

# Real Time Wireless Embedded Electronics for Soldier Security: A Review

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## ABSTRACT

Soldiers are an essential component of any country's security. The same soldiers who while safeguarding the nation's security are facing many obstacles which are bestowed on to their path either by nature or their own self. Some of the problems they face are the one's because of unforeseen condition such as due to the bad climatic conditions, sometimes their own health deteriorating because of the climatic changes or due to their own physiological factors and one among the most crucial problem they face is that of losing the communication with their fellow soldier's or with the base station. As the technologies are developing and every nation is trying to solve the problems that are encountered by the soldiers by making use of modern-day technologies that will be feasible to be used under any circumstances. In this article discusses about some of the many such technologies and projects that are being implemented for the betterment of the soldiers.

## Keywords

Internet of things (IOT), Global positioning systems, wireless area networks, Global systems for mobile communication

## 1.INTRODUCTION

Soldiers being one of the irreplaceable part and an asset to the country it is very important to address the problems being faced by the soldiers while safe guarding the nation while being in the borders under the adverse climatic conditions or by protecting us from the enemies while battling in the war field. In today's world with the various technologies being developed every nation try to implement those technologies to solve the problems faced by the soldiers and make their duty a little bit easier to them. The survey discusses about some of the research done in this field such as monitoring the physiological parameters, psychological parameters, tracking their location and sending their current situation to the base station so that they can be provided with the assistance to tackle the situations and the ways in which they can be implemented so that their situations become much easier.

## 2.LITERATURE SURVEY

In this paper[1] the authors Zeeshan Raza et.al explained about the monitoring of soldiers health, it states about the use of a numerous devices that are attached to soldiers to take care of their healthiness and proposes the safety services that consists of 2 units i.e. soldier unit and another one is base station by using WPAN, for more effective WPAN the project can choose low energy power sensor and equipment's like controllers because the army operations lasts for long duration , hence WPAN should be active throughout the operation . The system is designed with effective correlation by reading only two sensors "Easy Pulse v1.1" which measures the heartbeat rate of the soldier and the non-intrusive photosensitive method such as photo plethysmography in order to identify heart rate by cardiovascular beat surge from skin. To light up the finger Infrared LED is used. To measure the body temperature whose output voltage is in terms of Celsius LM35 is used. In order to reduce the complexity and size of the whole circuit Arduino UNO R3 a microcontroller board based on

the ATmega328 is incorporated, to track the exact location of the soldier the system uses GPS SKM53 along with this battery is used to keep the circuit alive, GSM SIM900D is used to send the SMS information to the base station and 20x4 character bit LCD are used for display of data at the soldier unit. This project has advantages such as that they are lightweight whose weight does not exceed 1.5 kilos and also battery timing is good up to 72 hours, by using this system the control station can reduce the rate of loss of lives in battlefield.

In this paper [2] discusses about soldier's health condition along with bomb detection by tracking explosive compounds in the environment and the use of k means machine learning algorithms. For transmitting the data from the soldier to the squadron leader and vice versa a Zigbee module is used, after receiving data they send it to the base station unit by making use of LoRaWAN module. Army base station consists of the LoRaWAN trans receiver which allows the transmission and reception between two units. The region such as high-altitude regions where either there will be no data transmission or network coverage is absent LoRaWAN can be used. This project can be improved in future days by adding the following features: Accelerometer along with Gyroscope can be used using machine learning to recognize the various activities done by the soldier, to determine as well classify whether the soldier is in distress or whether he/she is calm can be done using blood pressure sensor and electro thermal activity sensor.

Reference [3] talks about soldier monitoring system by using Arduino atmega328, heartbeat and heart level sensor, LCD display, there is a prewired Digital Compatible temperature sensor DS18B20 and waterproofed version of 1 compatible sensor i.e Wire DS18B20- which is used with 3-to-5-volt systems. The system uses a HC-12 module, the trans receiver are capable of communicating slightly beyond 1km. HC12 module sends and get information and behave like Wi-Fi. Python is used for creating GUI (graphical user interface) application on PC for association with underwriter organization. In order to make GUI, the quickest and most straightforward approach i.e python and tkinter is used.

This paper [4] reveals about the use of blockchain and IOT to create a secured soldier monitoring system. This work facilitates to handle crisis situation related to medical emergency and communication. The hardware components used in this projects are raspberry pi, temperature sensor, heart beat sensor (EC 0567), along with ADC, power supply, LCD display as well as an additional GPS and GSM module, the system is also provided with a Clickable button and a resistor. The internal body vital signals i.e the internal body temperature and environmental temperature are sensed and monitored using the sensors. The data sensed by these sensors are collected by the data acquisition module. Blockchain technology is used for storage of the data securely. An interface is created between the Raspberry pi, GPS module and the pulse sensor using the Arduino Uno board. Arduino compiler and Python are used to write the program. GSM module is used for higher speed data with effective range along

with enhanced features such as coverage. To provide long range communication a SIM900A GSM MODULE will be directly attached to the raspberry Pi. Data received at base station would be highly sensitive and needs protection so that the data will not be pinched. In order to achieve this the data can be stored and can be secured from theft by using blockchain technology. Voice protection system is used to recognize the voice samples of the soldier and the soldier module can be provided with a camera. The exact situation of the soldier from the warzone can be received using a faster communication channel.

The work references [5] in discussed about the health monitoring and tracking of soldiers using GPS. The hardware components that are used in these systems are Arduino atmega328p along with that LM35 low cost temperature sensor, heart beat sensor is connected to microcontroller in order to measure the heart beats in terms of beat per minute where the output is produced in digital form. Base station gets the exact location of the soldiers by monitoring the distance between the soldiers, their speed, the condition of the soldiers in the battleground are determined which helps the base station unit to plan their further war strategies by which the lives of the soldiers could be saved. The GPS module is used to monitor and track the exact location of the soldier and transfer the data to the base station unit.

The paper [6] discusses about some of the challenges encountered by soldiers while guarding our nation and the use of embedded electronics as the science and technology is growing in a faster pace. The challenges are tackled by the new inventions and technologies as they are used by the nation's defense services. The paper enlightens about the safety facilities that the defense services can provide to the soldier's likely: monitoring the body temperature, heart rate by making use of several sensors namely heart beat sensors along with temperature sensors and many more which are together called as WBSANS and these information's are provided to the base station; guiding the soldiers to the safer places as per the information collected by the base station from the GPS regarding the location of the soldier's ; to provide communication between the soldier with the base station so that they can overcome the unforeseen situations The system can be used in the battle field without any network restrictions, The system overcomes the disadvantage of the existing system which uses Zigbee module. The system makes use of Arduino microcontroller and GSM module for sending the information on health condition and a GPS module is used for locating the soldiers by sending the army base station with soldiers current locations longitude along with latitude.

The authors referenced [7] in aims in providing security to the soldiers and alerting them about the risks to be encountered. This work mainly focuses on surveilling the war field where the soldier is present and looks out for the gun shoot attacks, poisonous gas attacks, and also alert the soldiers in case of dreadful emergency situations. Also emphasis about creating a virtual boundary by making use of GPS to protect the soldiers by tracking them and creating a Geo fence in addition to the bi-directional communication between the surveillance unit or the base station with the soldiers by making use of Wi-Fi module. The project accentuates about the technology which is AI that is a combination of IOT and model RNN-LSTM which is called as deep learning that provides assistance in exchange of data followed by the forecasting regarding the presence of harmful gas in the atmosphere, between the administrator and soldier. The control station administrator or surveillance station administrator will also keep track on the status of the soldier's real time activity by making use of the created webpage by Programming Tool called Node Red where the data are executed by virtue of protocol SN-MQTT. This work could be further envisioned by including

bio sensors to monitor the physiological parameters along with the psychological parameters. The accelerometer along with gyroscope can be used in identifying the current pursuit of the troop with the help of machine learning algorithm.

Nadimpally Bharathgoud, Balaji Ramachandran, Sandeep Kodam [8] focuses on providing with all the possible way to safeguard them in all the aspect by granting the soldiers with the smart wearable's which makes use of technology known as WSN. Body Sensor Networks are embedded on the wearable's like a smart strap ,smart vest, smart helmet which is used to detect the different types of mental as well as the psychological status of soldiers. Smart strap makes use of various kinds of sensors namely; temperature sensor which monitors the temperature of the body and a sensor for analyzing the finger prints for authentication that finger prints being the source of identity which differs from soldier to soldier, other than these the smart strap consists of Zig bee module to establish a mode of communication between the soldier with the other soldiers by forming a network called as Mobile Ad-Hoc Network and also makes use of LoRA WAN for establishing the two way communication between base station unit and the soldier. The heart rate fluctuations is determined by sensors like ECG which are implanted on the smart vest, the smart vest also performs other functions such as adjusting the temperature of the body with regards to the temperature of the surroundings by making use of the thermostat sensor and other important feature provided by smart vest is to identify the injury that is caused by the bullet in the body of the soldiers if any. The smart helmet protects the soldier from head injuries during the course of the war, the other important aspect of the smart helmet is to detects drowsiness, monitor the amount of glucose in the brain, inculcates EYE blink detector and looks for fatigue. The advantage is that, there is transfer of information or data between the soldiers to soldier or to the administration unit without the loss of data. The Smart strap used here is very less power consuming and the design is compact. However, it is challenging to avoid the malicious attacks in MANET system which uses Zig bee and LoRA WAN. The smart wearable's can be improved by implementing status of ammunition and also making use of renewable energy sources by using harvesting methods to power up the sensor.

The authors [9] in their paper discussed about the different types of ways in which assistance can be provided to the soldiers so that the safety of the soldiers can be ensured. To achieve this the suggested system is making use of Internet of things (IOT). Also discussed about the methodology used in implementing the system that suggests about integrating the advanced wireless sensor networks with a GPS module so that it is possible to keep track on the security and safety of the soldiers and update about their health conditions to the administration station. The proposed system includes two parts namely the soldiers station and the base unit station wherein the soldier's part is mounted on the soldier's armour which is equipped with numerous sensors like RC-A-4015 a pulse sensor, oxygen sensor , LM35 a temperature sensor, humidity sensor (DHT11)along with the GPS module (Neo-6M) which supports for mobility and collectively useful in gathering the information regarding the soldier's health condition as well as the status of the surrounding environment and the collected data is analyzed and relayed in the base station which is done using the cloud platform. The data transfer is done using the Wi-Fi module (ESP8266). There are additional sensors which helps in detecting the presence of bomb explosives in the vicinity. The analog data that is collected through all these sensors will be converted to digital form and will be compared with the normal conditional signals and if a difference is found it is considered as an emergency and necessary actions will be taken and the soldier's current location will be collected by the base station. The

proposed system can be improved further by including a hand-held sensor device with additional sensing options such as Grove gas sensor to determine oxygen reflection in the environmental elements and the innovation in arduino to elevate the diverse local area for verbal commerce.

In this paper [10] proposes about the ways in which military can keep an account on the status of the soldier's health by monitoring the rate of the heartbeat, temperature of the body alongside the environmental conditions of their surroundings. The system also consists of an additional feature that allows the soldier to send the alert message or distress note to the control station if he is in the necessity of help. The base station is provided with the link pattern of the latitude and longitude so that they can track the soldier's location. The proposed system is also beneficial in providing conditions of the soldiers health by making use of the sensors such as the temperature sensors along with blood pressure sensors and oxygen level sensors which are attached to the soldiers along with a bag that carries the additional components like LCD, Batteries, GSM and PCB's, all of these are deployed with a personal server which will provide a connectivity with the administration station by making use of a wireless connection (GSM). The system that is proposed includes of two major functionalities as collecting the information's from the equipment's and transport the information via cloud computing. The advantage of the proposed system is the use of microcontroller which makes the system economical, whereas the limitation is that a GPS reception is put through a below par signal conditions of satellites.

Reference [11] talks about the concept of keeping a track of soldiers and also verifying each soldier's health status so that the army personnel can implement the responsive operations. The information's from the sensors will be fetched wirelessly using soldier's kit (LoRa). The information collected can be deployed for future analysis in the cloud. The proposed system by the author makes use of temperature sensor, body pressure sensor, ECG, Spo2 to examine the vitals and also makes use of an additional feature of using a manually pressing system to notify the emergency. The LoRa module used could be implemented in warzones with high-altitude where the WSN would find it difficult to transmit data or lacks the network coverage The LoRa module transmits the information's from all the sensors to the administration station where it also assists the soldiers with the indicator called as geo location indicator. This structure which uses LoRa is further integrated along with IoT to keep track and analyze the values.

The paper [12] discusses about the ability of the proposed system to trace the position of the soldiers and to keep an account of the health status which helps to reduce the time to perform the rescue operations. The system uses WBASNs likely humidity sensors, temperature sensor, pressure sensor etc. and GPS module. The information transmitted by the sensors along with the GPS receiver is transferred by Zig bee wirelessly to control unit. The information accumulated is updated on the thingspeak cloud platform for future analysis of the data. The above mentioned devices like WBASNs and the GPS are adhered to the body of the soldiers. The advantages being that the system can be used without any restrictions in the network. A better algorithm for routing could be used to make the system improve its efficiency, usage of LoraWAN alongside Zigbee helps to increase the data transmission.

The paper[13] addressed about, there are many concerns regarding soldier health and security, and hence the proposed system attaches many devices to the soldiers and indicate their health conditions and environmental condition by using various bio sensor networks like electrocardiogram(ECG) which is used

to sense the heart pulse rate and GPS modem which sends the geographical co-ordinate points with link pattern which helps to determine the exact position of soldier when they are in battlefield and helps in the rescue operation. GSM modem can operate either in 900 MHZ or 1800 MHZ frequency bands and it supports voice calls and data transfer along with the transmission of SMS. And when war occurs in the mountain region or in desert region GSM modem cannot be used as they wont be having any network access and to overcome this problem the system uses some wireless sensor that has Bluetooth and Wi Fi for security, safety and communication without any network interruption and the system can be implement by using raspberrypi OS this is one of the professional operating system and this includes gear for browsing , python program and a GUI desktop and in this system can also use the LCD 16\*2 this an electronic device use display data and the message. This proposed system acts a monitor system that helps in military operation in war zone or in rescue operations.

References [14] talks about that using sensor to monitor and also track the exact position of the soldier in military application. The objective of the work is location tracking of soldiers on battlefield using the sensors which mainly consists of two unit that is soldier unit and control room unit. The soldier unit mainly consists of microcontroller board that controls the overall process of sensing activity such as body temperature sensor, blood level sensor, etc. The system also uses LCD to display the value measured by the sensors and GPS can be used to determine the location of the soldier. The MCU Wi-Fi module is used to connect the soldier unit with the control room for communication activity. The control unit can keep tracking the location of soldier with help of desktop and monitoring using internet network. The control room to gets the respective information about soldiers health and environmental condition in the form of IP addresses with the help of internet.

The work referenced in [15] discussed about the many concerns regarding soldier's safety and security. This work mainly discusses about monitoring the health parameter of the soldier along with the actual location of the soldier. The implementation of the LoRa (Long Range) technique helps to transmitting the signals from the respective soldier to control room with a low data rate, at long distances. By using LoRa we can make a system that is better at low power and transmit at a high transmission power. Also mentions about components that are Arduino microcontroller which is mainly used for uploading the computer code to the physical board, similarly, to measure the temperature of the body temperature sensor LM35 is used and temperature can be measured more accurately with the help of thermistor. Also, the heart pulse rate can be measured by using pulse sensor and the concentration of atmospheric gas can be measured by using gas sensors. Accelerometers are integrated on the circuits or modules are used to measure an object's acceleration to which they are attached using which the soldiers motion can be monitored.

The paper [16] talks about many concerns about soldier health parameter. In this paper they mention about various smart sensors that are embedded to the soldier's body. Whenever the soldier's come in the vicinity of the enemies it becomes difficult to the army control station to know about the location as well as the health conditions of the soldiers, To overcome this problem every personnel in the army troop is provided with a GSM module which provides the opportunity for communicating with the control station if at all there are injuries. Also, Mentions about the various physiological sensors and Biomedical sensors for monitoring various environmental and health conditions of the soldiers.

In paper [17] discusses about the way of keeping the trace on the location of the soldiers using the technology of Internet of things (IOT). This method tries to replace the technologies like walkie-talkie, Zigbee and GSM module-based tracking system. The mentioned method includes two units namely; the hardware section and the software section, where the hardware unit includes sensors like DHT11(temperature and humidity sensor ), blood pressure sensor, heart rate sensor which will be interfaced using arduino programming, it also consists of interfacing display, power supply and micro controller. The server site (Apache http server) will monitor the results from the sensors and will be accessed by using Internet of Things (IOT) and also traces the location of the soldiers using GPS. Some of the limitations of the proposed model are: Loss of signal, High Installation cost.

In this article [18] explained the need of a tool for the security of the performance of the remote soldiers, keeping the status of the soldiers health and also tracing their current location by making use of Internet of Things technology. The proposed system is developed by making use of the biosensors such as heartbeat sensor, temperature sensor to monitor the health status and also makes use of GPS to track the location which are embedded on the soldiers jacket. In addition to this the project makes use of ESP8266 Wi-Fi module which is used to transfer the values continuously to base station and they are analyzed. The project can be improved further by adding the gas detective sensors.

Dnyaneshwar Theng et al[19] through the paper is discussing about monitoring the location of the soldiers making use of GPS along with monitoring the health parameters such as temperature sensor (LM 35) for body temperature monitoring, pulse rate(LM358) for pulse rate monitoring. These collected data will be sent to the base station using GSM module. If any variations is found in the heart rate or the pulse rate the information will be sent to base station to take the necessary actions along with the current location of the soldier using GPS. All these are deployed on the jacket for exchange of information between the soldier and the control unit or among the soldiers. The things speak platform is made used for wireless transmission of data. The data from GPS modem is RS-232 level data and hence it should be converted into 5V TTL/CMOS level using IC MAX232. The GPS and thingspeak used here makes use of Keil uvision software which is an IDE. The data from the soldiers side is transferred by using Zigbee Module for wireless communication.

The paper [20] discusses about the system that is a soldiers health tracking system which is designed based on that makes use of machine learning. the proposed system makes it possible for the army control room to keep continuous track on the soldiers location along with monitoring and updating regarding the health status of the soldiers with the help of biological sensors such as heart beat sensor, temperature sensor along with GPS and many other physiological sensors. The communication between the soldiers is done by transferring the data that are collected by the sensors as well as GPS using a wireless mode such as zig-bee module. for the communication between the head of the soldiers and the control room in the war zone where there is very poor cellular connectivity and in the war zone which prohibits data transmission, in such areas the proposed system suggests the usage of LoRaWAN network. for further analysis the data that are collected will be passed to the cloud and forecasted using the clustering algorithm known as k means clustering. the system uses Arduino uno as a processing device. the proposed project can be further improved by making use of renewable source of energy to power up such as solar harvesting module and also can integrate the camera to get the better information to the control room which helps in monitoring the actions of the soldiers.

The work referenced in [21] discussed about the ways of monitoring and tracking the health status of the soldiers using various sensors such as temperature sensor, pulse rate sensor and along with providing communication between the base station and soldiers as loss of connection is one of the major problems faced by the soldiers. The data that is collected from the sensors will be signal conditioned and later stored in the memory for further analysis. Also discusses about further improvement of services by hardware system optimization and also using the neural networks to improve the routing algorithm.

Reference talks [22] about keeping a track on the health of the soldiers by making use of IOT. This proposed system replaces the technologies those were used in the battlefields from decades like walkie-talkie etc. The system discussed here has two units in it; the hardware unit and the software unit. The hardware unit includes various hardware components like power supply, sensors, microcontroller and also the interfacing display. Similarly, the software section includes server-side scripting, internet, hardware programming and a web server. It also includes a database which helps in the soldier's health information storage.

### **3. CONCLUSION**

In this article, enlighten all the various possible ways with which it is possible to provide soldiers with various services by the country such as health monitoring and tracking system which helps the soldiers in the betterment of their performance and also protect them from some unforeseen conditions. Also emphasis the different ways in which communication can be established between the soldiers and the base station in the battlefield which helps the base station to take appropriate decisions in the time of critical situations, In this work, different ways in which the proposed projects can be improved so that better solutions can be provided to the soldiers who are facing the problems as explored.

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