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LoRa based conveying unit for armed force trooper monitoring system

Aanant V, Guhaneswar, Sharishkumar Gk, Mr.S.Elangovan

Student, ECE Department, Sri Venkateswara College of Engineering, Sriperumbudur,India
Student, ECE Department , Sri Venkateswara College of Engineering, Sriperumbudur,India
Student, ECE Department , Sri Venkateswara College of Engineering, Sriperumbudur,India
Assistant Professor, ECE Department, Sri Venkateswara College of Engineering, Sriperumbudur,India

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ABSTRACT-The Indian army is the land-based branch and it is the largest component of Indian Army. It will be beneficial for our country's safety if we try to provide them better advanced technology equipment. The proposed methodology gives us Long Range Radio (LoRa) based health monitoring and location tracking system for soldiers. This kind of advanced design can be mounted on the soldier's vest to ensure their safety. In case of any emergency for soldier, the controller intimates to the camp office control along with soldier's location. The proposed system comprises of wearable physiological sensors, GPS and transmission modules. The soldier's biometric and location status is monitored by the control room section with the help of a GUI. Hence, it is possible to implement a low cost mechanism to provide needed help in the battlefield. This information can also be used to devise war strategies as to how many more soldiers (and where) should be deployed to replace the martyrs. It helps to minimize the time, search and rescue operation efforts of army control unit.

Keywords— LongRange Radio (LoRa), GUI, Wearable Sensors, GPS

I. INTRODUCTION

The safety of soldiers is of utmost importance, and in recent years, various technologies have been developed to monitor their health and location in real-time. One such technology is the use of a soldier monitoring vest equipped with LoRa (Long Range) communication technology.Soldier Monitoring Vest using LoRa is a system that enables real-time tracking of soldiers' vital signs and location in combat zones. The system is designed to reduce the risk of casualties and enhance soldiers' safety. LoRa (Long Range) technology is used for wireless communication between the monitoring devices and the base station, providing a low-power, long-range communication solution. The system includes sensors that measure vital signs such as heart rate, body temperature, and blood oxygen level, a microcontroller, a LoRa module, and a base station.This model can be used to rescue soldiers under the following potential situations.

1.During combat operations, soldiers may become wounded or trapped in hostile environments. In such situations,the soldierscan be rescued using the GPS location.

2. If a soldier experiences a heart attack or other life-threatening condition, the sensors indicates the control room through a buzzer.

II.LITERATURE SURVEY

Victor Mora, Enrique Guzman, David Ruete, Jairo R.Coronado-Hernandez and Gustavo Gatica [8] proposed Cardio monitoring and geolocation control system for guards of the armed forces with LoRa technology in the year 2021.The current health status and location of the soldier can be monitored with the help of a GPS sensor and LoRa with necessary biometric sensor embedded in a prototype level system.The measured statistics validate if every guard has an appropriate heart rate, is in the assigned position, and requires collaboration. The results at the prototype level are satisfactory. Tests have been carried out in the Chilean Air Force. The project is in the process of validation by the responsible entities.

James Jin Kang, Wencheng Yang, GordanaDermody, MohammedrezaGhasemian, SasanAdibi, Paul Haskell-Downland [9] proposed No soldiers left behind: An IoT based low-power military mobile health system design in 2020.Low power wide area networks(LPWAN)and wireless body area networks is used to monitor the user's health s and location status. A multilayer

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interference system is used to conserve battery power of devices such as wearables and sensor devices. A Multilayer Inference System (MIS) was used to conserve the battery power of devices such as wearables and sensor devices. The results for this system showed a data reduction of 97.9% whilst maintaining satisfactory accuracy against existing single layer inference methods. Authentication accuracy can be further enhanced with additional biometrics and health data information.

VaibhaviWanjari, Chandra shekhar Kamarga onkar [10] designed a IoT based Cognitive Robot for Military Surveillance in the year 2020.In this model,a miniature size cognitive robot is done using LoRa technology for data transmission which is devised with episodic-like memory to observe protect remote spaces with multiple sensors.The objective is to contribute toward the realization of LoRa as a viable communication technology for military applications that needs long-range links and capability of maneuvering itself. NowadaysInternet of Things vision is constantly changing and developing assuchblynk app is used to display sensor data for real time communication.

P. Kanakaraja, S.V. Aswinkumer, B. Jaya Krishna, K. Sri hari, V. Mani krishna [11] proposed Communication through blackspot area using LoRa technology and IoT in 2021.The blackspot areas such as forests, hill stations, Islands, seas where connections can be established with the help of LoRa modules, GSM and biometric sensors with Raspberry Pi.Whenever we wish to transmit the message, we text the matter using the keypad at Transmitter board, The LoRa transmits the data to the reception board. GSM passes the passes the information to the Active center, if there is any emergency at that places, they can communicate with active center and the active center can reach them fast and easily.

III.PROPOSED WORKS

The existing works which was gathered, paved way for this proposed methodology to level up a bit considering the existing systems. After lot of research and analysis, additional vital sensors such as blood oxygen sensor, heart rate sensor and temperature sensor were added to monitor the soldier's vitals on a higher accuracy. The location of the soldier is monitored with the help of GPS sensor based on latitude and longitudinal coordinates. When compared to other existing systems, a user friendly user interface has been designed so that it provides a healthy environment for the user to monitor the vital status and location of the soldier effectively. The GUI consists of a homepage where the soldier's profile can be seen and a check button when pressed jumps to the cayenne IoT platform which shows the vital status and location. The sensors used here are cost effective and provide the status and vitals on a high level accuracy. The threshold values have been set and loaded on both the soldier and control room section. If the soldier's vitals drop below the pre-set threshold values, the control room section gets an emergency note on the LCD. The soldier's section has been soldered and fixed on a vest which is the whole point of the proposed methodology. This has become a wearable device now, as a successful prototype. The proposed methodology has been designed in such a way that many points of drawbacks from the pre-existing systems has been sorted out in the meantime and has been taken into consideration while designing the system.

IV.SYSTEM ARCHITECTURE

There are two main sections in this model, the Control room section and the Soldier room section. The block diagram representation of the system components of the Control room section is as shown in figure 1.

CONTROL ROOM SECTION:

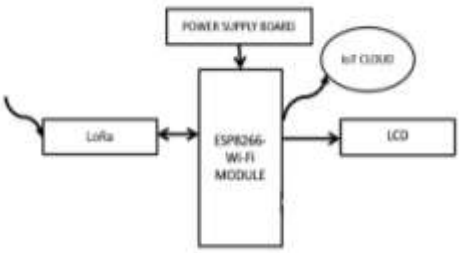

Fig. 1 Block diagram of the Control room section

LoRa, LCD, Arduino UNO, ESP32 wifi module are the major components used in the Control room section.Arduino UNO is aopen source microcontroller board based on the ATmega328P. LCD is interfaced with the Arduino UNO.The connections from LoRa receiver are given to the Arduino.The code has been written in Embedded C in such a way that it gets input from the soldier section.

The block diagram representation of the system components of the Soldier room section is shown is as shown in figure 2.

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SOLDIER ROOM SECTION:

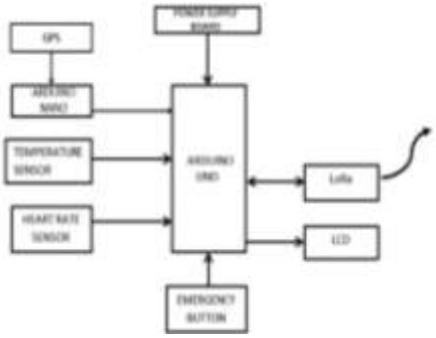

Fig. 2 Block diagram of the Soldier room section

LoRa, Arduino UNO, Arduino Nano, LM35 Temperature sensor, MAX30102 Heart rate sensor,NEO-6M GPS sensor are the major components used in this section.This section is dedicated to tracking and monitoring the soldier's vital signs and physical activity.The soldier section also have a rechargeable batteryto ensure that the monitoring equipment can operate for an extended period of time and can be considered asa reliable source of power.The use of a rechargeable battery ensures that the soldier can operate for extended periods without needing to replace or dispose of the battery, which is particularly important in combat situations where access to replacement batteries may be limited or non-existent.An Ammunition pouch tactical vest is used in the soldier section. The sensors and the other components are embedded within the vest.

GRAPHICAL USER INTERFACE:

Fig. 3 Homepage of user interface

Figma IDE has been used to design the template for user interface. The interface is designed in such a way that its user friendly. The homepage consist of soldier's profiles with a check status button, when pressed it jumps to a portal where soldier's heart rate, temperature and location (monitored based on latitude and longitude) will be shown. The status and location of the soldier is shown on Cayenne (an IoT platform) where the data from cloud is fed to Cayenne with the help of ESP8266 module in control room section. In that way, the status and location of the soldier will be reflected on Cayenne.

CAYENNE:

Fig. 4 Homepage of Cayenne

Cayenne, an IoT platform specifically designed for embedded and IoT projects. This platform has been used to show the vitals and location status of the soldier/wearer in a digitalized manner. The location of the soldier has been plotted in terms of latitude and longitude. The emergency button has two values 0 and 1, where 0 indicates "OFF" and 1 indicates "ON". The Cayenne has an historian of previous data which could be seen on the overview option.

V.CONCLUSION AND FUTURE WORKS

The proposed methodology is an economic friendly wearer device to monitor the vital status and location of the soldier, who is in the border from the base station (control room) with the help of control room section with the help of LoRa based network. These sensors are used to monitor the main vitals such as heart rate, blood-oxygen levels and body temperature and the location is monitored with the GPS sensor with very low power usage. Our proposed methodology could be the next big thing in the armed forces as it will be cost effective and more useful. LoRa unlike other networks transmits high data rate at a very low power consumption. The implementation of this whole methodology could bring immense change in the armed forces thereby reducing the amount of deaths or fatalities that could happen in the borders with the help of low per consuming communication networks.

The battery issue can be tackled in future with the help of Piezoelectric effect where the wearer's shoe can be implanted with piezoelectric plates. By piezoelectric effect, when the crystal gets compressed, it produces electric field. In that

phenomenon, a shoe containing piezoelectric plate, when pressed on ground, gets compressed and produces electricity which can be used to recharge the battery thereby acting as a charger. This method could reduce the usage of more number of batteries.

An application can be developed in such a way that instead of accessing the resources on another portal it can be interfaced under the same roof so that it's easily accessible for the user to track status and location of the soldier and more sensors can be used to track not only the soldier's location and status but also any hindrance in their path and extreme climate conditions should also be monitored in order to ensure the safety of soldier's life.

When GPS tracking isn't available on closed areas such as buildings, caves and etc., accelerometer and gyro can be used to track the movement of the soldier. An accelerometer is used to track motion while gyro can be used to track the direction. When these two gets synchronized they can be compared with the last known location of GPS sensor thereby, Soldier's location can be tracked even in closed areas.

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