School of Computer Science Engineering and Information Systems
M.Tech (Integrated) Software Engineering
WINTER 2023-2024

SOLDIER HEALTH MONITORING & TRACKING SYSTEM

Submitted for the Course

SWE 1901 : Technical Answers for Real World Problems (TARP)

Offered during WINTER 2023-2024

(Dr. R. K. Nadesh)

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Project Title: **SOLDIER HEALTH MONITORING & TRACKING SYSTEM**

1. Introduction

1.1 Background (System Study Details in brief)

There was very less and poor soldier health monitoring and tracking system used during the warfare's by the militaries. Though there were many other technologies also used, LoRa (Long Range) technology is a significant advancement in military operations. This project is designed to monitor the health parameters of soldiers and track their location in real-time, providing crucial data for operational efficiency and safety.

1.2 Problem Statement

In today's world, warfare plays a crucial role in any nation's security. Soldiers, who are at the forefront of these operations, often face harsh and unpredictable conditions. Their health and safety are of utmost importance. It has been a great challenge in identifying the soldiers whereabouts and also tracking their health in real time. Due to this many soldiers have lost their lives because of late rescues and late medications. The problem also lies in developing a system that can effectively monitor the health status and location of soldiers in real-time, transmit this data securely and reliably.

1.3 Abstract

Soldier Health Monitoring & Tracking System transforms military operations by providing real-time monitoring and tracking of soldiers' health parameters. Since the increase in rivalry among nations, more warfare has occurred in the recent times. The military and soldiers' safety are seen as playing a crucial role during the wars. The soldiers' inability to interact directly with the military control center is one of the main charges in military operations. Real-time GPS tracking and Lora technology installed in the control unit of the military camps are the greatest way to guarantee the security of these military soldiers. This technology not only ensures the safety of individual soldiers but also enables high commands to take decisions based on real-time data.

Using the LoRa module, a low-power, long-range LPWA modulation technology, this gadget is meant to record and send real-time data on soldiers' movements, positions and health conditions. The suggested technique is suitable for applications where data must be transferred over long distances while using less power. The soldier health monitoring & tracking system has the potential to increase military personnel's safety and effectiveness. LoRa technology, which enables long-distance communication with low power consumption, makes it ideal for usage in isolated locations or at hazardous or remote location. This method could help overcome the drawback of a missing soldier by identifying the exact location of any soldier who is in severe condition.

1.4 Literature Summary

2. Overview and Planning

2.1 Proposed System Overview

- **Sensors:** Soldiers will be connected to various sensors like heartbeat sensor, temperature sensor and GPS to monitor their vital signs and activity levels.

- **Transmitter Side:** The sensors continuously collect data from the soldiers and transmit it wirelessly to the receiver side. This transmission can be facilitated through LoRa.

- **Receiver Side:** The receiver side is responsible for receiving, processing and analysing the data from the transmitter side. It consists of a buzzer which identifies any abnormalities.

- **Location Tracking:** In addition to health monitoring, the system tracks the location of soldiers using GPS technology. This feature enables higher officials to know the whereabouts of the soldiers at all times, enhancing situational awareness and enabling quick response in emergencies.

- **Alerts:** The receiver side generates alerts with the help of buzzer connected to it in real-time to alert soldiers, commanders or medical personnel of any critical health issues or emergencies.

2.2 Challenges

- LoRa Ra-02 which operates only on 433MHz can be used legally for education purpose. We also have to follow other rules and standards.

- It might not work as well in certain places or weather conditions.

- Make sure that the soldiers’ data are kept private and secured.

2.3 Assumptions

- The project is built in such a way that less power is consumed by the components is very less so that the soldiers' data can be tracked for a longer period of time.

- The project is built in such a way that the components are lightweight for the soldiers to wear during the wars.

- The project assumes that immediate medical help can be provided to the soldiers based on the health data tracked on the receiver side.

2.4 Methodology and Architecture Specifications

Methodology:

- **Requirement Analysis:** Identify key requirements such as types of sensors, monitoring parameters, range, battery life, data security and technology to be used.

- **Prototype Building: (Hardware)** Developing the prototype by fixing all the components and connecting them.
  (Software) Writing code for the ATMega328p

- **Data Collection:** With the help of various sensors, we collect various data like pulse rate, body temperature and location.

- **Evaluation:** The collected data from the transmitter side and receiver side are evaluated based on the values produced by the sensors, conducting thorough tests to validate if the project works properly and also checking the metrics of the project.

Architecture Specifications:

- **Sensor Nodes:** The proposed system is equipped with sensors for monitoring vital signs like heart rate, body temperature and location tracking. LoRa transceiver for long-range communication with LoRa receiver. Power supply connected to all components and sensors for data transmission.

- **LoRa Transceiver:** This is used for long-range communication. It connects to the sensors and the GPS module via ATMega328p and collects the data, transmits it to the LoRa receiver.

- **LoRa Receiver:** This receives the data from the LoRa transceiver and forwards it to the ATMega328p where the data is processed.

2.5 Realistic Constraints and Standards

Realistic Constraints:

- **Power Consumption:** The components and sensors in the project should operate on limited battery power, facilitating efficient power management to prolong battery life.

- **Range and Coverage:** LoRa technology offers long-range communication, but the operational range may still be limited by environmental factors like terrain and obstacles.

- **Data Rate:** LoRa technology has lower data rates compared to other wireless technologies like Wi-Fi or cellular networks, which may affect the frequency and volume of data transmission.

- **Security:** Ensuring the security of transmitted data is crucial, especially in military applications. Encryption and authentication mechanisms must be implemented to protect sensitive information from unauthorized access.

Standards:

- **Wireless Communication Standards:** The system would use wireless communication standards for the transmission of data. This includes standards for data rates, frequencies, and power levels.

- **Health Data Standards:** The health data collected from the soldiers would need to adhere to certain standards to ensure accuracy and reliability. This could include standards for heart rate monitoring, temperature measurement, and other vital signs.

- **GPS Standards:** The system would use GPS standards for tracking the location of the soldiers.

2.6 SWOC Analysis

Strengths:

- **LoRa Technology:** Utilizing LoRa technology enables long-range communication, making it suitable for tracking soldiers even in remote or difficult terrains.

- **Real-time Monitoring:** The project enables real-time monitoring of soldiers' health metrics, allowing for timely intervention in case of emergencies.

- **Data Accuracy:** LoRa provides reliable data transmission, ensuring accurate health metrics monitoring.

- **Cost-effective:** LoRa technology tends to be cost-effective, which could make implementation feasible, especially for military applications.

- **Battery Life:** LoRa devices typically have long battery life, ensuring prolonged monitoring without frequent recharging.

Weaknesses:

- **Limited Bandwidth**: It's like having a small pipeline for information, so we can't send everything we might want.

- **Interference:** Sometimes other devices might "talk" at the same time, which could mess up our communication.

- **Security Concerns**: There's a risk of someone sneaking into our health data, so we need to be careful.

- **Setup Complexity:** It might take some time to set up the technology correctly.

Opportunities:

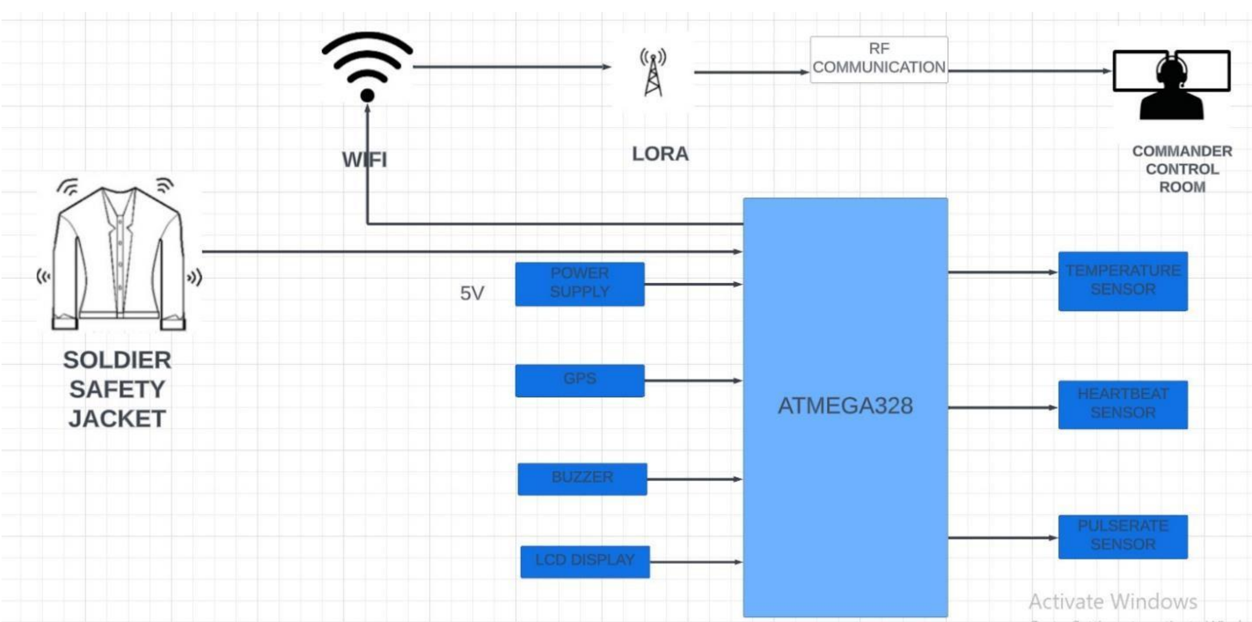
- **Military Uses:** We can use this technology for more than just health tracking, like keeping track of equipment or monitoring areas.
- **Partnerships**: Working with other groups could help us make the technology even better.
- **Expanding to Civilians**: This could also help people outside the military, like monitoring patients at home.

Challenges:

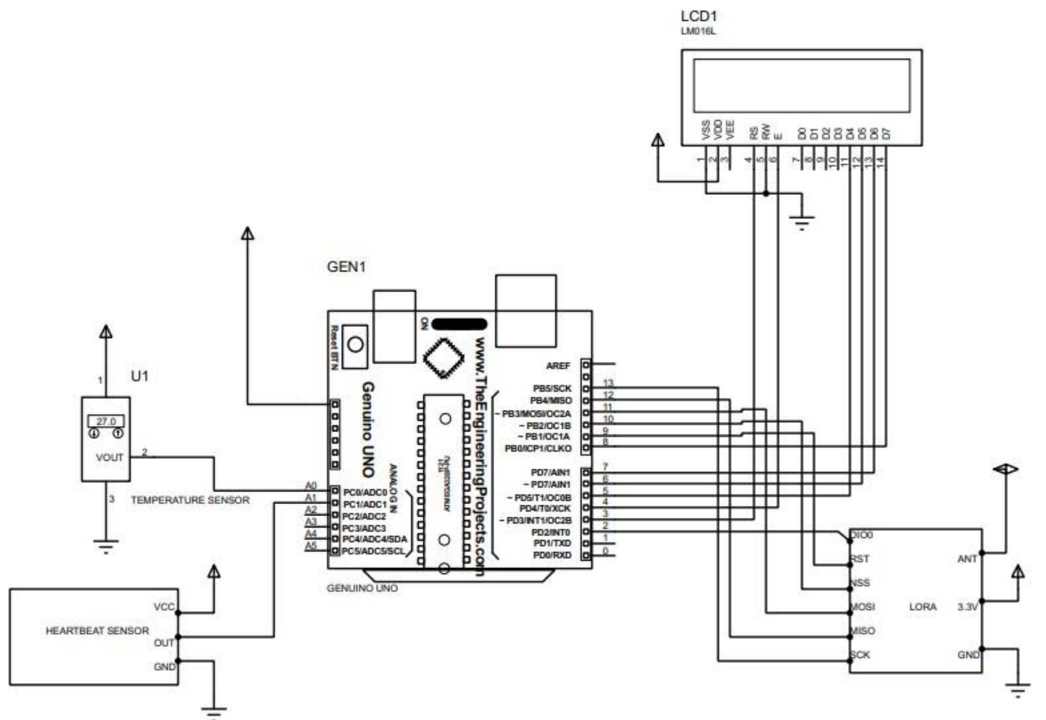
- **Regulations**: We have to follow certain rules and standards, which can be tough.
- **Different Environments**: It might not work as well in certain places or weather conditions.
- **Integration**: Making sure our new system works well with what the military already uses could be tricky.
- **Privacy**: We need to make sure we're only looking at health data that we're supposed to and keeping it safe.
- **Maintenance**: Keeping everything running smoothly over time, especially in tough conditions, is a big job.

3. System Design

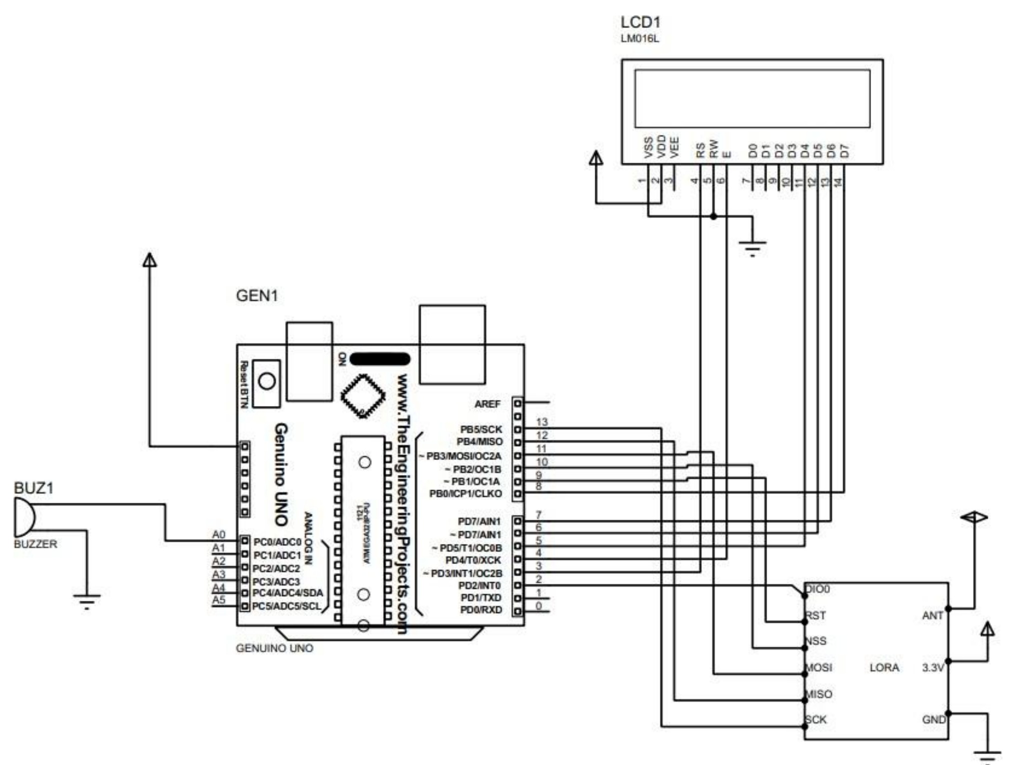
3.1 High-Level Design



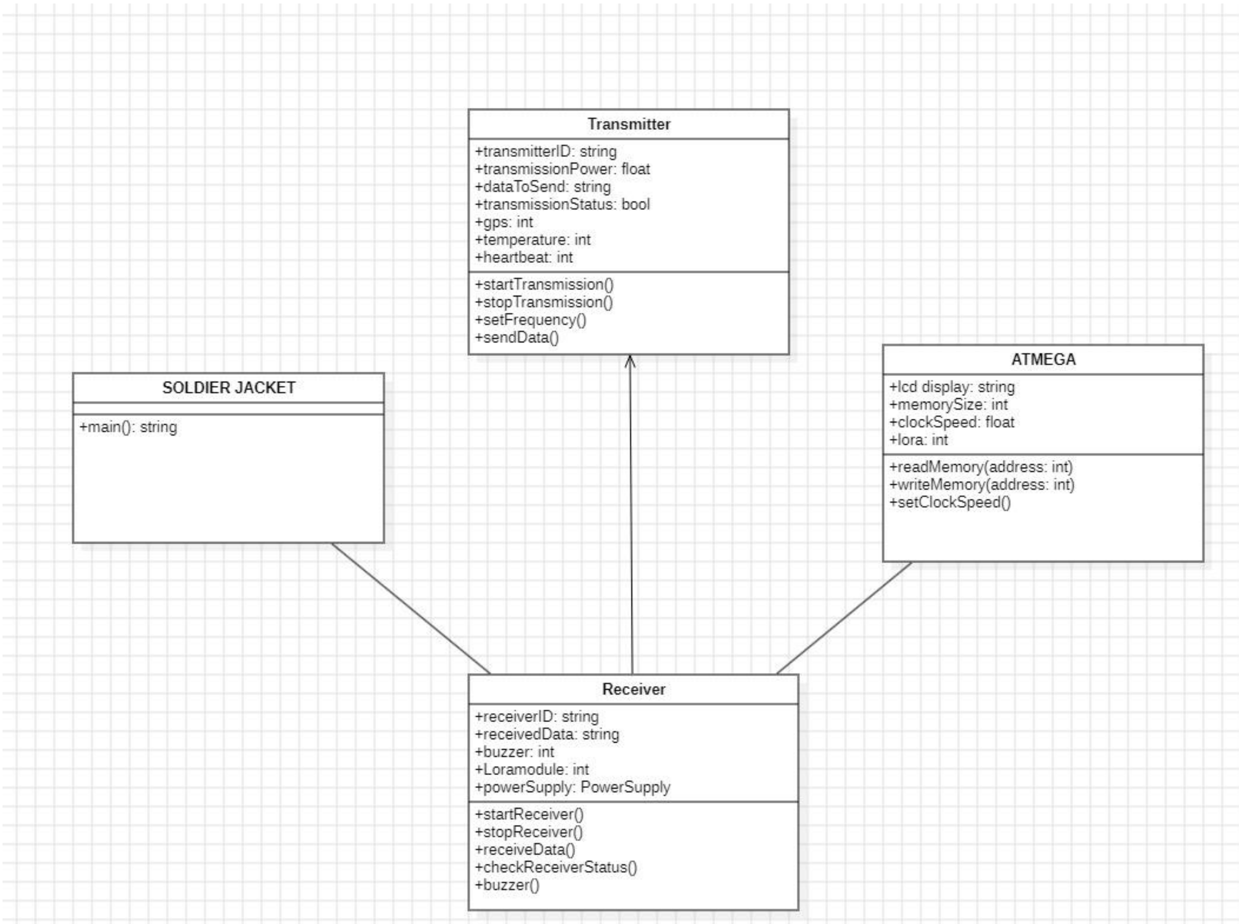
TX Side



RX Side



3.2 Low-Level Design



4. System Implementation

4.1 Module Development –Code

Transmitter Side (TX)

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(3,4,5,6,7,8);
#include <SPI.h>
#include <LoRa.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
TinyGPSPlus gps;
SoftwareSerial ss(A5,A4);
#define pulsesensor A1
int temperaturesensor=A0;
int temperature,hb=0,h=0,count,val;

void Lora_send();
void Lora_Decimal3(int);
```

```
void Lcd4_Decimal3(int, int, int);
void gps_loc();
void setup()
{

  lcd.begin(16, 2);
  lcd.setCursor(0,0); lcd.print(" SOLDIER HEALTH ");
  lcd.setCursor(0,1); lcd.print(" LORA SYSYEM TX ");
  delay(3000);
  Serial.begin(9600);
  ss.begin(9600);
  lcd.clear();
  lcd.setCursor(0,0);
  if (!LoRa.begin(433E6))
  {
    lcd.print("LoRa failed!    ");
    while (1);
  }
  else{lcd.print("LoRa is Ready    ");}

  delay(100);
  lcd.clear();
}

void loop()
{
   gps_loc();
   temperature = analogRead(temperaturesensor);
   temperature = temperature/4;
   temperature = temperature-115;
   if(hb>2)
   {
    (millis() / 1000);
         if(val!=(millis() / 1000)){ val=(millis() / 1000);count++; }
   }
         if(count>10){h=hb*6;}
   if(digitalRead(pulsesensor)==LOW)
      {
         while(digitalRead(pulsesensor)==LOW);hb++;
      }

  lcd.setCursor(0,0);  lcd.print("T:"); Lcd4_Decimal3(2,0,temperature);
  lcd.setCursor(0,1);  lcd.print("H:"); Lcd4_Decimal3(2,1,h);
  lcd.setCursor(6,0);  lcd.print(gps.location.lat(), 6);
  lcd.setCursor(6,1);  lcd.print(gps.location.lng(), 6);
```

```
  LoRa.beginPacket();
  Lora_Decimal3(temperature);
  LoRa.print(':');   Lora_Decimal3(h);
  LoRa.print(':');
  LoRa.print(gps.location.lat(), 6);
  LoRa.print(':');
  LoRa.print(gps.location.lng(), 6);
  LoRa.print(':');
  LoRa.println();
  LoRa.endPacket();
  delay(500);
  Serial.print(gps.location.lat(), 6);
  Serial.print(":");
  Serial.println(gps.location.lng(), 6);
  if(count>10){hb=0;count=0;val=0;}
}
void gps_loc()
{
  while (ss.available() > 0)
  {
    gps.encode(ss.read());
    if (gps.location.isUpdated())
    {
      ;
    }
  }
}

void Lcd4_Decimal2(int clm, int row, int num)
{
    unsigned int ans1,ans2;
    ans1=num/10;
    ans2=num%10;

    lcd.setCursor(clm+0, row+0);  lcd.print(ans1);
    lcd.setCursor(clm+1, row+0);   lcd.print(ans2);
}

void Lcd4_Decimal3(int clm, int row, int num)
{
    unsigned int ans1,ans2,ans3,a;
    ans1=num/100;
    a=num%100;
    ans2=a/10;
```

```
    ans3=a%10;

    lcd.setCursor(clm+0,  row+0);  lcd.print(ans1);
    lcd.setCursor(clm+1,  row+0);  lcd.print(ans2);
    lcd.setCursor(clm+2, row+0);  lcd.print(ans3);
}

void Lora_Decimal3(int val)
{
    unsigned int ans1,ans2,ans3,a;
    ans1=val/100;
    a=val%100;
    ans2=a/10;
    ans3=a%10;
    LoRa.print(ans1);
    LoRa.print(ans2);
    LoRa.print(ans3);
}
```

Receiver Side (RX)

```
#include <SPI.h>
#include <LoRa.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(3,4,5,6,7,8);

#define alarm  A0


void Lcd4_Decimal2(int, int, int);
void Lcd4_Decimal3(int, int, int);
void Lora_Event();
void Lora_Received();
int  Receive=1;//lora
char data[52];
int ind=0;
int t,h;
char latitude[10],longitude[10];

void setup()
{
  pinMode(alarm, OUTPUT);
  digitalWrite(alarm, LOW);

  Serial.begin(9600);
```

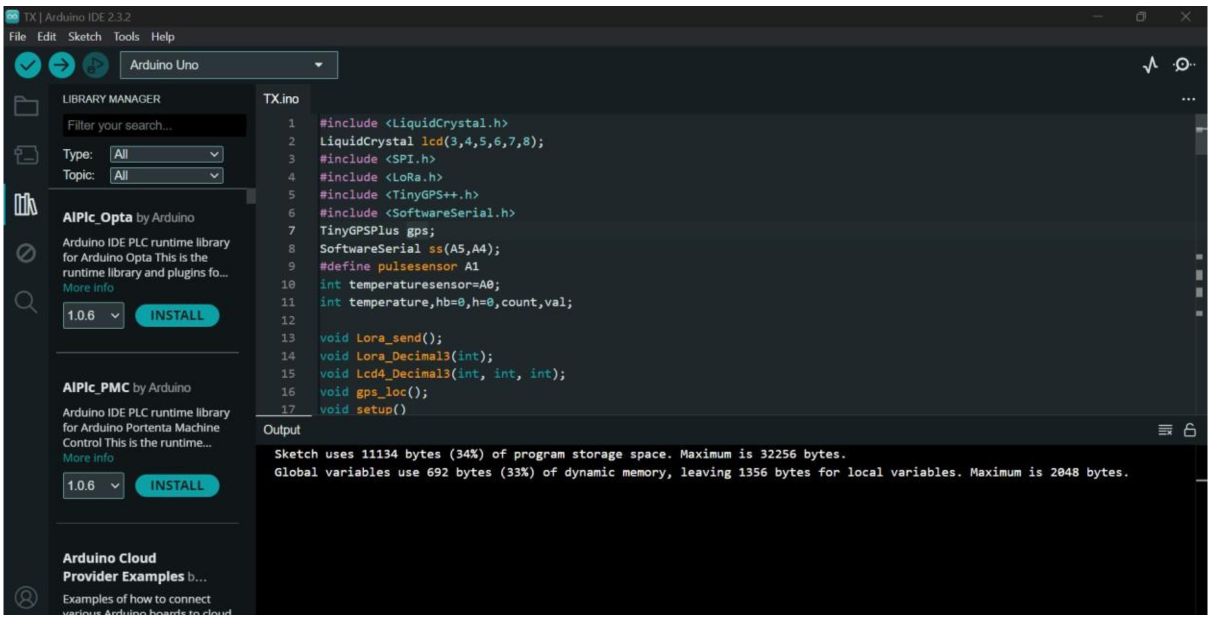
```
  while (!Serial);
  Serial.println("LORA RX");

  lcd.begin(16, 2);
  lcd.setCursor(0,0);
  lcd.print(" SOLDIER HEALTH ");
  lcd.setCursor(0,1);
  lcd.print(" LORA SYSTEM RX ");
  delay(2000);
  lcd.clear();
  lcd.setCursor(0,0);
 if (!LoRa.begin(433E6))
  {
    lcd.print("LoRa failed!     ");
    while (1);
  }

  else{lcd.print("LoRa is Ready    ");}
  delay(100);
  lcd.clear();
}

void loop()
{

 Lora_Event();

  lcd.setCursor(0,0);  lcd.print("T:"); Lcd4_Decimal3(2,0,t);
  lcd.setCursor(0,1); lcd.print("H:");Lcd4_Decimal3(2,1,h);
  lcd.setCursor(6,0); lcd.print(latitude);
  lcd.setCursor(6,1);  lcd.print(longitude);
  if(t>40){digitalWrite(alarm, HIGH);}
  else if(h>100){digitalWrite(alarm, HIGH);}
  else{digitalWrite(alarm, LOW);}


}

////////////////////////////////////////////////////////////////////////////////////
////////////
void Lora_Event()
{
  int packetSize = LoRa.parsePacket();
    if (packetSize)
     {
```

```
     // if (!LoRa.available()) {Lora_send();}
        while (LoRa.available())
            {
             if(Receive==1)
                {
                 //123:123  //temp:rate
                 data[ind]=(char)LoRa.read();
                 if(data[ind]!='\n'){ind++;}
                 if(data[ind]=='\n'){Receive=0; Lora_Received(); Receive=1;}
                 if(ind>50){ind=0;}
                }
             }

  }
}

/////////////////////////////////////////////////////////////////////////////////////
/////
void Lora_Received()
{
 //123:123  //temp:rate
          t = (data[0 ]-'0')*100 + (data[1 ] -'0')*10 + (data[2 ]-'0')*1;
          h = (data[4 ]-'0')*100 + (data[5 ] -'0')*10 + (data[6 ]-'0')*1;
          for(int i=0;i<9;i++){latitude[i]=data[8+i];}
          for(int j=0;j<9;j++){longitude[j]=data[18+j];}
 data[ind]=' ';
 ind=0;
 Serial.println(data);
}

//////////////////////////////////////////////
void Lcd4_Decimal2(int clm, int row, int num)
{
    unsigned int ans1,ans2;
    ans1=num/10;
    ans2=num%10;

    lcd.setCursor(clm+0, row+0);  lcd.print(ans1);
    lcd.setCursor(clm+1, row+0);  lcd.print(ans2);
}

//////////////////////////////////////////////
void Lcd4_Decimal3(int clm, int row, int num)
{
    unsigned int ans1,ans2,ans3,a;
```

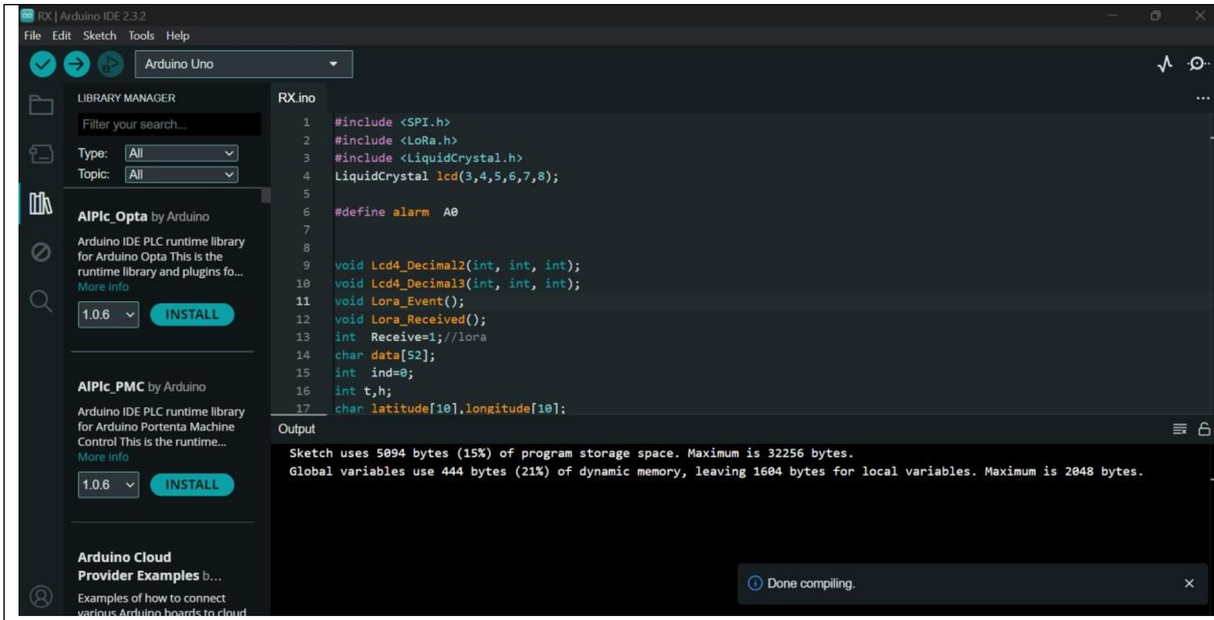
```
    ans1=num/100;
    a=num%100;
    ans2=a/10;
    ans3=a%10;

    lcd.setCursor(clm+0,  row+0);  lcd.print(ans1);
    lcd.setCursor(clm+1,  row+0);  lcd.print(ans2);
    lcd.setCursor(clm+2, row+0);  lcd.print(ans3);
}
```

4.2 Output/Results

TX Side



RX Side



4.3 Discussion

- **TX Side** – In the transmitter side, the SPI module is used for synchronizing communications within ATMega328p and the LCD of the transmitter module. The body temperature, location and heartbeat are calculated with the help of temperature sensor, GPS and heartbeat sensors respectively. These values are displayed in the LCD and are also transmitted to the receiver side using LoRa Transmitter.

- **RX Side** – In the receiver side, the LoRa Receiver receives the data from the transmitter side and sends them to the ATMega328p. The ATMega328p calculates according to the conditions set for the data and if the data varies from the given condition, an alarm is invoked to warn us. The SPI module is used for synchronizing communications within ATMega328p and the LCD of the receiver module.

5. Conclusion and Future Developments

Conclusion:

A soldier health monitoring and tracking system using LoRa technology holds great promise, it requires careful design and implementation to ensure it meets the unique demands of military operations. With advancements in technology and further research, such systems can potentially revolutionize the way military operations are conducted, contributing to the safety and well-being of soldiers.

Future Development:

- **Advanced Sensors:** The integration of more advanced sensors to monitor a wider range of health parameters such as blood pressure, oxygen levels and stress levels, could provide a more comprehensive overview of a soldier's health

- **Improved Communication:** Future systems could leverage advancements in LoRa technology to improve the range, reliability and power efficiency of the communication between the sensors and the central monitoring station.

- **Enhanced Security:** As the security of the health data is crucial, future systems could incorporate more advanced encryption and security protocols to protect the data from potential threats.

- **Integration with Military Equipment**: Future systems could be more seamlessly integrated with the soldier's protective vest, making them more comfortable to wear and less likely to interfere with the soldier's duties.

6. References

1. Nikam S, Patil S, Powar P, Bendre VS. GPS based soldier tracking and health indication system. Int J Adv Res Electr Electron Instrum Eng. 2013;2(3):1082.

2. Khan A, Sabeenian RS, Cindiya R, Deenan B. Soldiers Health Monitoring and Position Tracking System. Sona College of Technology, Salem, Tamil Nadu, India; [correspondence to] ayubkhan.slm@gmail.com. [Professor and Head] sabeenian@sonatech.ac.in. [Student] cindiya2017@gmail.com. [Student] deenan241b@gmail.com.

3. Patil A, Shelake B, Pinjari R, Mirajkar PP. GPS Based Soldier Tracking and Health Monitoring. Annasaheb Dange College of Engineering and Technology, Ashta, Maharashtra, India. International Research Journal of Engineering and Technology (IRJET). 2017;4(3):1659-1661. e-ISSN: 2395-0056, p-ISSN: 2395-0072. Published online Mar 2017 on www.irjet.net. Impact Factor value: 5.181. ISO 9001:2008 Certified Journal.

4. Chakravarthi P, Natarajan S, Bennet MA. GSM BASED SOLDIER TRACKING SYSTEM AND MONITORING USING WIRELESS COMMUNICATION. Vel Tech, Chennai, India. International Journal on Smart Sensing and Intelligent Systems. 2017;10(5):260-267. Published online Sep 1, 2017.

5. Gondalia A, Dixit D, Parashar S, Raghav V, Sengupta A, Sarobin VR. IoT-based Healthcare Monitoring System for War Soldiers using Machine Learning. Procedia Computer Science. 2018;133:1005-1013. Available from: https://doi.org/10.1016/j.procs.2018.07.075.

6. Kulkarni P, Kulkarni T. Secure Health Monitoring of Soldiers with Tracking System using IoT: A Survey. International Journal of Trend in Scientific Research and Development. 2019 May-Jun;3(4):693.

7. Hari Krishna J, Pramoth R, Anoint Joshua Paul J, Abhishek S, Prabhu T. Soldiers health monitoring and tracking system using IOT and UAV. Student, Department of Electronics and Communication Engineering, SNSCT, Coimbatore, Tamilnadu. Assistant professor, Department of Electronics and Communication Engineering, SNSCT, Coimbatore, Tamilnadu. hari41014@gmail.com. Special Issue of First International Conference on Science, Technology & Management (ICSTM-2020).

8. Muthusamy S, Pandiyan S, Paramasivam M. A Novel GPS based soldier health monitoring and position tracking system. Research Article. Kongu Engineering College, Saveetha Engineering College; 2022 Jul 6. Available from: https://doi.org/10.21203/rs.3.rs-1773317/v1.

9. Kruthikaran V, Nandhu S, Sakthi Krishnan K, Sajan P Philip. LORA BASED SOLDIER TRACKING AND HEALTH MONITORING DEVICE. International Research Journal of Engineering and Technology (IRJET). 2023 Mar;10(03):426.

10. Rao HS, Kumar NNH, Gowda NR, Jeevan S, Ashwini R. Novel wearable health monitoring and tracking system for soldiers based on IoT. Int Res J Modernization Eng Technol Sci. 2023 May;05(05):[page range]. DOI: https://www.doi.org/10.56726/IRJMETS39806.

11. Lim HB, Ma D, Wang B, Kalbarczyk Z, Iyer RK, Watkin KL. A soldier health monitoring system for military applications. In2010 International Conference on Body Sensor Networks 2010 Jun 7 (pp. 246-249). IEEE.

12. Nikam S, Patil S, Powar P, Bendre VS. GPS based soldier tracking and health indication system. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. 2013 Mar;2(3):1082-8.

13. Bhivarkar MV, Asole AG, Domkondwar PB. IOT and GPS based soldier position tracking and health monitoring system. International Journal of Emerging Technologies in Engineering Research (IJETER). 2018;6:47-50.

14. Vithiya R, Karthika S, Sharmila G. Detection, monitoring and tracking of survivors under critical condition using Raspberry-Pi. In2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN) 2019 Mar 29 (pp. 1-5). IEEE.

15. Eliyaz M, Prudvi ML, Reddy GP, Pavan M. Soldier Tracking and Health Monitoring System using LabVIEW. International Journal. 2020 May;8(5).

16. Devi MA, Kumar MN, Rajesh N, Nitheshwaran S. Real Time Tracking And Health Monitoring Of Soldiers Using Gps And Gsm Module. International Research Journal of Engineering and Technology. 2021;8(5):120-1.

17. Sabarimuthu M, Krishna MP, Sundari PM, Aarthi L, Juhair PM, GowthamRaj G. IoT Based Soldier Status Monitoring Using Sensors and SOS Switch. In2022 Second International Conference on Computer Science, Engineering and Applications (ICCSEA) 2022 Sep 8 (pp. 1-6). IEEE.

18. Rajini SN, Veeramanickam MR, Anuradha K, Marappan R, Kirubadevi T, Bharathiraja N, Chandrakala T, Bhaskaran S. Soldier's Position Tracking & Health Monitoring Optimization Model Using Biosensors. In2023 International Conference on Computer Communication and Informatics (ICCCI) 2023 Jan 23 (pp. 1-4). IEEE.

19. Prabagar S, Reddy CS, Murthy CR, Kumar GH. Cloud based Location Tracking and Controlling Parameters System Implementation for Armed Forces in the War field. In2023 Third International Conference on Artificial Intelligence and Smart Energy (ICAIS) 2023 Feb 2 (pp. 471-475). IEEE.

20. Devi SS, Lakshana S, Pavithra SV, Roshini SR. LoRa based Smart Soldier Jacket. In2023 Second International Conference on Augmented Intelligence and Sustainable Systems (ICAISS) 2023 Aug 23 (pp. 1391-1395). IEEE.

21. Patii N, Iyer B. Health monitoring and tracking system for soldiers using Internet of Things (IoT). In2017 international conference on computing, communication and automation (ICCCA) 2017 May 5 (pp. 1347-1352). IEEE.

22. Jain Y, Soni B, Goyal A, Sharma C. Novel wearable device for health monitoring and tracking of soldiers based on LoRa module. In2020 IEEE 4th Conference on Information & Communication Technology (CICT) 2020 Dec 3 (pp. 1-5). IEEE.

23. Priyanka JS, Deshpande A, Mourya GR, Kumar A. Soldier Safety using GPS and GSM Modem. In2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA) 2021 Sep 2 (pp. 49-53). IEEE.

24. Prasanna JL, Kumar MR, Santhosh C, Kumar SA, Kasulu P. IoT based Soldier Health and Position Tracking System. In2022 6th International Conference on Computing Methodologies and Communication (ICCMC) 2022 Mar 29 (pp. 417-420). IEEE.

25. Thakre L, Patil N, Kapse P, Potbhare P. Implementation of soldier tracking and health monitoring system. In2022 10th International Conference on Emerging Trends in Engineering and Technology-Signal and Information Processing (ICETET-SIP-22) 2022 Apr 29 (pp. 01-05). IEEE.

26. Buddhi D, Joshi A. Tracking Military soldiers Location and Monitoring Health using Machine Learning and LORA model. In2022 IEEE 2nd Mysore Sub Section International Conference (MysuruCon) 2022 Oct 16 (pp. 1-6). IEEE.

27. Veerasamy B, Durga BG, Kumaran TH, Devika IV, Akshaya MJ. Soldier Health Detection and Position Tracking System using LoRaWAN Sensor for Low Power and Long-Range Access. In2023 7th International Conference on Trends in Electronics and Informatics (ICOEI) 2023 Apr 11 (pp. 9-13). IEEE.

28. Aggarwal A, Kumar V, Singhal V, Yadav R. Soldier Health and Position Tracking System. In2023 International Conference on Sustainable Emerging Innovations in Engineering and Technology (ICSEIET) 2023 Sep 14 (pp. 1-5). IEEE.

29. Manoje BM, Tamilarasan V, Yusuf AM, Vishwa S, Rengan PK. IoT based Military Health Service in Battle Field and GPS Tracking. In2023 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS) 2023 Mar 23 (pp. 1538-1542). IEEE.

30. Narra R, Naguboiana LP, Nallapaneni S, Pandalaneni LP. Implementation of IoT-based Para Commando Helpro Kit with GPS Tracking System using LoRa. In2023 7th International Conference on Trends in Electronics and Informatics (ICOEI) 2023 Apr 11 (pp. 383-390). IEEE.

31. Akshay P, Balaji S, Raju P, Mirajkar PP. GPS based soldier tracking and health monitoring. Department of ETC engineering. 2017 Mar;40(03)

32. Mallikarjun BC, Kiranmayi KJ, Lavanya N, Prateeksha KH, Sushmitha J. Intruder Detection System-A LoRa Based Approach. In2020 5th International Conference on Communication and Electronics Systems (ICCES) 2020 Jun 10 (pp. 255-258). IEEE.

33. Michaelis J, Morelli A, Raglin A, James D, Suri N. Leveraging LoRaWAN to support IoBT in urban environments. In2019 IEEE 5th World Forum on Internet of Things (WF-IoT) 2019 Apr 15 (pp. 207-212). IEEE.

34. Chhabra JS, Chhajed A, Pandita S, Wagh S. GPS and IoT based soldier tracking & health indication system. International Research Journal of Engineering and Technology (IRJET). 2017 Jun;4(06):1228-32.IEEE

35. Shende DH, Pohekar KV, Gaydhane AS, Bakhade SS, Nagne KB. GPS Based Real Time Soldier Tracking and Health Indication System.IEEE

36. Archana Padikar A, Cinmayee CK, Chaithra E, Chethan PK. Health monitoring and soldier tracking system using IOT. Int J Eng Res Technol. 2020;8:14.IEEE

37. Sakthi P, Vishnuram T, Satheeshkumar N, Sathishkumar SB. IoT-based Real-Time *System for Tracking and Monitoring the Health of Soldier. In2023 Second International Conference on Electronics and Renewable Systems (ICEARS) 2023 Mar 2 (pp. 531-536). IEEE*

38. Michaelis J, Morelli A, Hernandez L, James D, Freeman J, Suri N. LoRaWAN Testing for Military Communications in Urban Environments. In2021 IEEE 7th *World Forum on Internet of Things (WF-IoT) 2021 Jun 14 (pp. 885-890). IEEE*

39. Narra R, Naguboiana LP, Nallapaneni S, Pandalaneni LP. Implementation of IoTbased Para Commando Helpro Kit with GPS Tracking System using LoRa. In2023 7th International Conference on Trends in Electronics and Informatics (ICOEI) 2023 Apr 11 (pp. 383-390). IEEE.

40. Ganesh SJ, Dhivya K, Kannagi V, Rajkumar M, Suriya N. LoRa Assisted Intelligent Troop Tracking and Location Monitoring System over Defense Environment. In2022 6th International Conference on Computing Methodologies and Communication (ICCMC) 2022 Mar 29 (pp. 288-294). IEEE.

41. Devala S, Karthikeyan A. LoRa technology-an overview. Proceedings of the 2nd International Conference on Electronics, Communication and Aerospace Technology (ICECA 2018); 2018.

42. Gondalia A, Dixit D, Parashar S, Raghav V, Sengupta A. IoT-based Healthcare Monitoring System for War Soldiers using Machine Learning. Procedia Comput Sci. 2018;133:1005-1013.

43. B.C. Mallikarjun, K.J. Kiranmayi, N. Lavanya, H. Prateeksha, J. Sushmitha. Intruder Detection System - A LoRa Based Approach. In: Proceedings of the Fifth International Conference on Communication and Electronics Systems (ICCES 2020); 2020.

44. Gaikwad NB, Ugale H, Keskar A, Shivaprakash NC. The Internet-of-Battlefield-Things (IoBT)-Based Enemy Localization Using Soldiers Location and Gunshot Direction. IEEE Internet Things J. 2020 Dec;7(12).

45. Priyanka S, Deshpande A, Mourya GR, Kumar A. Soldier Safety using GPS and GSM Modem. In: Proceedings of the Third International Conference on Inventive Research in Computing Applications (ICIRCA-2021); 2021.

46. Sharma MK, Singal G, Gupta SK, Chandraneil B, Agarwal S, Garg D, Mukhopadhyay D. INTERVENOR: Intelligent Border Surveillance using Sensors and Drones. In: Proceedings of the 2021 6th International Conference for Convergence in Technology (I2CT); 2021 Apr 02-04; Pune, India.

47. Kumar CA, Ajmera S, Kumar B, Srikar D, Prasad SVS, Datta JR. Real-time embedded electronics using wireless connection for soldier security. In: International Conference on Advancements in Smart, Secure and Intelligent Computing (ASSIC); 2022.

48. Devi SS, Lakshana S, Pavithra SV, Roshini SR. LoRa based Smart Soldier Jacket. In: Second International Conference on Augmented Intelligence and Sustainable Systems (ICAISS 2023); 2023.

49. Lloyd DG, Saxby DJ, Pizzolato C, Worsey M, Diamond LE, Palipana D, Bourne M, Cardoso de Sousa A, Mannan MMN, Nasseri A, Perevoshchikova N, Maharaj J, Crossley C, Quinn A, Mulholland K, Collings T, Xia Z, Cornish B, Devaprakash D, Lenton G, Barrett RS. Maintaining soldier musculoskeletal health using personalised digital humans, wearables and/or computer vision. J Sci Med Sport. 2023;26(Suppl 1):S30-S39.

50. Vadivel M, Vimal SP, Sivakumar VG, Vijaya Baskar V, Selvi M. Internet based Defence Surveillance Robot to Prevent Intruder Activities and Auto Combat System using SONAR Technology. In: International Conference on Innovative Data Communication Technologies and Application

(ICIDCA-2023); 2023.