IOT BASED MILITARY HEALTH SERVICE IN BATTLE FIELD AND GPS TRACKING

A PROJECT REPORT

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Finally, we sincerely acknowledged in no less term for all our staff members, colleagues, our parents and friends for their co-operation and help at various stages of this project work.

DECLARATION

I hereby declare that the work entitled **"IOT BASED MILITARY HEALTH SERVICE IN BATTLE FIELD AND GPS TRACKING"** is submitted in partial fulfillment of the requirement for the reward of the degree in B.E., Anna University, Chennai, is a record of our own work carried out by me during the academic year 2022-2023 under the supervision and guidance of Mr. P. KASTHURI RENGAN, M.E, Assistant professor, Department of Computer Science and Engineering, K.Ramakrishnan College of Engineering (Autonomous). The extent and source of information are derived from the existing literature and have been indicated through the dissertation at the appropriate places. The matter embodied in this work is original and has not been submitted for the award of any degree or diploma, either in this or any other University.

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ABSTRACT

Now a days, preserving national security is of utmost importance and a key aspect of this is the battlefield. The soldiers in the army play a crucial role in ensuring safety and protection for the country. To ensure their safety, various measures are taken, including the use of advanced medical monitoring instruments integrated into their equipment. These instruments consist of a range of biosensors, peltier crystals, and transmission systems with processing capabilities, enabling low cost wearable health monitoring solutions. Thermal jacket which gives better protection to them who are working in extreme weather conditions. Additionally, GPS technology is used to calculate latitude and longitude of soldiers, facilitating easy tracking and direction finding. In fact, some militaries are even considering embedding GPS devices into the vests and uniforms of their soldiers, enabling real-time monitoring by a central base station. In case of an urgent situation, the soldier has the capability to communicate with the server by pressing a button on the keypad connected to the device. The software running on a PC to monitors the status of the Server Unit, and the relevant information is exhibited on an LCD display.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
IOT	Internet of Things
GPS	Global Positioning System
UIDs	Unique Identifiers
RFID	Radio Frequency Identification
ECG	Electrocardiogram
LCD	Liquid Crystal Display
BPM	Beats Per Minute
RAM	Random Access Memory
ROM	Read Only Memory
PIC	Peripheral Interface Controller

CHAPTER 1

INTRODUCTION

The infantry soldier of tomorrow promises to be one of the most technologically advanced modern warfare has ever seen. Around the world, various research programs are currently being conducted, such as the United States‟ Future Force Warrior (FFW) and the United Kingdom‟s Future Infantry Soldier Technology (FIST), with the aim of creating fully integrated combat systems. Alongside vast improvements in protective and weaponry subsystems, another major aspect of this technology will be the ability to provide information superiority at the operational edge of military networks by equipping the dismounted soldier with advanced visual, voice, and data communications. Helmet mounted visors, capable of displaying maps and real-time video from other squad members, ranges of physiological sensors monitoring heart rate, core body temperature etc. These devices will improve situational awareness, not only for the host, but also for collocated military personnel who will exchange information using wireless networks.

The challenge was to integrate these piecemeal components into a lightweight package that could achieve the desired result without being too bulky and cumbersome or requiring too much power. One of the fundamental challenges in military operations lies that the soldiers are not able to communicate with control room station. In addition, the proper navigation between soldier‟s organizations plays important role for careful planning and co-ordination. So in this paper we focus on tracking the location of soldier from GPS, which is useful for control room station to know the exact location of soldier and accordingly they will guide them. Also High speed, short-range, soldier-to-soldier wireless communications to relay information on situational awareness.

1.1 INTRODUCTION TO INTERNET OF THINGS

The IOT is a technology concept and/or an architecture which is an accumulation of already available technologies. Here by things we mean all available digital devices. IOT has evolved from the convergence of wireless technologies, micro electromechanical systems and the Internet. The IOT is defined as a paradigm in which objects equipped with sensors, actuators, and processors communicate with each other to serve a meaningful purpose. IoT could also be looked at as simply an interaction between the physical and digital world. Once standalone devices and applications now have the potential to be connected to a network through sensors, actuators, processors, and transceivers. Starting from the bottom level, the data row gets generated from any ―thing‖ through sensors that are being sent out to the cloud through communication gateway for analysis, which turns out to be useful information.

The IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT architecture adopts a model which can also be called as an event-driven model. The visionaries have also realized that this IoT ecosystem has business applications in areas of Home Automation, Factory/assembly line automation, Retail, Medical/Preventive healthcare, Automotive and more. The definition of the IoT has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional yields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things.

1.1.1 Scope of Internet of Things

The Internet of Things (IoT) is a network of physical objects (or "things") that are connected with sensors, apps, and other technology to communicate and exchange data with other devices and systems over the Internet. The prospects for IoT in the future are endless. Increased network mobility, advanced artificial intelligence (AI), and the ability to deploy, automate, orchestrate, and defend complex use cases at hyper-scale would drive advancements in the industrial Internet. The IoT was initially most interesting to business and manufacturing, where its application is sometimes known as machine-to-machine (M2M), but the emphasis is now on filling our homes and offices with smart devices, transforming it into something that's relevant to almost everyone.

1.1.2 Overview of Internet of Things

The IoT systems allow users to achieve deeper automation, analysis, and integration within a system. They improve the reach of these areas and their accuracy. IoT utilizes existing and emerging technology for sensing, networking, and robotics. IoT exploits recent advances in software, falling hardware prices, and modern attitudes towards technology. Its new and advanced elements bring major changes in the delivery of products, goods, and services; and the social, economic, and political impact of those changes.

The most important features of IoT include artificial intelligence, connectivity, sensors, active engagement, and small device use. The hardware utilized in IoT systems includes devices for a remote dashboard, devices for control, servers, a routing or bridge device, and sensors. These devices manage key tasks and functions such as system activation, security, communication, and detection to support-specific goals and actions.

1.1.3 Concept of Internet of Things

The concept of adding sensors and intelligence to physical objects was first discussed in the 1980s, when some university students decided to modify a Coca-Cola vending machine to track its contents remotely. But the technology was bulky and progress was limited. The term „Internet of Things" was coined in 1999 by the computer scientist Kevin Ashton. While working at Procter & Gamble, Ashton proposed putting radio-frequency identification (RFID) chips on products to track them through a supply chain. He reportedly worked the then-buzzword „internet" into his proposal to get the executives" attention. And the phrase stuck. Over the next decade, public interest in IoT technology began to take off, as more and more connected devices came to market.

In 2000, LG announced the first smart refrigerator, in 2007 the first iPhone was launched and by 2008, the number of connected devices exceeded the number of people on the planet.

1.1.4 Methodology of Internet of Things

The Every new project, the project team always needs to follow a methodology that helps them to satisfy the customer and work with peace of mind. So, several methods exist for this mission. This section presents a definition of selected methodologies for IoT domain. The selection based on the 13th annual state of Agile report which shows that the Scrum (54%) and Kanban (5%) are the most common agile methods used by organizations, in addition, the SAFe (30%) dominates scaling methodologies. In the other hand, we choose Ignite IoT Methodology because they are the first methods created in IoT organizations specifically for IoT projects.

CHAPTER 2

LITERATURE SURVEY

Literature survey is a text written by someone to consider the critical points of current knowledge including substantive findings, as well as theoretical sections.

2.1 GLOBAL POSITIONING SYSTEM (GPS) AND INTERNET OF THINGS (IOT) BASED SOLDIER POSITIONING AND HEALTH SIGNAL SYSTEM [1]

In 2019, Global Positioning System and Internet of Things are proposed as the foundation for a military location and health signal system by Jasvinder Singh, et al. [1] It's feasible to communicate continuously. Because troops can communicate from wherever, they can always reach out to one another in an emergency. The combination of an ARM Processor and low-power peripherals lowers the total energy use of the module. Peripherals are more lightweight and compact so that soldiers may transport them safe and securely. Security and safety are provided by the ability to trace a soldier's whereabouts utilising GPS from any location on earth and by a health system that monitors important health markers.

2.2 IOT BASED HEALTH MONITORING AND TRACKING SYSTEM FOR SOLDIERS [2]

Niket Patil et al. [2] suggested a method for assessing and observing health, in 2018. This project resulted in an Internet of Things based tracking and system for monitoring troop health. The module may be attached to the army soldier body and utilise GPS to detect position and state of health. The base station will get this data via IoT. Module permits the usage of a low-cost circuit to protect a valuable soldier's life on the front lines regression.

2.3 BNS BASED MOBILE HEALTH MONITORING [3]

In 2018, William Walker A.L.,et al.[3] suggested a portable system of health monitoring. The writers debated numerous biosensors that are light, portable, wearable and tiny devices designed to assess military health. The BSN is composed of sensors that may be applied to a soldier's body to track their health status in real time, including heart rate and temperature. An technique for establish a BSN-based system for monitoring the soldiers health in real time is given inside this paper.

2.4 REAL TIME TRACKING AND HEALTH MONITORING OF SOLDIER USING ZIGBEE TECHNOLOGY [13]

In 2015, Dineshwar Jaiswar, Sanjana S. Repal [13] proposed ‖Real Time Tracking and Health Monitoring of Soldier using ZigBee Technology‖. Soldiers are very essential part of any nation‟s security system. During, wars and search operations soldiers get injured and many of them become lost. As, soldiers health is important because they are the savior of our country who protects us from enemy attacks, terrorist activities and from many suspicious activities which can harm us as well as our nation too. This project gives an ability to track the location and monitor health of the soldiers in real time who become lost and get injured in the battlefield. It helps to minimize the time, search and rescue operation efforts of army control unit. This system enables to army base station to track the location and monitor health of soldiers using GPS module and wireless body area sensor networks (WBASNs), such as temperature sensor, heart beat sensor, etc.. The data coming from sensors and GPS receiver is transmitted wirelessly using ZigBee module. Also, a soldier can ask for help from control room and can communicate with other fellow soldier present within the wireless transmission and reception range.

2.5 IOT BASED HEALTH MONITORING VIA LORAWAN [5]

Afef Mdhaffar, et al.[5] published a paper in 2017 on Internet of Things based Health Monitoring using LoRa WAN, in which collected biosensor data is transmitted to be analysed module using low power, low cost, and secured communication utilising a LoRa WAN network architecture. Heartbeat rate, temperature and blood sugar levels has been monitored in isolated locations where cellular network coverage is either limited or non-existent or does not permit data transfer. The typical region served by LoRa WAN is around 33 km when the LoRa WAN gateway is located outdoors at a 12 metre height. Other long-range cellular systems like GPRS/3G/4G have a claimed power consumption that is five times higher than that of this monitoring module.

2.6 IOT BASED HEALTHCARE MONITORING SYSTEM FOR WAR SOLDIERS USING MACHINE LEARNING [4]

An Internet of Things-based heath monitoring system for soldiers engaged in war was developed by Akshay Gondalic, et al. in 2018 [4]. This technology allows an army base station to track soldier movements and keep an eye on their wellbeing by using GPS, temperature sensors, heart rate monitors, and other equipment. Wireless sensor and GPS data transmission between the other soldiers will be accomplished using ZigBee technology. Moreover, it has been suggested that the LoRaWAN network be used in conflict zones with no cellphone network coverage nonexistent or does not allow data transfer between the leader and base station. The acquired information will be uploaded to the cloud to be utilised for that K denotes data analysis using the clustering approach and forecasting in the next stges.

CHAPTER 3

SYSTEM ANALYSIS

The process of analyzing the system that existed and alterations that are made in the proposed system is stated in system analysis.

3.1 EXISTING SYSTEM

In the existing systems are using Internet of Things(IoT) propose a model which monitors various health parameters like heart rate (BPM), body temperature, blood pressure monitor (mm Hg) and ECG (Electrocardiogram) of an individual. The collected data through the system is then transferred over the internet to a smartphone application of the patient. This data is transferred to the registered doctors on to their smartphone application as well as standalone computers. The doctor can then prescribe the medication based on the data results shown by the system.

3.1.1 Limitations

In existing system, Data privacy and security, this system will collect sensitive health data from soldiers, which must be stored securely and in compliance with data privacy regulations. Battery life, this system should have a long battery life to enable continuous monitoring, reducing the need for frequent recharging. Accuracy and reliability, this system must provide accurate and reliable data to ensure medical personnel can make informed decisions based on the readings. Time wastage, the doctor can then prescribe the medication based on the data results shown by the system.

3.2 PROPOSED SYSTEM

The proposed system will be consists of two unit‟s viz., ‒Solider unit‖ and ‒Server unit‖. The wireless technology (IoT) is used in our project for the communication. We are using a programmable IC (PIC16F877A), with a RAM memory 368bytes and ROM 8K which is of Flash type, to control the operations.

GPS is interfaced with the Solider Unit (moving unit) which sends the current location of the soldier in the battle field, to the server unit, via IoT module. The receiver in the server unit receives the signal and tracks the location. Heart beat sensor and temperature sensor are attached with the soldier unit, to check if the soldier is alive or dead, and sends the information to the server unit. In any emergency situation soldier can contact the server by giving a request through keypad interfaced with the unit. To prevent inactive the body part for examples finger, heart, leg& hand due to heavy snow. Thermoelectric cooling uses the peltier effect to create a heat flux between the junctions of two different types of materials which is wearied by soldier for worm up. LCD display shows the status.

The primary goal of the study is to present an Internet of Things (IoT) based the system for keeping track of troop‟s whereabouts and keeping tabs on their health. A microcontroller board with open source software built on the programmable IC (PIC16F877A) microcontroller and developed by IoT module. It examines location, body temperature and heart rate. The IoT module triggers the buzzer if the heart rate exceeds or falls below its threshold value, as well as if the temperature exceeds or falls below its threshold value, it activates the heater or cooler. IoT module gets temperature, heartbeat rate and location data through serial connection. It

reads and receives serial data when Wi-Fi is available, uploads data to the IoT and compare the data to see if any threshold values deviate and then does all of this in real time, it will display on the army base station. In case of an urgent situation, the soldier has the capability to communicate with the server by pressing a button on the keypad connected to the device. The software running on a PC to monitors the status of the Server Unit, and the relevant information is exhibited on an LCD display.

3.2.1 Advantages

The advantage of proposal system is more efficient. This project's objective is to develop a soldier monitoring system that can track a variety of vital indications, such as heartbeat rate, body temperature and soldier location. To ensure high integrity and security to the soldier‟s data. The health conditions of the soldier can be closely monitored from the remote location. Using a heart rate monitor is an ideal method of assessing one's cardiovascular condition. Keypad linked to the device to hit a button to call the server in case of an emergency. So, soldier no need to go base station. Thermal jacket which gives better protection to them who are working in extreme weather conditions. It‟s cost effective. The use of the GPS provides the location from any part of the world. It‟s fast and efficient.

CHAPTER 4

SYSTEM REQUIREMENTS

Every project needs certain hardware components or other software resources to be present. These prerequisites are known as the system requirements and are often used as a guideline as opposed to an absolute rule.

4.1 SOFTWARE REQUIREMENTS

- MPLAB IDE Software
- PICkit 2 Programmer
- Cayenne IoT Builder

4.2 HARDWARE REQUIREMENTS

- Microcontroller PIC 16877A
- Heart beat sensor
- Temperature sensor (LM35)
- Matrix keypad
- Peltier crystal
- 2×16 LCD display
- Global Positioning System (GPS)
- NodeMCU (IoT module)
- Transformer
- Relay Drivers and LED
- Regulator and Rectifier

CHAPTER 5

MODULE DESCRIPTION

Module description describes about the various modules that are used to perform the task. We have using six modules in this project. They are following:

5.1 TEMPERATURE SENSOR

This module is designed to measure the surface of the body temperature. Temperature sensor are attached with the soldier unit, to check the soldier‟s body temperature and sends the information to the server unit. The Temperature sensor (LM35) is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in oC).

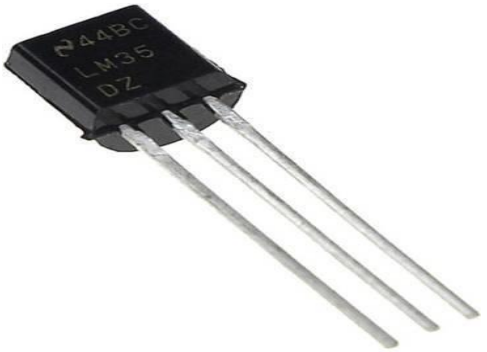


Fig 5.1 Temperature sensor

The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. Using temperature data to activate the Thermoelectric cooling system. Thermoelectric cooling system uses the peltier effect to create a heat flux between the junctions of two different types of materials which is wearied by soldier for worm up.

5.2 HEART BEAT SENSOR

This module is designed to track and check the soldier heart rate. Heart beat sensor and temperature sensor are attached with the soldier unit, to check if the soldier is alive or dead, and sends the information to the server unit. Heartbeat sensor that gauges heart rate by observing blood flow of the soldier.

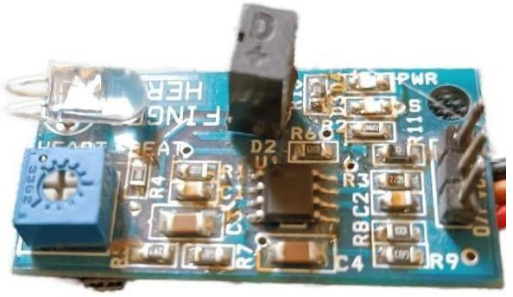


Fig 5.2 Heart beat sensor

Here we are using IR sensor for detecting the Heart beat. IR has less noise and ambient light than at normal optical wavelengths. The light is produced only when current passes through in the forward direction and block current in the reverse direction. A change in finger blood flow, reflected by PWA is derived from the finger plethysmography. PWA derived from finger plethysmography allows continuous, noninvasive measurement of changes in finger blood flow during wakefulness and sleep.

5.3 PELTIER CRYSTAL

This module is designed for produce heat and cooling based on soldier different body temperature. Thermoelectric cooling uses the Peltier effect to create a heat flux between the junctions of two different types of materials. A Peltier sensor is a solid-state active component which transfers heat from one side to other side, while consumption of electrical energy, depending on the

direction of the current. They can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools.

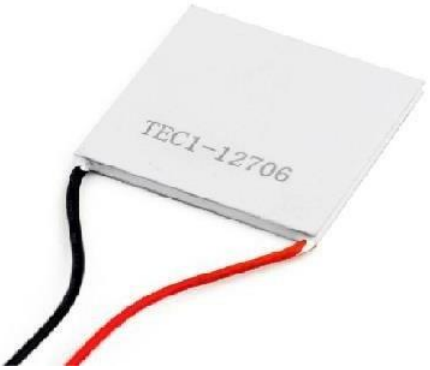


Fig 5.3 Peltier crystal

Soldier body temperature exceeds the threshold value of 30 degree, the cooling system will be activated. Similarly, if the temperature drops below the threshold value of 22 degrees, the heating system will be activated.

5.4 MATRIX KEYPAD

This module is designed for soldier can call the base station in case of emergency. Keypads are a part of HMI or Human Machine Interface and play really important role in a small embedded system where human interaction or human input is needed. Soldier can be use the keypad linked to the device to hit a button to call the server in case of an emergency. To avoid bodily parts becoming inactive such as leg, hand, fingers and others because of a lot of snow. The Matrix keypads are well known for their simple architecture and ease of interfacing with any microcontroller.

This keypad provides a visually appealing way to get numeric data to your control system. The board is a series of pushbutton switches that provide structured input for measuring user input.

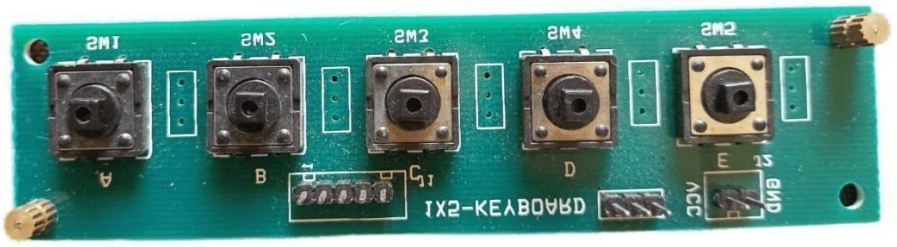


Fig 5.4 Matrix keypad

5.5 IOT MODULE

This module is used to transmitting the data to server unit or base station via Internet. The Internet of things (IoT) is the network of everyday objects — physical things embedded with electronics, software, sensors, and connectivity enabling data exchange. Basically, a little networked computer is attached to a thing, allowing information exchange to and from that thing. Be it light bulbs, toasters, refrigerators, flower pots, watches, fans, planes, trains, automobiles, or anything else around you, a little networked computer can be combined with it to accept the input or to gather and generate the informational output.

Fig 5.5 IoT module

This means computers will be permeating everything around us - ubiquitous embedded computing devices, uniquely identifiable, interconnected across the Internet. Because of low-cost, networkable microcontroller modules, the Internet of things is really starting to take off.

5.6 GPS MODULE

This module is designed to track the soldier exact location. To locate soldiers, the system incorporates GPS technology, which provides precise location information. The GPS modem is utilized to receive signals from satellites and determine the soldier's latitude and longitude, which are subsequently transmitted through serial data to the controller.

Fig 5.6 GPS module

The Global Positioning System (GPS) is a space-based global navigation satellite system that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites.

CHAPTER 6

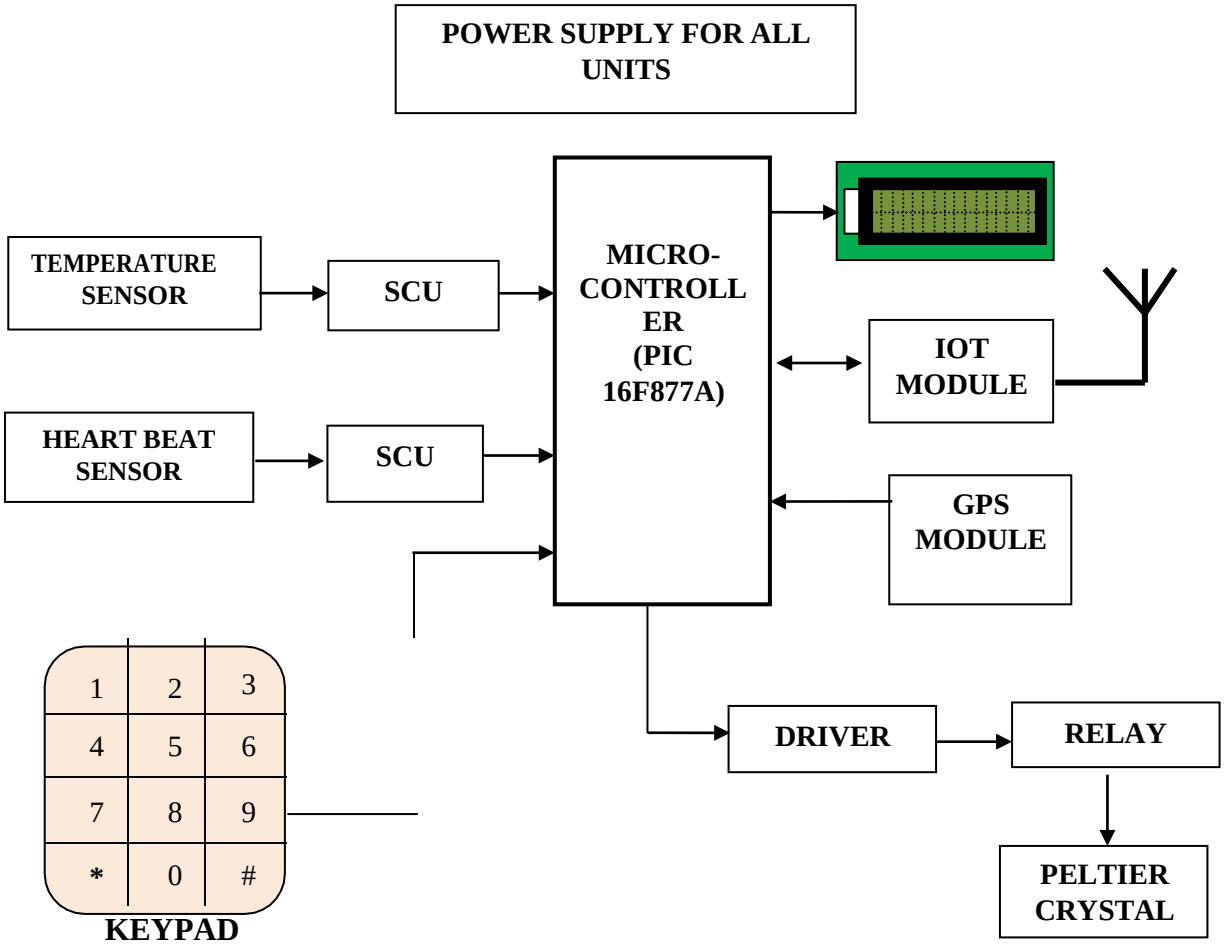
SYSTEM DESIGN

System architecture is the process of defining the architecture, modules, interfaces and data for a system to satisfy specified requirements.

6.1 ARCHITECTURE DIAGRAM

An architecture diagram is a graphical representation of a set of concepts that are part of architecture, including their principles, elements and components. Our system consists of two unit‟s viz., –Solider unit‖ and –Server unit‖.

SOLDIER UNIT:



SERVER UNIT:

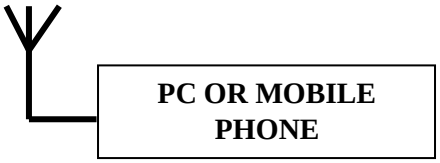


Fig 6.1 System architecture diagram

The Concept of the system is to monitoring the soldiers in the battle field. It consists of temperature sensor, heartbeat sensor and also GPS tracker. Temperature sensor detects the actual body temperature of the soldier‟s, heartbeat sensor detects the pulse rate of the soldier. GPS tracker is used to track the exact location of the soldier. The inputs it given into the micro-controller and then output is displayed in the LCD display and also in the computer system using Cayenne application. There are three buttons in the system, first button denotes "I need Gun", second button denote "Emergency", third button denotes "Enemy detected".

In case, the soldier's body temperature rises, the peltier crystal cools down the body. These are the electrical components, so we use DC current. We use step-down transformer to reduce 230V AC to 12V AC current. The AC current is converted to DC using rectifier, then filter the 12V DC to 5V using 7805 voltage regulator. There are three pins in the regulator. They are input ground and output. The input should be 12V and the output will be 5V. The 5V is given to all the components.

The IOT module must have internet connection. The username and password should be programmed, then only it is connected to the IOT. When one key is pressed, the input is passed through microcontroller and IOT modules sends it to cloud, then only the output should be accessed. The

Driver Relay is used to switch on the Peltier Crystal. The peltier crystal runs by a battery. The software running on a PC or Mobile to monitors the status of the Server Unit (Base station) and the relevant information is exhibited on an LCD display.

6.2 LM35 CIRCUIT

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ^{o}C). The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ^{o}C at room temperature and +/- 0.8 ^{o}C over a range of 0 ^{o}C to +100 ^{o}C.

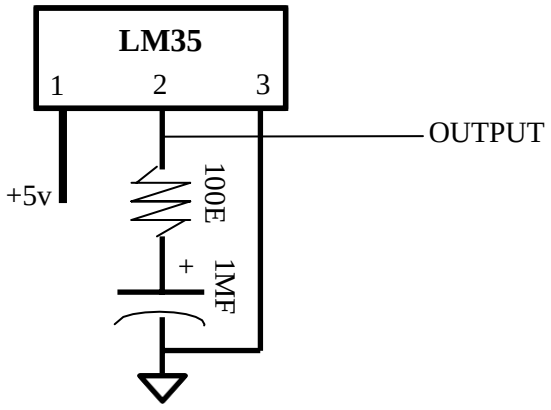


Fig 6.2 LM35 circuit diagram

6.3 HEART BEAT SENSOR CIRCUIT

Here we are using IR sensor for detecting the HEART BEAT. IR has less noise and ambient light than at normal optical wavelengths. The light is produced only when current passes through in the forward direction and block current in the reverse direction.

Plethysmograph is an infrared photoelectric sensor used to record changes in pulsatile blood flow from the finger. The Plethysmograph operates by recording changes in blood volume as the arterial pulse expands and contracts the microvasculature. A change in finger blood flow, reflected by PWA is derived from the finger plethysmography.

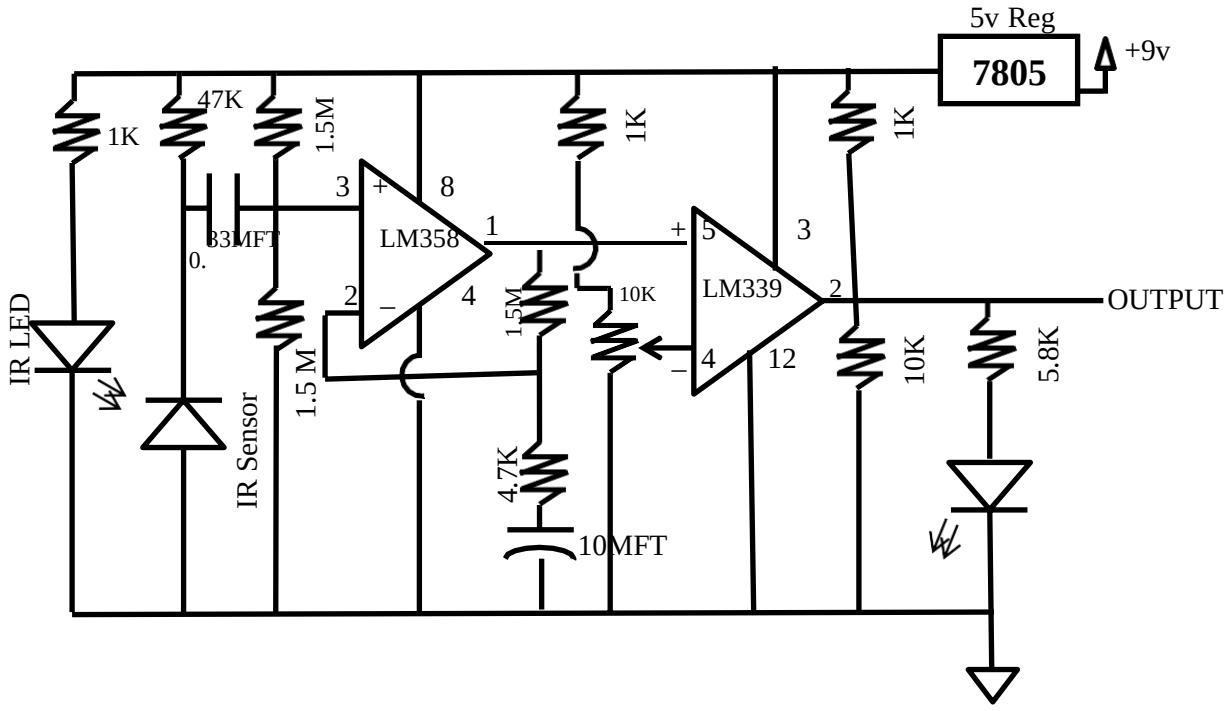


Fig 6.3 Heart beat sensor circuit diagram

6.4 PIC MICROCNTROLLER

The PIC microcontroller PIC16f877A is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology.

PIC16F877A is used in many pic microcontroller projects. PIC16F877A also have many applications in digital electronics circuits.

Easy programming and erasing are other features of PIC 16F877. PIC16F877A microcontroller is used in the project.

Pin Description:

PIC16F877A consists of 40 pins enclosed in 5 ports. Each port holds 8 pins which are bidirectional input/output pins. It has a total number of 40 pins and there are 33 pins for input and output. Pin diagram of PIC 16F877A is represented in Fig 6.4.

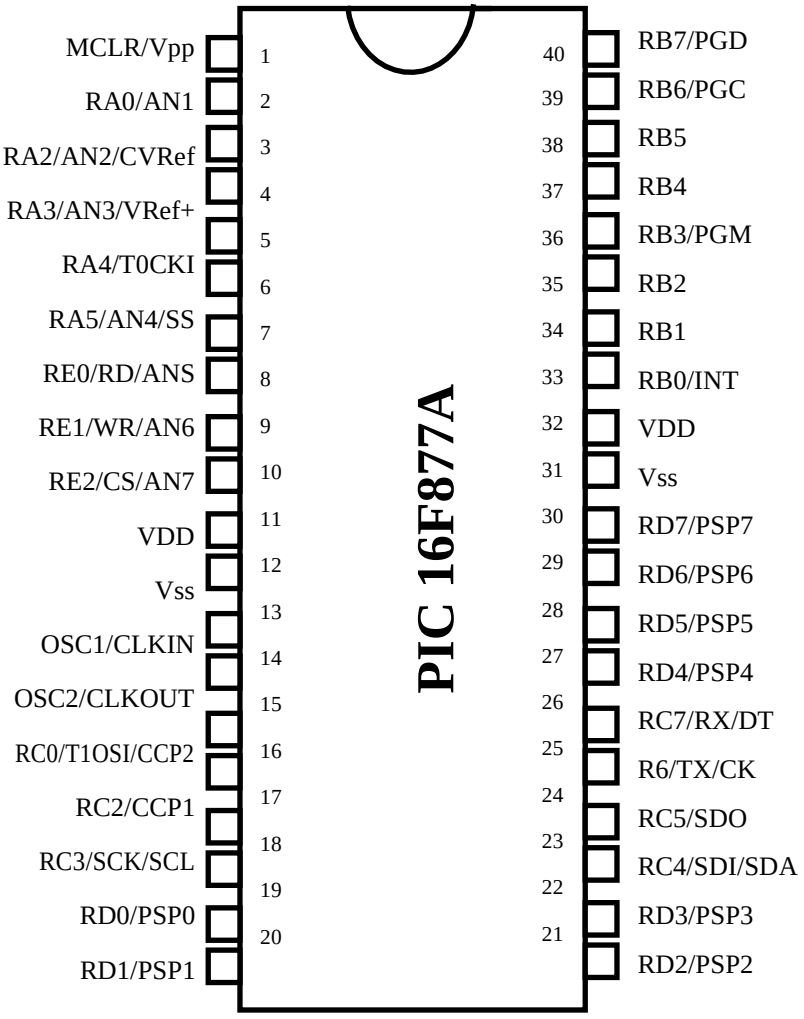


Fig 6.4 PIN diagram of PIC 16F877A

6.5 NODE MCU PIN DIAGRAM

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266.

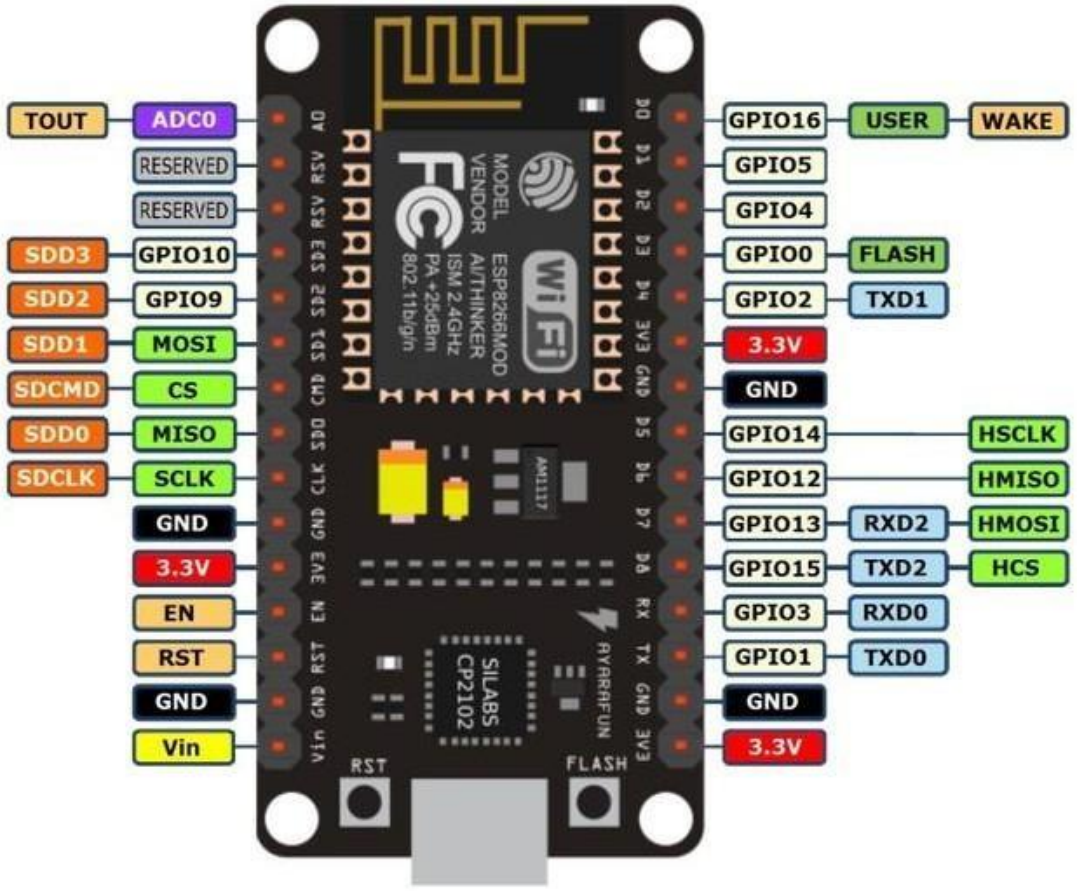


Fig 6.5 NodeMCU PIN diagram

The ESP8266 series, or family, of Wi-Fi chips is produced by Espressif Systems, a fabless semiconductor company operating out of Shanghai, China. Another important update was made on 30 Jan 2015, when

Devsaurus ported the u8glib to NodeMCU project, enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

6.6 NODE MCU Vs ARDUINO

In The ESP8266 is a microcontroller with Wi-Fi capability. There are different modules and development boards with this system. Some development boards use basic esp8266 modules and some integrate the chip flash memory and the antenna on the PCB. NODEMCU is a development board with ESP8266 and a firmware with the same name.

Similarly the Arduino Uno is a microcontroller board based on 8 bit ATmega328P microcontroller. Beside ATmega328P it contains other elements such as crystal oscillator serial communication voltage regulator etc. to support the microcontroller.

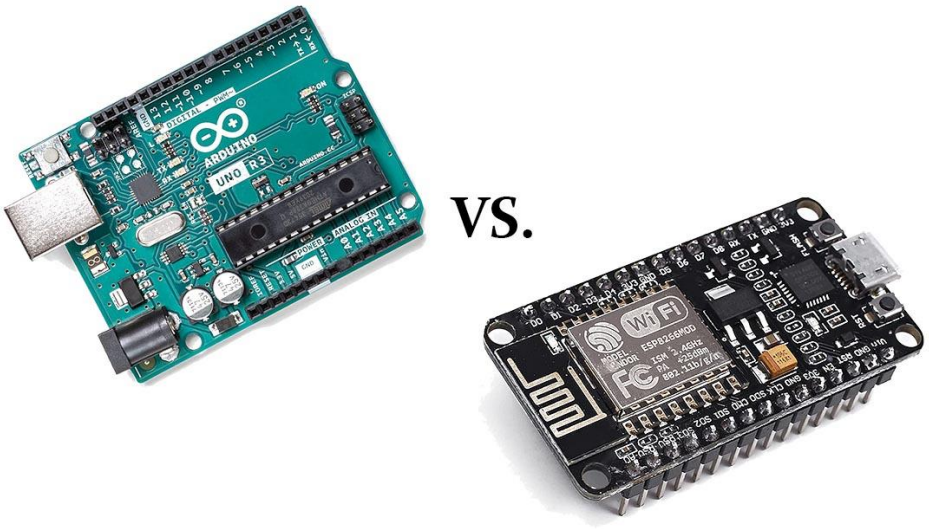


Fig 6.6 Node MCU Vs Arduino

The Arduino Uno has 14 digital input output pins out of which 6 can be used as PWM outputs 6 analog input pins a USB connection The Power barrel jack an ICSP header and a reset button.

The ESP based boards are fast have a low power consumption a high memory and Wi-Fi build in also the price is very low. The ESP8266 is still great and extremely useful. Even Lua is useful for quick small projects. In most cases where internet connectivity is required they seem to be the best solution.

Only use case I can think the Arduino boards are better is when it comes to analog inputs. If you working to read a lot of analog input values and you do not want to use a multiplexer than you should go with an Arduino board. As always, “ the right tool for the job ” is the way to go or combination of tools.

CHAPTER 7

SYSTEM TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, Sub-assemblies, assemblies and/or a finished product.

IOT TESTING

IoT testing involves executing QA tests to check IoT devices‟ functionality, security, and performance. It is crucial to ensure that your IoT devices can transmit sensitive information wirelessly before going to market because every IoT device sends and receives data over the Internet. IoT testing aims to ensure that IoT devices comply with specified requirements and work as expected. There are various type of testing addresses a specific testing requirement.

TYPES OF TESTING IN IOT

- Usability
- Reliability
- Data Integrity
- Security
- Performance

TYPES OF TESTS

7.1 USABILITY TESTING

There are so many devices of different shape and form factors are used by the users. Moreover, the perception also varies from one user to other. That‟s why checking usability of the system is very important in IoT testing.

7.2 COMPATIBILITY TESTING

There are lots of devices which can be connected though IOT system. These devices have varied software and hardware configuration. Therefore, the possible combinations are huge. As a result, checking the compatibility in IOT system is important.

7.3 RELIABILITY TESTING

Reliability and Scalability is important for building an IOT test environment which involves simulation of sensors by utilizing virtualization tools and technologies.

7.4 DATA INTEGRITY TESTING

It‟s important to check the Data integrity in IOT testing as it involves large amount of data and its application.

7.5 SECURITY TESTING

In the IOT environment, there are many users are accessing a massive amount of data. Thus, it is important to validate user via authentication, have data privacy controls as part of security testing.

7.6 PERFORMANCE TESTING

Performance testing is important to create strategic approach for developing and implementing an IOT testing plan.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENTS

Conclusion conveys the completion and also defines the limitations that are not processed. Future enhancements provide an innovation that could be made in this project.

8.1 CONCLUSION

Following conclusion can be retrieved from above implementation are:

- Security and safety for soldiers: GPS tracks position of soldier anywhere on globe and also health system monitors soldier‟s vital health parameters which provides security and safety for soldiers.
- Continuous Communication is Possible: Soldiers can communicate anywhere using IoT module which can help soldier to communicate among their squad members whenever in need.
- Less complex circuit and power consumption. Use of PIC Microcontroller and low power requiring peripherals reduce overall power usage of system.

Biomedical sensors can provide heartbeat and body temperature of every soldier to control room. This technology can be helpful to provide the accurate location of missing soldier in critical condition and overcome the drawback of soldiers missing in action. The addressing system is also helpful to improve the communication between soldier to soldier in emergency situation and provide proper navigation to control room.

Modules used are smaller in size and also lightweight so that they can be carried around. So in this way concept of tracking and navigation system

is very useful for soldiers when they are on military field during war. And also for base station so that they can get real-time view of soldier‟s on field displayed on PC or Mobile.

8.2 FUTURE ENHANCEMENTS

In the future, there is always chance to improve any system as research & development is an endless process. The following measurements can be done in future:

- Soldier Voice Recognition system: IC HM2007 can be used to recognize the voice samples of the soldier, for better security purpose.
- A Camera can be fitted into the system so as to enable the base station to get a real time view of the battlefield.
- In the future we can add the gas detective sensors. So that it can detect the gases which are harmful for the human beings in forest area specially.
- In the future, it is possible to enhance the system by incorporating a solar collector that can recharge the power source automatically when the device is exposed to sunlight.

APPENDIX A

SAMPLE CODINGS

CHIP PROGRAM:

```
#include<pic.h>

__CONFIG(0x3f72 );

static bit rs@((unsigned )&PORTD*8+1);
static bit rw@((unsigned )&PORTD*8+2);
static bit en@((unsigned )&PORTD*8+3);

static bit RELAY1@((unsigned )&PORTC*8+0);
static bit RELAY2@((unsigned )&PORTC*8+1);

static bit RELAY7@((unsigned )&PORTC*8+2);

static bit SWITCH1@((unsigned )&PORTB*8+1);
static bit SWITCH2@((unsigned )&PORTB*8+2);
static bit SWITCH3@((unsigned )&PORTB*8+3);

//static bit sensor@((unsigned )&PORTB*8+7);
//static bit SWITCH3@((unsigned )&PORTB*8+3);

bank2 unsigned char VAL55=0,
VAL8=0,CNT,val1=0,val2,val3,val4,val6=0,a,b,c,d,e,g,f,h,i,j,k,l,m,n,o,p,q,r,s,t,z,
COUNT;

unsigned char val5=0,VAL5=0;
```

```
unsigned int COUNT1,val22,val33,val44,val55;
unsigned char gpsdata[50];

unsigned char T,VAL5,ser=0x37,st=0x01,data_cap=0x00, rf_rxdata,VAL4;
unsigned int VAL1,adc_value;
unsigned char H1,H2,H3,T1,T2,T3,M1,M2,M3,L1,L2,L3;

void delay(unsigned int y)//delay prg
{
while(y--);
}
void lcd_command(unsigned char com)
{
unsigned char temp;

PORTD=com&0xf0;
rs=0;
rw=0;
en=1;
delay(10);
en=0;
temp=com<<4;
PORTD=temp&0xf0;
rs=0;
rw=0;
en=1;
delay(10);
en=0;
}
```

```
void lcd_init()
{
lcd_command(0x02);
lcd_command(0x2c);
lcd_command(0x06);
lcd_command(0x0c);
lcd_command(0x01);
lcd_command(0x80);
}

void lcd_data(unsigned char data)
{
unsigned char val1;

PORTD=data&0xf0;
en=1;
rs=1;
rw=0;
delay(10);
en=0;
val1=data<<4;
PORTD=val1&0xf0;
en=1;
rs=1;
rw=0;
delay(10);
en=0;
}
```

```
void lcd_display(const unsigned char*word,unsigned int n)
{
unsigned char l;
for(l=0;l<n;l++)
{
lcd_data(word[l]);
}
}

void interrupt rx()

{
if(RCIF==1)
{
RCIF=0;
ser=RCREG;

if((ser==0x52)&&(st==0x01))
{
data_cap=0x01;
st=0x00;
}
if((data_cap==0x01)&&(i<45))
{
gpsdata[i]=ser;
i=i+1;
}
}
```

```
}

 void heart_beat1()
 {
 TMR1ON=1;
 TMR1CS=0;     // TIMER MODE
 T1CKPS1=1;    // SETTING PRESCALAR VALUE AS 8
 T1CKPS0=1;

 TMR1H=0xCF;
 TMR1L=0x2B;

 while(CNT<=25)
 {
 if((RB7==1)&&(VAL8==0))
 {
 VAL8=1;
 COUNT=COUNT+1;
 delay(10000);
 }
 if(RB7==0)
 {
 VAL8=0;
 }

 if(TMR1IF==1)
  {
 TMR1IF=0;
 CNT=CNT+1;
```

```
TMR1ON=0;
TMR1ON=1;

TMR1CS=0;     // TIMER MODE
T1CKPS1=1;    // SETTING PRESCALAR VALUE AS 8
T1CKPS0=1;
TMR1H=0xCF;
TMR1L=0x2B;
}
}

CNT=0;
 if(COUNT>0)
{
 COUNT=COUNT*2+8;
 COUNT=COUNT*4;
}
 val2=COUNT%10;//UNIT DIGIT
 val3=COUNT/10;
 val4=val3%10;    // tens digit
 val5=val3/10;
 COUNT=0;
 // hundred digit
 }

void adcconvert()
{
b=adc_value%10;
c=adc_value/10;
```

```
e=c%10;
f=c/10;
g=f%10;
h=f/10;

lcd_data(g+0x30);
H1=(g+0x30);
delay(100);

lcd_data(e+0x30);
delay(100);
H2=(e+0x30);

lcd_data(b+0x30);
delay(100);
H3=(b+0x30);
}

void hb_send()
 {
    delay(10000);
TXREG=('H');
delay(100);

 TXREG=(val4+0X30);
delay(600);

TXREG=(val2+0X30);
```

```
delay(600);

TXREG=('T');
delay(100);

TXREG=H1;delay(600);
TXREG=H2;delay(600);
TXREG=H3;delay(600);

delay(10000);

delay(2000);

delay(35000);       delay(35000);

}
void gps_send()
 {
          T=0;
lcd_command(0x80);
delay(1000);
TXREG=('Z');
delay(100);
 for(j=16;j<28;j++)
{

ser=(gpsdata[j]);
TXREG=(ser);
delay(600);
```

```
}
TXREG=('L');
delay(100);

for(j=30;j<41;j++)
{

ser=(gpsdata[j]);
 TXREG=(ser);
 delay(600);

}
delay(10000);

delay(2000);

}
void gps_init()
{
TXSTA=0X24;
RCSTA=0X90;
SPBRG=25;
BRGH=1;
GIE=1;
PEIE=1;
RCIE=1;

}
void main()
```

```
{

ADCON1=0X82;
ADCON0=0X00;

TRISD=0X00;
TRISC=0X80;
TRISA=0X03;
TRISE=0X00;
TRISB=0XFF;

PORTD=0X00;
PORTC=0X80;
PORTA=0X03;
PORTE=0X00;
PORTB=0XFF;

VAL55=0;

delay(100);
lcd_init();
lcd_command(0x82);
delay(100);
lcd_display("WELCOME",7);
delay(50000);delay(50000);delay(50000);delay(50000);
delay(50000);delay(50000);delay(50000);delay(50000);
RELAY7=0;
i=0x00;
T=0;
```

```
 delay(5000);
 data_cap=0x00;
 st=0x01;
 i=0x00;
gps_init();
 delay(5000);
        delay(5000);
delay(5000);

delay(2000);
TXREG=('A');delay(100);TXREG=('0');delay(600);
TXREG=('B');delay(100);TXREG=('0');delay(600);
TXREG=('C');delay(100);TXREG=('0');delay(600);
while(1)
{

lcd_command(0x01);
delay(1000);
lcd_command(0x80);
delay(100);
lcd_display("HB:",3);
heart_beat1();

lcd_command(0x83);
delay(100);
```

```
lcd_data(val4+0x30);
delay(100);
lcd_data(val2+0x30);
delay(50000);delay(50000);

CHS0=0;
CHS1=0;
CHS2=0;

ADON=1;
delay(200);
ADCON0=ADCON0|0X04;
delay(200);
adc_value=ADRESH;
adc_value=adc_value<<8;
adc_value=(adc_value+ADRESL)/0x02;
VAL1=adc_value;
//adc_value=adc_value/0x02;
delay(100);
lcd_command(0x01);
delay(1000);
lcd_command(0xC0);
delay(100);
lcd_display("TEMP:",5);

lcd_command(0xC5);

adcconvert();
delay(10000);
```

```
hb_send();


if((VAL1>38)&&(VAL1<70))
{
RELAY1=1;RELAY2=0;
}

if((VAL1>29)&&(VAL1<38))
{
RELAY1=0;RELAY2=0;
}
if((VAL1>0)&&(VAL1<29))
{
RELAY1=0;RELAY2=1;
}

if((SWITCH1==1)&&(SWITCH2==0)&&(SWITCH3==0))
{
TXREG=('A');delay(100);TXREG=('1');delay(600);
delay(10000);delay(10000);delay(10000);delay(10000);delay(10000);
}

if((SWITCH1==0)&&(SWITCH2==1)&&(SWITCH3==0))

{
TXREG=('B');delay(100);TXREG=('1');delay(600);
delay(10000);delay(10000);delay(10000);delay(10000);delay(10000);
```

```
}

if((SWITCH1==0)&&(SWITCH2==0)&&(SWITCH3==1))
{
TXREG=('C');delay(100);TXREG=('1');delay(600);
delay(10000);delay(10000);delay(10000);delay(10000);delay(10000);
}

      delay(50000);  delay(50000);  delay(50000);  delay(50000);
if(i>43)
{

lcd_command(0x01);
                  delay(1000);
                  delay(35000);
                  lcd_command(0x80);
                  delay(1000);

                  gpsdata[16]=0x3c;
                  lcd_command(0x80);
                  delay(1000);

                  for(j=17;j<28;j++)

      {

                  ser=(gpsdata[j]);
                  lcd_data(ser);
                  delay(600);
```

```
                    }
                    lcd_command(0x0c0);

                    for(j=30;j<41;j++)
                    {

                    ser=(gpsdata[j]);
                    lcd_data(ser);
                    delay(600);

          }
          delay(5000);
        data_cap=0x00;
        st=0x01;
i=0x00;
delay(35000);
delay(35000);
delay(35000);

        delay(50000);
                  //VAL5=0x31;
   //gps_init();

gps_send();
        delay(50000);
}
}

}
```

IOT DEVICE CONECTION PROGRAM:

```
#define CAYENNE_PRINT Serial
#include <CayenneMQTTESP8266.h>

// WiFi network info.
int sen1=0,sen2=0,sen3=0,sen4=0;
char ssid[] ="soldier";           //manojsoldier@gmail.com
char wifiPassword[] ="123456789";    //123456789
char red1;
// Cayenne authentication info. This should be obtained from the Cayenne
Dashboard.
char username[] = "da51db90-cac1-11ed-b72d-d9f6595c5b9d";
char password[] = "61df584f40ee6248e5cbfac34cef349810b5af12";
char clientID[] = "ea6e27e0-cac1-11ed-b0e7-e768b61d6137";


void setup()
{
  Cayenne.begin(username, password, clientID, ssid, wifiPassword);
Serial.begin(9600);
}
```

```
void loop()
{
   Cayenne.loop();
  if(Serial.available()>0)
{
  char red1=Serial.read();delay(100);
  if(red1=='H')
{
  float sen1=Serial.parseFloat();
  Cayenne.virtualWrite(1,sen1);delay(200);
}
  if(red1=='T')
{
  float sen2=Serial.parseFloat();
  Cayenne.virtualWrite(2,sen2);delay(200);
}

 if(red1=='Z')
{
  int sen3=Serial.parseFloat();
  Cayenne.virtualWrite(3,sen3);delay(200);
}
```

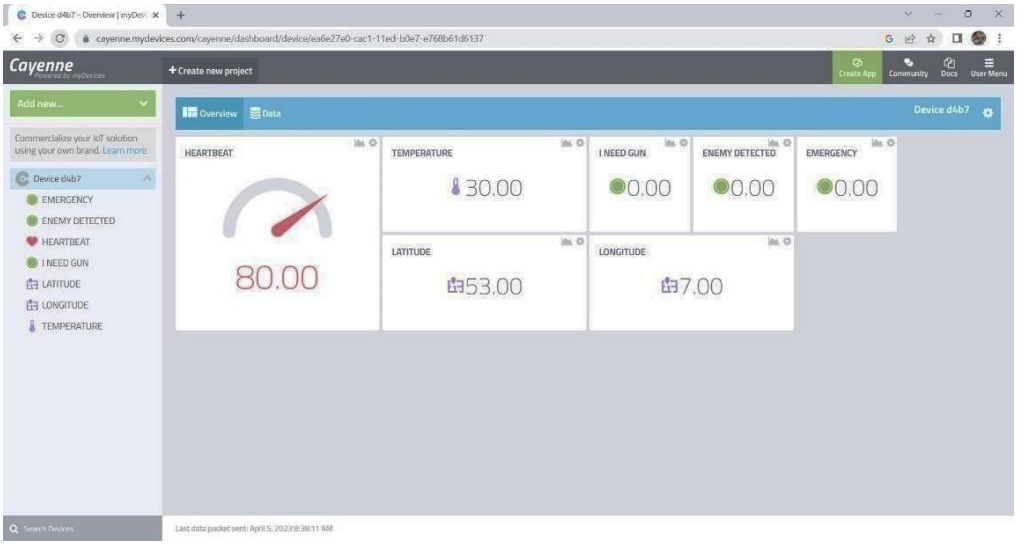
```
 if(red1=='L')
{
  int sen4=Serial.parseFloat();
  Cayenne.virtualWrite(4,sen4);delay(200);
}
 if(red1=='A')
{
  int sen5=Serial.parseFloat();
  Cayenne.virtualWrite(5,sen5);delay(200);
}
 if(red1=='B')
{
  int sen6=Serial.parseFloat();
  C:ayenne.virtualWrite(6,sen6);delay(200);
}
 if(red1=='C')
{
  int sen7=Serial.parseFloat();
  Cayenne.virtualWrite(7,sen7);delay(200);
}
}
}
```

APPENDIX B

SCREENSHOTS

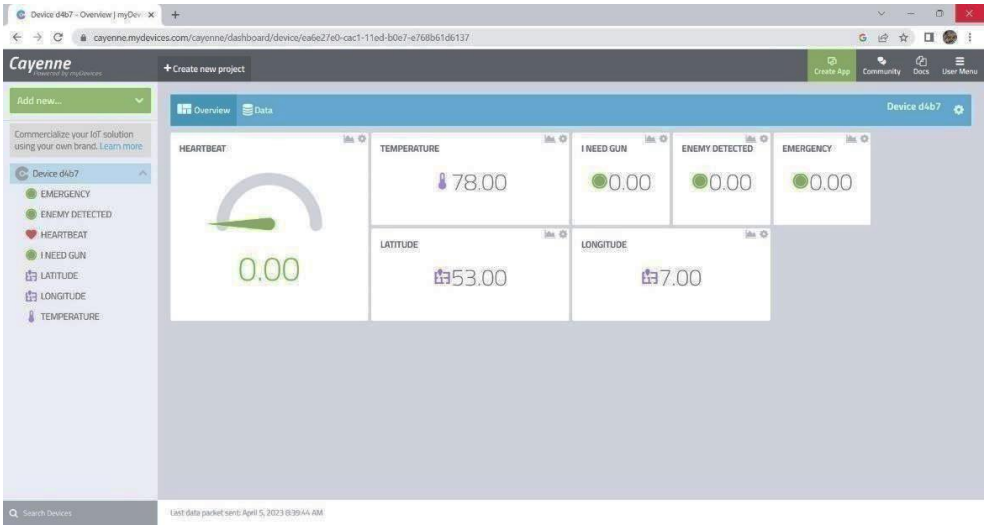
HEART BEAT SENSOR

Here in this screenshot, we monitoring the Heartbeat. It is showed soldier‟s heartbeat.



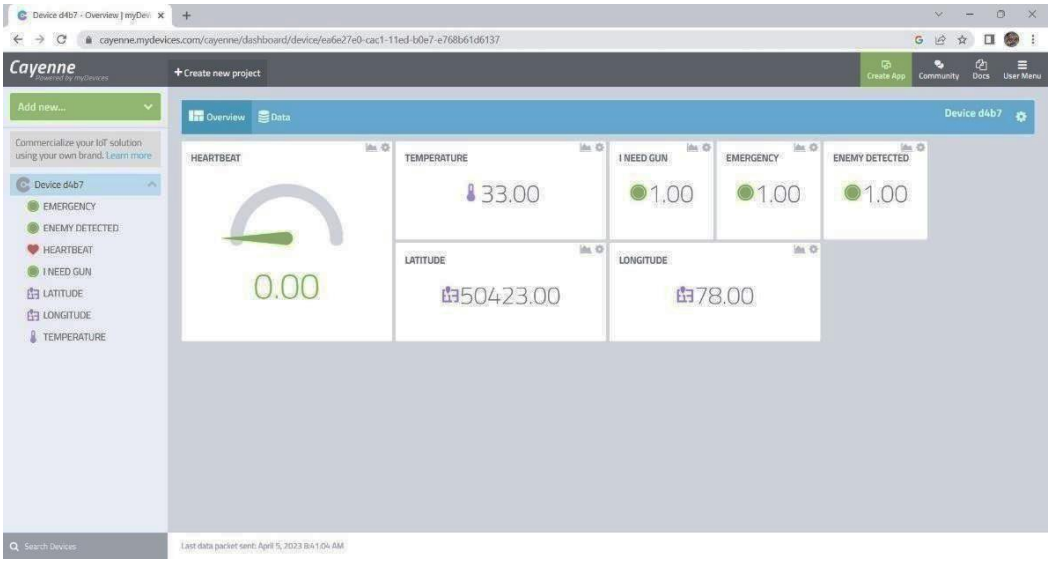
TEMPERATURE

Here in this screenshot, we monitoring the Temperature. It is showed soldier‟s body temperature.



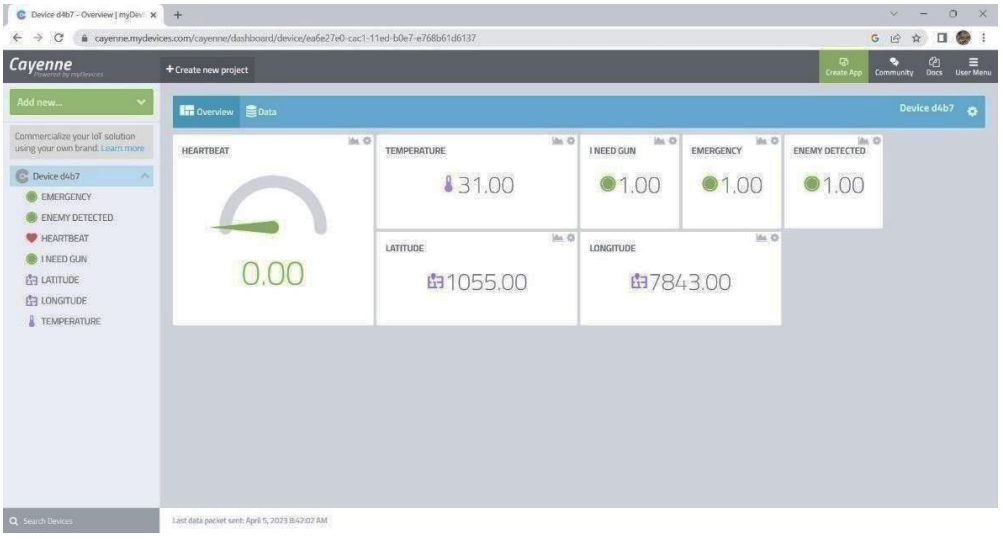
KEYPAD

Here in this screenshot, soldier can manually ask help for base station. It is showed soldier‟s manually pressed button status.

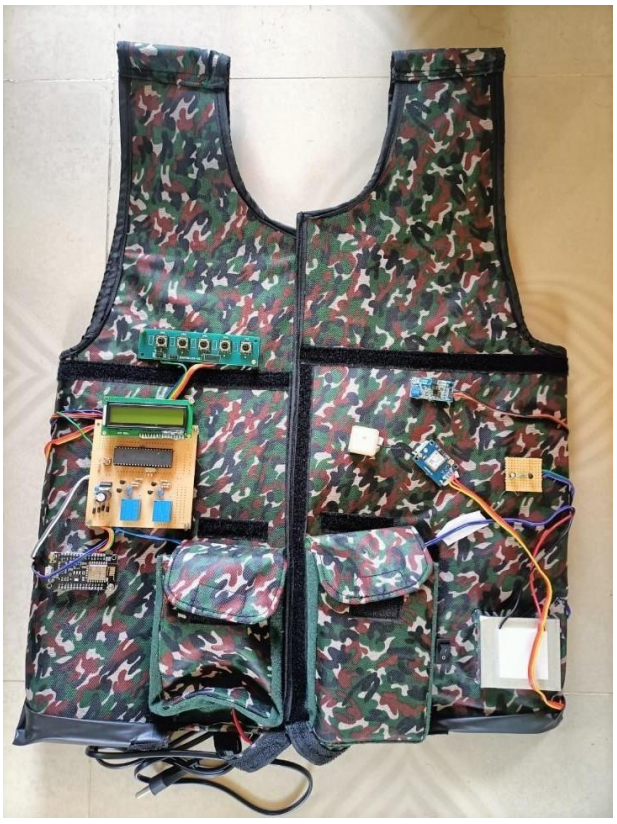


GPS

Here in this screenshot, we monitoring the location. It is showed soldier‟s current location.



PROJECT KIT:



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