Smart Health Monitoring And Bullet Detection Jacket

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Abstract- *The military army is heavily armed and extremely organized force, whose main task is typically outlined as defense of the state and its interests against external armed threats. It becomes very important to safeguard and protect the lives which indeed protect us. During the warfare times, the health of the soldier, whether they are injured, and finding their location always becomes a tedious task. Thus, developing a system which monitors their health status and location without compromising the security of data becomes necessary. Using this system during war times, it also helps in monitoring where the enemies are taking control and where the soldiers are losing more lives and need extra force can be monitored in real time.*

Keywords- Health monitoring system, Bullet detection circuit, Frequency hopping technique, Adafruit IO

I. INTRODUCTION

The military army is heavily armed, highly organized force which is intended for the warfare and defense of the country. The main task of the armed forces is defined as the defense of its state and its interests against external armed threats. Indian army is currently the second largest army in the world.

But however, when it comes to the safeguarding and monitoring the health status of the soldiers, the state of the defense still lacks it. The jackets that military uses is made up of kelvar and is still of a second generation design. It lacks in advancement and use of innovative technology to provide more security to the soldiers. When, the soldiers are located at places like Siachen, the temperature is less than zero degrees, the soldier faces many difficulties and it becomes very hard to patrol the border. The existing jacket does not provide any warmth facility which can maintain a constant temperature inside the jacket. Also, during the warfare times, the number of soldiers injured, the location where many army personals are injured and needs more force, the enemies strength, etc is not monitored in real time and the calculation is done on statistics and communicating with the soldiers from the war field. This takes too long and can have major impact in further planning and decision making.

The problems faced by the soldiers mentioned above can be overcome by developing a jacket, which makes use of innovative technology, and can monitor the health status, location, providing warmth and also detecting the injury of the soldier. By this, the soldiers can be continuously be monitored from the base station, and during the need or emergency, all the data can be obtained in real time, and by plotting the graph efficient planning and decision can be made. This also helps the rescue teams, which face difficulty in finding out the missing soldiers and the time consumed can be drastically reduced.

II. LITERATURE SURVEY

According to the research journal [1]*Health Monitoring vest with Bullet Detection for Soldiers, 2018.* Here, the concept of bullet detection circuit, the technique used to detect the position of the bullet hit is studied, and also use of various sensors integrated within the jacket is reviewed. The communication established with the base station here is using GSM/GPRS network. The problem with this network is that the availability of proper connectivity especially at the hilly areas and high altitudes. Also, security of the data using this network cannot be guaranteed.

In the journal [2] *Designing wearable devices in jacket form for health monitoring, 2018*. Here, the heart rate monitoring sensor, the temperature sensor, interfaced with the microcontroller and embedded inside the jacket. The heart beat monitoring algorithm used is studied. Here, PPG sensor is used to measure the pulse. This sensor uses a red light and infra-red for seeing the changes of the blood vessels.

In the journal [3], *A secure frequency hopping synthesizer for reconfigurable wireless radio, 2013.*Here , the concept of frequency hopping technique is studied, and the security level for secure communication is reviewed.

In the journal [4],*Soldier Health Monitoring and Tracking System using IoT, 2020.* described a system, which can monitor the health parameters, location and real-time video transmission, wound and bomb detection to the base station from soldier unit. The soldier unit consists of pulse rate sensor to sense the heartbeat, bomb sensor detects the

presence of explosive chemicals around the soldier, vibration sensor, made up of piezoelectric sensors, detects any wounds caused by gun shot or explosion, camera, to transmit the real time video of the soldier's mission through RF transmitter, temperature sensor to sense the temperature of the surroundings.

III. PROPOSED METHODOLOGY

The first part of the system is integrated with on the jacket, which consists of various sensors like pulse sensor, temperature sensor and humidity sensor. It also consists of bullet detection circuit made up of thin sheets of copper or aluminum. The whole system is controlled by Arduino microcontroller with all the sensors connected to it.

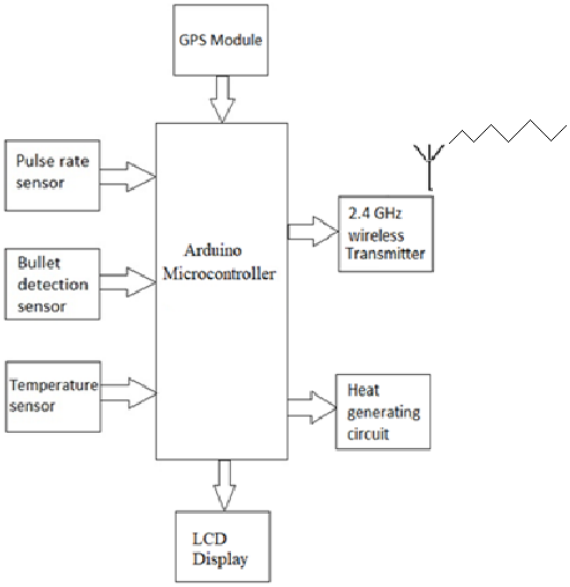

fig 1:Functional block embedded in jacket

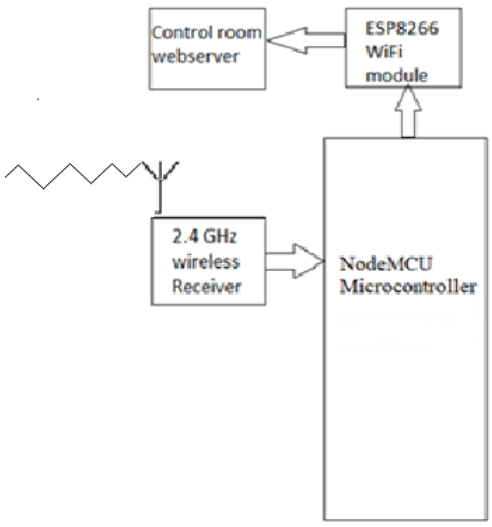

fig2: Functional block at the base station

The second part of the system is connected to the webserver located at the base station, which consists of Nodemcu microcontroller. Both, the first and second system are connected wireless using NRF module. The communication between these two is encrypted and uses Frequency hopping technique to avoid tampering and stealing of data thus maintaining security of the data .

The system at the jacket monitors the soldier health status like pulse and whether hit with bullet. Also it monitors the surrounding temperature and humidity and provides warmth when temperature is too low. When an abnormal pulse is detected, or if hit with a bullet, the system sends the alert message for help to the base station informing the status of the soldier along with his location using the wireless transceiver system.

At the base station, the data sent by the nRF module is received, and the Nodemcu uploads the data to the webserver portal for access of the data to the authorized personal. When help is needed, the system alerts the base station, in response the help arrival status is sent to the soldier and will be displayed on the OED display.

IV. IMPLEMENTATION

Hardware Implementation

Arduino Nano is small, flexible, compatible and bread board friendly microcontroller board, which was developed byArduino.cc in Italy and uses an ATmega328pchip.It has an operating voltage of 5V, although, the input voltage can vary from 7 to 12V. Its Pinout contains 14 digital pins 8 analog Pins, 2 Reset Pins & 6 Power Pins.

The Node MCU board is an open-source firmware and development kit. It has an built in ESP8266 module which is a highly integrated chip designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

Sensors like Pulse sensor, DHT11 sensor and bullet detection circuit is used to measure the physical quantities and convert it into electrical signals. Almost all sensors are based on same conversion values, except different principles and materials are used for physical to electrical conversion. All the sensors values ranges from voltage values ranging from 0-1024 mV which changes based on change in physical quantities.

The NRF24L01 is a wireless transceiver module so that each module can both send as well as receive data at the same time. They operate in the frequency range of 2.4GHz, which falls under the ISM band and hence it is efficient to use in almost all engineering applications. The module operates at 3.3V hence can be easily used with 3.2V systems or 5V systems. Each module has an address range of 125 and hence can be used in different frequency bands and therefore the module can be operated using frequency hopping technique.

Software Implementation:

Arduino IDE

Here, the Arduino microcontroller board is programmed using the Arduino IDE which is an open source software easy to use and program many microcontroller boards. With the many other libraries available, it makes a lot easier and efficient to interface other devices and sensors to the microcontroller. There is also a serial monitor so that the sensor values can be directly displayed on the monitoring needing no other external display board. Also for easy computation, serial plotter is available to plot the graph of the various values received for different sensors.

Adafruit IO

Adafruit IO is an open source platform, used for development of IoT projects, which is easy to build, design and interface microcontroller device Adafruit webserver. It is easy and simple to use with minimum programming knowledge.

It uses MQTT or message queue telemetry transport. It is a protocol for device communication that Adafruit IO supports. Using a MQTT library or client one can publish and subscribe to a feed to send and receive feed data.

V. BASIC ALGORITHM

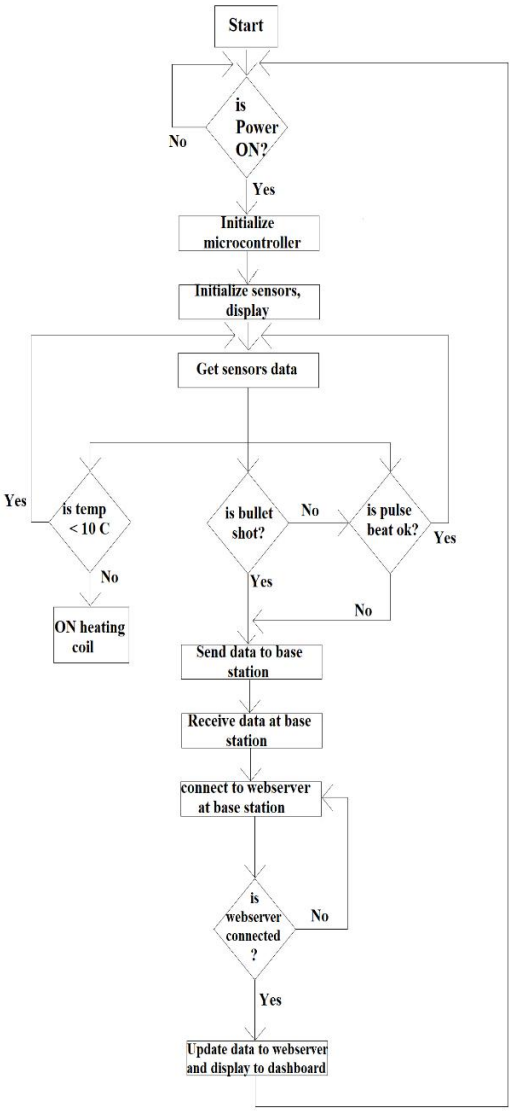

fig 3: Flow chart of the system

The algorithm is as follows which is explained using the above flow chart. The system when powered on, the microcontroller is initialized at first, and then the sensors, display and other external devices get configured with the microcontroller. The pulse sensor, starts monitoring the heart beat of the soldier and sends it to microcontroller.

Also, the bullet hit status from the bullet detection circuit is monitored. When, the values of these sensors exceeds the set threshold values, the message is sent to the control room alerting the injury or abnormal health condition of the soldier via the nRF module along with the location of the soldier in an encrypted manner with frequency hopping technique. The data is received at the base station, decrypted and updated in the webserver portal for authorized personals.

Similarly, the values like temperature and humidity from DHT11 sensor is passed to microcontroller. If the surrounding temperature is lower than the set temperature, (here 10 degree Celsius) the heating coils get activated thus providing warmth inside the jacket and hence protecting from cold.

VI. ADVANTAGES

- This system helps in monitoring the soldiers health status continuously.
- At the time of warfare, the condition of the soldiers, the place where enemies strength is more and where more force is required can be monitored in real time.
- Protecting the soldiers from extreme cold conditions by generating warmth.

VII. RESULTS

The prototype of the system is designed and tested which works as per the algorithm with satisfactory results.

Result analysis in Adafruit IO webserver:

The Adafruit IO server is used to make the database server where all the soldier's information and their current status is been monitored at the control room.

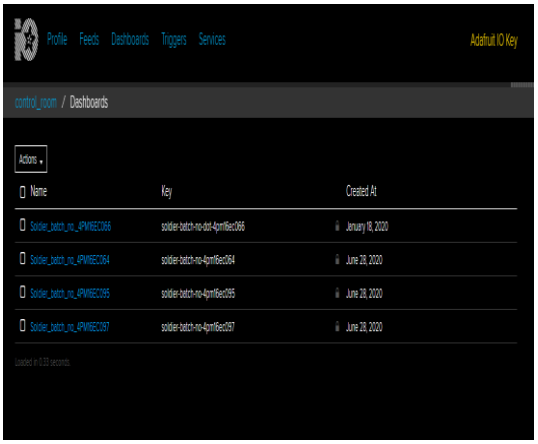

fig 4: Dashboard of Adafruit IO webserver

The first page after logging to the control room database comes the dashboard, where the list of soldiers with respect to their batch numbers are listed, where clicking on to the particular soldier id, redirects the page to the soldiers details and the current status of the soldier shown in the below figure.

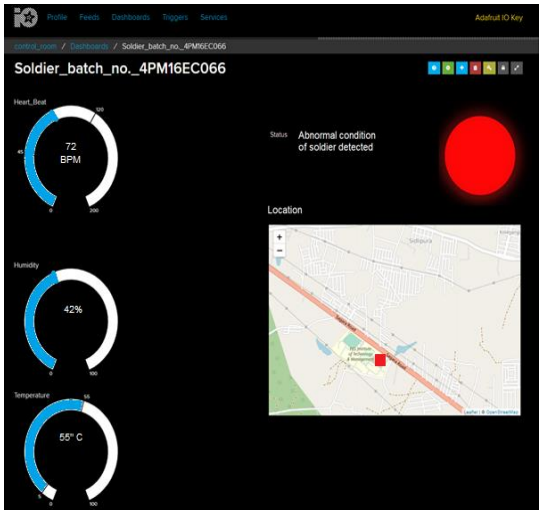

fig 5: Soldier health status on the webserver

Here, the data sent by the Nodemcu is directly uploaded to this feed, and hence the values are continuously been updated. The Nodemcu is programmed in such a way that it is given the Adafruit ID number and the hash functioned secret key to securely login to the account and update the data values to the webserver. A reference values are kept with respect to the values been updated. Any raise or fall in the values set for the respective data points will be treated as abnormal conditions and thus is alerted by the Red light in the database.

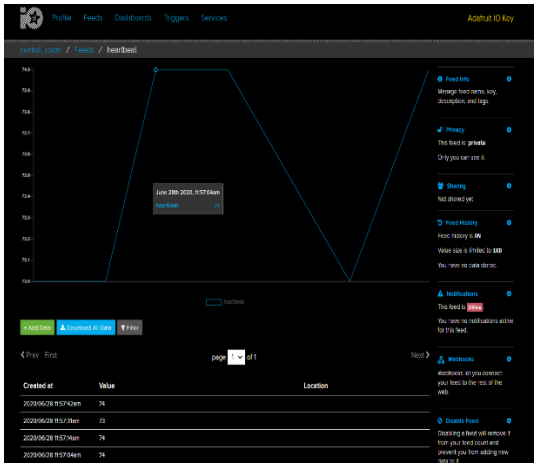

fig 6: Health history of the soldier

The above figure shows the history of the various data values updated in the webserver so that one can keep track of the previous health records of the soldier if required and keep a track record of his locations and other parameters in case of emergency situations.

Result analysis on OLED display:

The current temperature, humidity of the surrounding is shown in the OLED display which is fixed in the box with the jacket. Also, at the times when a soldier is injured, the status of the help arriving is also displayed on the display.

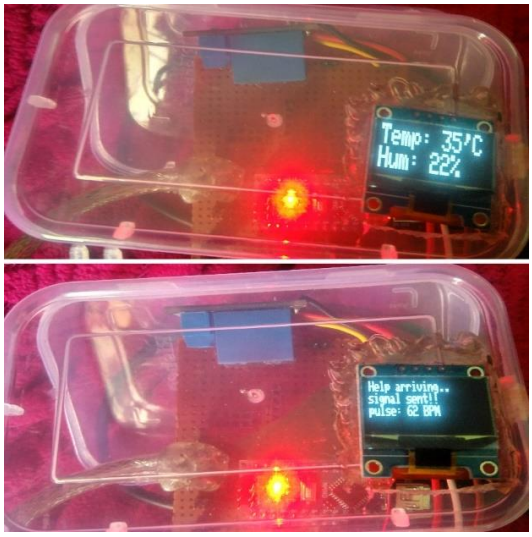

fig 7: Result on the OLED display

VIII. CONCLUSION

The smart vest provides security and safety for the soldiers. GPS and the RF modules track the position of the soldiers anywhere on the globe and the health monitoring system monitors soldier's vital health parameters. Soldiers can have a continuous communication with the base station. The clothing will remain lighter and durable. Body armor suits of the future for the military consist of lightweight materials, having integrated sensors and wearable devices that are meant to resist enemy attacks. This project, if implemented, would help the soldier to survive intense battle and may help to save the lives of wounded soldiers. Hence, all these developments may eventually inspire many to join the Army.

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