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IoT Based Military Task Force Health Parameters and GPS Position Tracking System using Raspberry PI

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Abstract: *In this project we present an Internet of Things based Soldier Health Status Detection and Location Tracking System using Internet of Things for the safety purpose of the soldier. The soldier is the critical unit of the nation and their life is valuable. Lot of soldiers are facing many problems such as communication with the control room and no proper medical help at a proper time which leads to the death of the soldier. To minimize such cases, we have proposed a continuous alert system to track location and monitor the health of the soldier. The proposed system is very useful in detecting location of the soldier in real time using GPS and communicating the health status parameter continuously using GSM module embedded in microcontroller. The tiny sensors can be fixed to the Soldier body or dress of the soldier to detect body parameter and transmit the information to the control room and other solider when there is a low body rate or when it falls than the defined threshold value. The soldier can send an alert message to the guardian and control room for the help in the panic situation using an application. The control room/guardian also uses android application to request the location of the solider automatically in the panic situation. The soldier can also request for the nearest hospital information in the emergency.*

Keywords: GPS.

I. INTRODUCTION

In this modern era, enemy warfare is one of the most significant factors in any nation's security. Nation's security mainly depends on these three specialized uniformed services: The Army, the Air Force, and the Navy. Soldiers are a very essential part of these security systems. During any special operation or mission that's been carried out by these services, soldiers involved tends to get injured or get lost on the battlefield. As the soldier plays a significant role in national security, we cannot afford to let them get lost, or have any delayed medics reach the injured ones. So, to protect these soldiers we should have some technology that monitors and tracks the soldiers in real-time and help minimize the time of search operation, and rescue operation efforts of the control unit.

So, to support this idea, the project presents an effectual system that is capable of monitoring the health vitals of soldiers and at the same time able to record their current position using necessary sensors. The data collected from the sensors are then transmitted to the next level of the hierarchy using wireless RF modules. This system enables the control room unit to track the location and monitor the health vitals of the soldiers constantly using the wireless body sensor network, and the GPS receiver at frequent intervals. Arduino associated with the control room constantly monitors the data received from the different subsystems of the proposed design and triggers a warning if any values cross the set threshold values. Live health monitoring and position tracking of the soldiers will ensure that they are safe on the battlefield and if any abnormalities are found in the values received to the control unit node, they make sure that relief is sent from the control unit node or the squadron leader's node within a minimum amount of time.

1.1 Problem Statement

- To provide the real-time continuous monitoring of soldier's health parameters.
- To tracking location using IOT, GSM and GPS module.

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- To provide panic button for emergency situation.
- To provide voice alert which will help to have communication.
- To give better quality product.

1.2. Hardware Used

- Raspberry pi
- GSM Module
- Heart Rate Sensor
- Temperature Sensor
- Buzzer
- LCD Display
- Battery

Specifications

A. Temperature Sensor:

This sensor is useful for measuring temperature from -55°C to 150°C even in wet conditions. It is useful in compact systems.

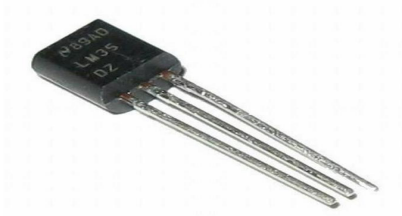

Fig 1. Temperature Sensor

Features:

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full −55°C to 150°C Range
- Suitable for Remote Applications
- Low-Cost Due to Wafer-Level Trimming
- Operates From 4 V to 30 V
- Less Than 60-µA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Non-Linearity Only ±¼°C Typical
- Low-Impedance Output, 0.1 Ω for 1-mA Load

B. Pulse Oximeter Sensor

MAX30100 is an integrated Pulse Oximetry and Heart Rate monitor sensor solution. It requires a 1.8V to 3.3V power supply to operate. Also, we can power it down through program code by decreasing its standby current and providing a power supply all the time.

This oximeter sensor has two LEDs, photodetector optimized optics, and low-noise-analog signal processing to detect heart-rate signals.

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Fig 2 Pulse Oximeter Sensor

C. Optical Sensor

- IR and red LED combined with a photodetector
- Measures absorbance of pulsing blood
- I2C interface plus INT pin
- 3.3V power supply complete pulse oximeter and heart rate sensor solution, simplifies design, integrated LEDs, photo sensor
- high-performance analog front
- Ultra-low power operation increases battery life for wearable devices
- Advanced functionality improves measurement performance, high SNR provides robust motion artifact resilience integrated
- ambient, light cancellation high sample rate capability fast data output capability
- It is an integrated pulse oximetry and heart rate monitor sensor solution.

D. Temperature and Humidity Sensor

The DHT22 is a simple, ultra-low-cost digital temperature & humidity sensor. DHT22 uses a capacitive humidity sensor and a thermistor to measure the surrounding temperature and humidity. It sends data in digital signal form so no analog input pin is required.

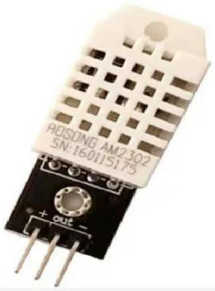

Fig 3 Temperature and Humidity Sensor

Features:

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 0-100% humidity readings with 2-5% accuracy
- Good for -40 to 80°C temperature readings ±0.5°C accuracy
- No more than 0.5 Hz sampling rate (once every 2 seconds)
- Body size 27mm x 59mm x 13.5mm (1.05" x 2.32" x 0.53")
- 4 pins, 0.1" spacing
- Weight (just the DHT22): 2.4g

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E. Raspberry Pi

Fig 4 Raspberry Pi

- Processor: Broadcom BCM2837 Processor Quad core A53 (ARM v8) 64-bit SoC
- Memory: 1GB LPDDR2 SDRAM
- Bluetooth: Cypress BLE chip 2.4Ghz/5.0GHz IEEE 802.11ac
- Ethernet: Gigabit Ethernet over USB 2.0 (300Mbps max)
- USB: Four USB 2.0 ports
- Connection: GPIO Header 40-pin
- HDMI: 1 x full size
- Video: MIPI DSI display port, MIPI CSI camera port & 4 Pole stereo output and composite video port
- Multimedia: H.264, MPEG-4 decode (1080p30). H.264 encode (1080p30). OpenGL ES 1.1, 2.0 graphics.
- Storage: microSD card slot for loading operating system and data storage
- Power: USB connector for 5.1V / 2.5A dc
- POE enabled

F. Neo 7m GPS module

Fig 5 Neo 7m GPS module

- Programmable (Flash)
- Data logging
- Additional SAW
- Additional LNA
- RTC crystal
- Internal oscillator
- Active antenna / LNA supply
- Active antenna / LNA control
- Antenna short circuit detection / protection pin
- Antenna open circuit

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- Detection pin
- Frequency output

G. Features of the AD8232 ECG Module:

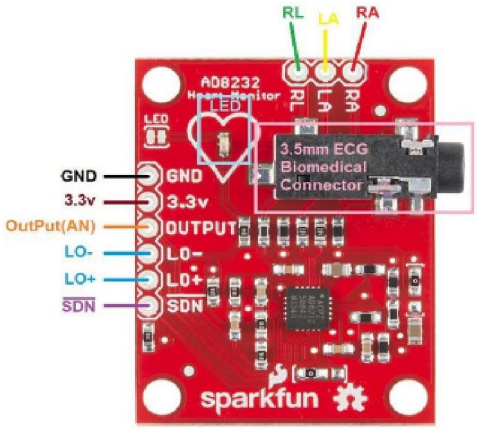

Fig 6 AD8232 ECG Module

- Fully integrated single-lead ECG front end
- Common-mode rejection ratio: 80 dB (dc to 60 Hz)
- Two or three-electrode configurations
- Qualified for automotive application
- Single-supply operation: 2.0 V to 3.5
- Fast restore feature improves filter settling
- Size: 3.5cm x 3cm

1.3 Advantages

- IOT Monitoring proves really helpful when we need to monitor & record and keep track of changes in the health parameters of the patient over a period of time. So, with the IOT health monitoring, we can have the database of these changes in the health parameters. Doctors can take the reference of these changes or the history of the patient while suggesting the treatment or the medicines to the patient.
- Hospital stays are minimized due to Remote Patient Monitoring.
- Hospital visits for normal routine check-ups are Minimized.
- No need to go on the field.
- Higher reliability.
- Cost-effective.
- Fast and efficient.

1.4 Applications

- Allow task force to track GPS position and health status.
- In panic situation it can send all information related to health and position to base station.
- Quick response to small change in health parameter
- Wide range of connectivity over internet

II. LITERATURE REVIEW

2.1 Recent Trends

A. Artificial Intelligence

The adoption of AI in defense enhances computational military reasoning for intelligence, surveillance, and reconnaissance (ISR) missions. Computer vision enables equipment safety management and empowers autonomous

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weapon systems, thereby reducing soldier casualties. By leveraging digital twins and machine learning, defense manufacturers test new military product iterations and enable predictive maintenance for military assets. Additionally, startups are developing self-organizing intelligent systems that work collaboratively toward a strategic objective using swarm computing.

B. Advanced Defense Equipment

Militaries are developing more sophisticated and advanced defense equipment to counter emerging threats. Innovations ranging from hypersonic flights and directed energy weapons to space militarization are underway. Also, the defense industry is aligning its objective with achieving net-zero emissions. Investments in battlefield electrification techniques through electric propulsion and hydrogen fuels for military aircraft facilitate this transition. Besides, defense organizations are advancing research in biotechnology and nanotechnology for creating self-healing armors and other innovative equipment.

C. Robotics & Autonomous Systems (RAS)

Protecting forces, increasing situational awareness, reducing soldiers' physical and cognitive workload as well as facilitating movement in challenging terrains are a few crucial objectives for militaries. The integration of RAS technologies allows militaries to achieve these objectives and control terrain, secure populations, and consolidate gains. RAS is increasingly important to ensure freedom of maneuver and mission accomplishment with the least possible risk to soldiers. The use of drones also enhances battlefield situational awareness. Moreover, multi-mission robots facilitate landmine clearance, search rescue operations, explosive ordnance disposal, and logistics support.

D. Internet of Military Things (IoMT)

Applications of IoT in defense include connecting ships, planes, tanks, drones, soldiers, and operating bases in a cohesive network. This enhances perception, understanding in the field, situational awareness, and response time. Edge computing, AI, and 5G support the smooth flow of data across all branches of the military, and this strengthens the command and control structure. In IoMT, the sensing and computing devices worn by soldiers and embedded in their equipment collect a variety of static and dynamic biometric data.

E. Cyber Warfare

Military systems are often vulnerable to cyber-attacks which could potentially lead to the loss of classified military information and damage to military systems. Over the past several years, the frequency and severity of cyberattacks have steadily increased. Prescriptive security technology uses cybersecurity, AI, and automation to detect potential threats and stop them before they impact defensive cyber warfare capabilities. Connected military equipment security, cyber protection for major institutions as well as in nuclear security are major areas of focus. Militaries are also developing offensive cyber warfare capabilities ranging from malware and ransomware to phishing attacks.

2.2 Literature Survey

Brijesh Iyer et.al (2018) [2] proposed a paper entitled "IoT enabled tracking and monitoring sensor for military applications". They suggest a technique that is specifi cally designed to meet the safety needs of armed personnel on the battlefi eld. The proposed method is primarily concerned with determining the exact location of soldiers on the battlefi eld. For determining human life expectancy, many human key signs and physical status conditions such as temperature, pulse rate, smoke detection, and oxygen saturation are used.

Kahtan Aziz et.al (2016) [11] proposed a paper entitled "Smart Real-time Healthcare

Monitoring and Tracking System using GSM/GPS Technologies". Physical status monitoring techniques have improved in recent years, and they have suggested a new innovative system to detect the patient's current physical status in their proposed and used method. They are completely focused on keeping track of the pressure and temperature rates. This method can be used by animals, schoolchildren, and transportation personnel to determine the exact location. Pratik Kanani et.al (2020) [19] proposed a paper Page 2/19entitled "Real-time Location Tracker for Critical Health Patients using Arduino, GPS Neo6m and GSM

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Sim800L in Health Care". They focused their proposed work on an IOT device that detects the precise latitude and longitude, i.e. the location of the patients in relation to the base station room. Doctors and health centre staff can also determine the exact location of the patient using web applications on the server and Google Maps, and medical assistance can be provided accordingly.This technique can also be used by wild animals, schoolchildren, and transportation personnel to determine their exact location.

Pallavi Kulkarni et.al (2019) [14] proposed a paper entitled "Secure Health Monitoring of Soldiers with Tracking System using IoT ". The paper fully focuses on an IOT developed Physical status observing and continuous following system for our armed forces. This system can also be placed on the person's body to key an eye on tracking their health status and the exact location using GPS. This system also comprises small wearable transmission modules,tools and sensors. Patil Akshay et.al (2017) [15] proposed a paper entitled "GPS Based Soldier Tracking and Health Monitoring". This paper which they proposed helps to monitor the armed force at any instance with the help of GPS. Here, soldiers' physical

status is measured continuously and then the measured information is passed to the base station.

If and only if any death occurs, unfortunately for any person in the war fi eld, the base station will know the difference in pulse rate and exact spot of the person who has died.

Manoj K et.al (2019) [13] proposed a paper entitled "Soldier Health Monitoring and Tracking System".

In their proposed method they focused on knowing the exact spot of the soldier as well as physical status of the armed person. The base station will come to the exact spot where the soldier is present by the message sent by the GPS and the physical health condition of them with the help of the message sent by GSM to them Here they also used Google map which can be used to display the locations of soldiers.

Jasvinder Singh Chhabra et.al (2017) [10] proposed a paper entitled "GPS and IoT Based Soldier Tracking & Health Indication System". With the help of their proposed method, soldiers are able to communicate regularly in all areas. Their approach is much simpler. The graphical display section of their proposed method for displaying the digital map can be added in the future. D. Poornakumar et.al (2020) [3] proposed a paper entitled "Soldiers Navigation and Health Monitoring System using GPS and GSM".

This method is an effective safety and protective method which is done by combining the developments in embedded along with wireless automation. It is useful for a Confi dential mission. In the proposed method developing a hardware system and picking a suitable GPS may be included in their future works. Deepa J et.al (2019) [4] proposed a paper entitled "Soldier Health Positioning Tracking System Using GPS and GSM Modem". They created a project using a wireless body area sensor network (WBASN), which includes temperature and heartbeat sensors, which is used to track the physical health of the armed person wherever it is needed.The proposed method is useful for determining the exact location of a

soldier and map-reading is accomplished between one soldier and another soldier by knowing their height, speed, distance, and physical status of all armed people on the battlefi eld, allowing military personnel to coordinate war strategies. Thanga Dharsni et.al (2017) [25] proposed a paper entitled "Soldier Security and Health Monitoring".

It is an acute secure and comfort system done by combining the advancements in far and new ideas. This method has a stable capacity. This method can also be Page 3/19applied as a factor of basic conditions.

III. DESIGN & DEVELOPMENT

3.1. Block Diagram and Description

Block diagram of the proposed concept. The above figure represents the block diagram representation of the proposed concept. The temperature sensor DS18B20 is interfaced with Raspberry Pi to fetch the data of body temperature, also MAX30100 is interfaced to get data about heartbeat and ECG sensor is used to see diagnosis and detection of heart disease. Then all this data is processed and transmitted over Wi-Fi using inbuild Wi-Fi module.

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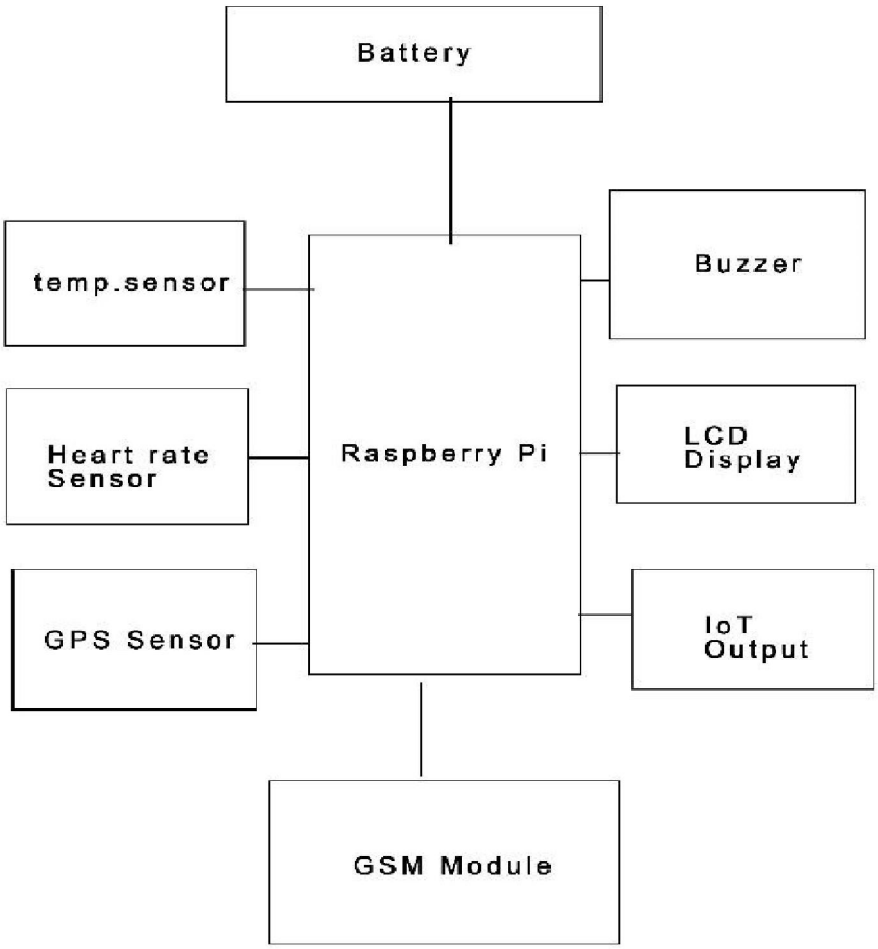

Fig 7 Block Diagram

3.2 Algorithm

Our proposed system is briefly explained in the flowchart shown above.

When the sensor begins to operate, the GPS will begin monitoring the soldier's position in both latitude and longitude.

The soldier's temperature is determined using a temperature sensor, and the natural temperature of the human body is between 31 and 37 degrees Celsius. If the sensor level oscillates below or above the usual body temperature, a warning SMS is sent to the control room, and the thermoelectric device automatically begins heating the soldier's body if it falls below the normal level.

The soldier's pulse rate is calculated using a heartbeat sensor, and a typical human heartbeat rate is 60 to 100 beats per minute. The control room will receive an SMS with the position if it goes below or above the usual threshold value.

To assess the level of pressure, a pressure sensor is used. If the pressure falls below or increases above the normal range of 80 to 120, it is considered dangerous.

The standard gas level is 100 to 150 ppm, and the gas concentration is determined using a Grove gas sensor. A warning SMS with the Oxygen level and position will be sent to the control room if it exceeds the normal level.

In the event that a soldier uses a button available there in an emergency, the control room will be notified via his locator that the soldier is in an emergency situation.

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3.3 Flowchart

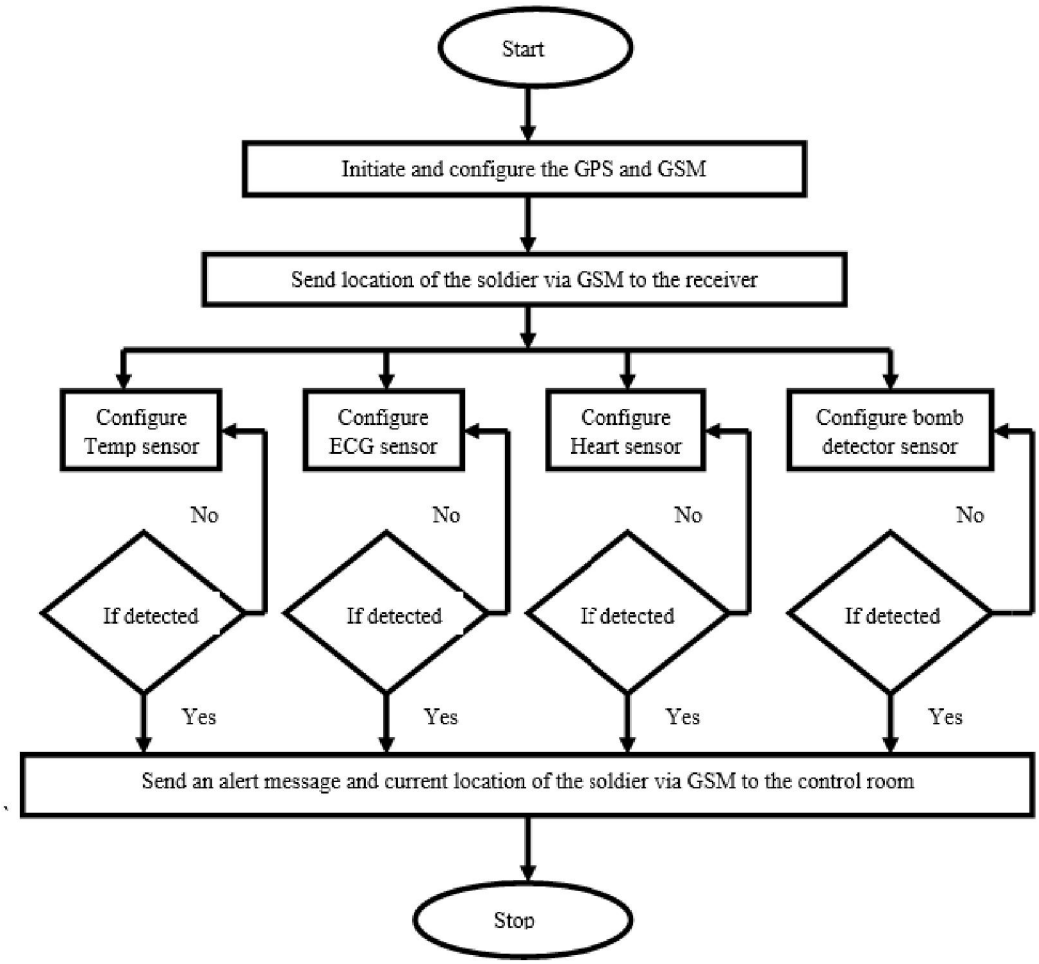

Fig 8 Flow chart

IV. RESULT AND DISCUSSIONS

4.1 Discussion

The sensor readings shown on the LCD display.

The performance from the mobile device is depicted in with latitude and longitude.

The message indicating an emergency when the soldier presses the button, as well as the location. The entire hardware setup for our project.

4.2. Results

The major problem in the military is lack of proper communication between the soldier and the control room. From the proposed system we can conclude that the various biomedical sensors sense the body parameters in real time and transmit the data to the control room, there by tracking the current location of the soldier using GSM and GPS technology and even the bomb near the surrounding of the soldier. It also provides the spontaneous communication with control room and other fellow soldier in a panic situation to get help.

The “Soldier health monitoring and position tracking system using GPS” project is a critical safety and security approach that incorporates embedded and wireless automation technologies. We infer that using a heart beat sensor, a temperature sensor, a pressure sensor, and an oxygen sensor, the above proposed approach is used to monitor a soldier's physical health parameters. This approach is also useful for soldiers in battle since it helps them to request assistance from the base station if they feel they are in a critical situation by pressing the button located there. Our proposed

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approach also sends information to the base station via SMS about where he is and how he is feeling. By attaching a breath sensor and a suitable sensor base station, the above proposed method by us will provide additional security to our soldiers. The graphical display portion of our proposed system for viewing the digital map may be added in the future. Interconnecting a camera to the controller may also be used to improve this process

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V. EXPECTED RESULTS

5.1 Expected Results

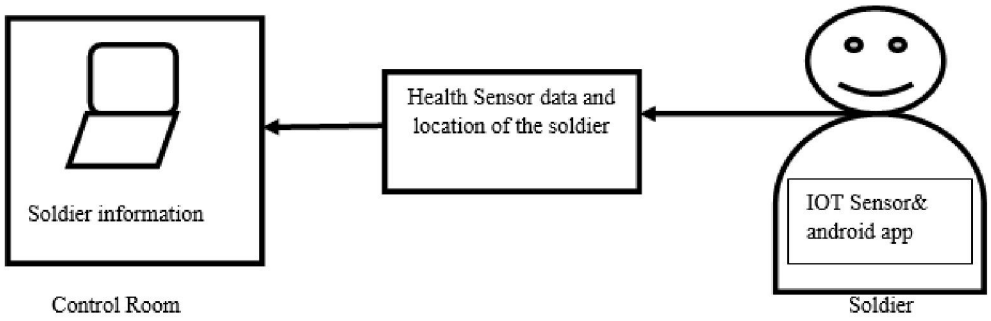

Fig 9 Proposed System

Fig 10 LED Display

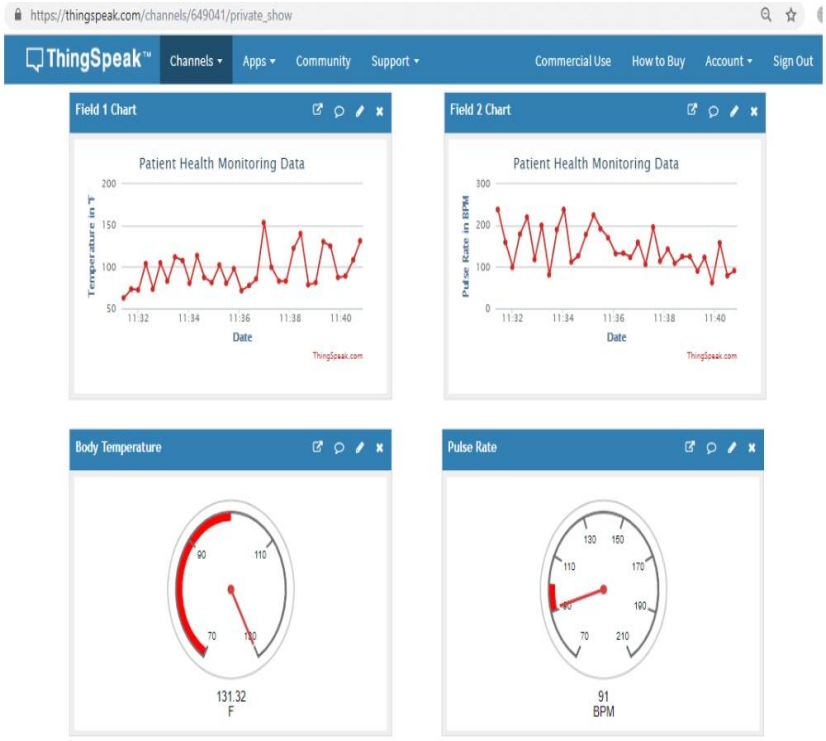

Fig 11 Web Output

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