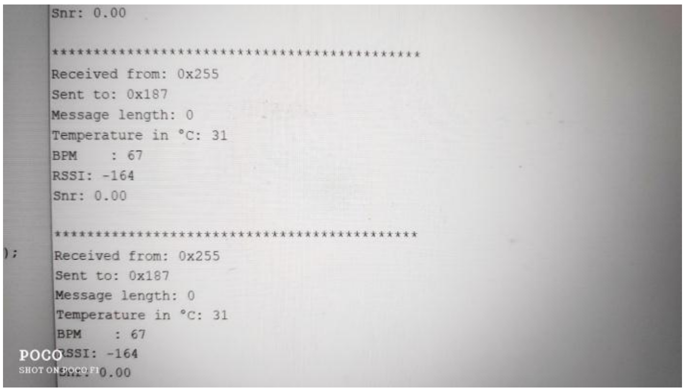
It has been detected to measure the temperature and blood pressure. This is the soldier node.



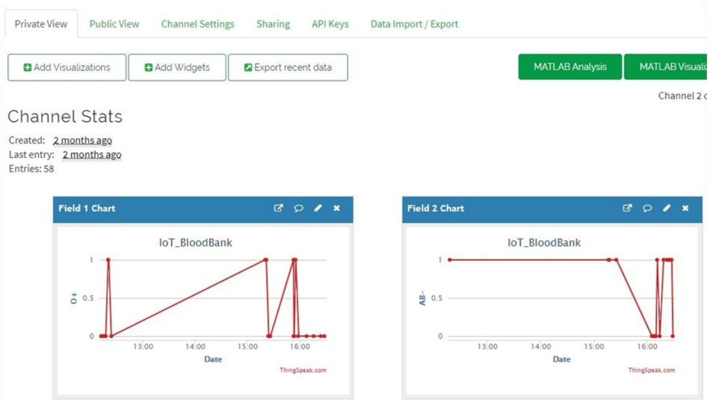
When a soldier is in a situation that requires immediate action, SOS alert will be sent.



The soldier's location and health are being tracked by the hub node.



The primary hub systems may see the troop circumstances.



Open your channel in the Thing Talk API at this point. The value "143" in the Field 1 Chart may be seen in the "Private View" tab. Everything is done. If you comprehended and completed all of these instructions, you may have linked the ESP8266 to the ThingSpeak API with success. Repeat the procedures from setting up the TCP Connection to transfer more data.

CONCLUSION

A LoRa-based IoT monitoring system was implemented. We have developed a protection system that monitors the soldier's temperature, blood pressure, oxygen saturation, and electrocardiogram while also transmitting the soldier's location in an emergency. This tool aids military authorities in knowing how the soldiers are doing at the bivouac. By using geo-location to narrow the search area and begin checking as soon as the soldier's health starts to change, the rescue procedure is frequently made more effective. Because this technology can be used without network restrictions, it can be of considerable assistance to military troops during combat and rescue operations. And our warriors are protected by this system.

REFERENCES

1. Temperton, J.: Why does hot weather make railways bend (2015). http://www. wired.co.uk/article/uk-heatwave-rails-buckle

2. Kerr, M., Wilson, A.: Engineering Manual Track, TMC 226, Rail Defects Handbook, Version 1.2. Transport Rail Corps Engineering Standards and Procedure Publications, June 2012

3. Othman, M.F., Shazali, K.: Wireless sensor network applications: environment monitoring system. In: International Symposium on Robotics and Intelligent Sensors (2012)

4. Hodge, V.J., O'Keefe, S., Weeks, M., Moulds, A.: Wireless sensor networks for condition monitoring in the railway industry: a survey. IEEE Trans. Intell. Transp. Syst. 16(3), 1088–1106 (2015)