Smart Soldier Armour

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***Abstract*— We sleep peaceably in our beds at night only because rough men stand ready to do violence on our behalf. They are soldiers. We often see many soldiers using their lives without being properly able to share their location and health status till their last moment. In order to overcome this problem, we come up with a solution called Smart Soldier Armor.Smart soldier armor is a device which shares Vital body parameters of the soldiers who is wearing it. This device contains GPS module, Temperature sensor, Heart rate sensor, Triple axis accelerometer and an ATMEGA328P microcontroller of Arduino UNO. In order to share all these parameters to the destination we are using Grove-LoRa 433MHZ. The main challenge we are facing here is power backup so we use flexible solar panels as a regenerative power source which collects light energy and then this gets stored as electrical energy in battery.Neo-6M. GPS Module for identifying the location coordinates, Triple axis accelerometer to know the movement, LM35 sensor to record the temperature, SEN 11574 sensor to record heartbeat. We are connecting all these components to the ATMEGA328P microcontroller of Arduino UNO to program this device.**

***Keywords*— Soldier armor, GPS module, Temperature sensor, Heart rate sensor, Triple axis accelerometer, ATMEGA325 microcontroller, Arduino UNO, Grove LoRa 433MHz, Solar Panel, Location, Movement.**

I. INTRODUCTION

Body armor is protective clothing designed to absorb or deflect physical attacks. Historically used to protect military personnel. Able to stop multiple hits and save lives, they are essential to our military capability in the current conflicts. Many factors have affected the development of personal armor throughout human history. At times the development of armor has run parallel to the development of increasingly effective weaponry on the battlefield, with armorers seeking to create better protection without sacrificing mobility.
With the development of capitalism and technological advancements armor became more available to the lower classes often at a cost of quality.Keeping all the above things in mind so many people have worked on and created effective armors.How well the design and implementation may be, each and every model has its own conflicts and backdrops. Here we go with our proposal called Smart soldier armor.

Smart soldier armor is a device which shares specific parameters related to the soldier wearing it such as vital body parameters. This device contains some main components for working such as GPS module to share the location coordinates, Heart rate sensor to mention the heartbeat, Accelerometer to mention the movement, Temperature sensor to note the temperature.All these components only record or store the parameters they have recorded and cannot transmit the parameters recorded and we need a mode of transmission to retrieve the data all the components have collected.So, we are using Grove-LoRa 433MHZ as communication source to transmit the parameters the components have recorded, because if we use any other type of communication there are more chances of data to be transmitted being hacked.This type of communication though a secure way of transmission it has its own drawback when used here with this case that is, it requires source of power which is a great challenge.

Basically, the source of power to this communication in our case is a battery, but it can supply power only till it expires and the further point of supply is left as a question mark.Being used in an emergency kit we cannot risk it using only power source from battery and needs something more.As the process happening in this Armor is a continuous process, we need a regenerative power source in which Grove-LoRa 433MHZ module helps us by providing regenerative power supply.Even though we are creating regenerative power using Grove-LoRa 433MHZ we need to assume a case of dead power caused due to over usage of battery or the transmission getting hold due to loss of signals for transmitting.In this case the system should be active till it gets signals, so we are using Solar Panel to receive light energy and store it as electrical power which acts as a startup power source.Here we are using an ATMEGA328P microcontroller of Arduino UNO for programming the device.

II. LITERATURE SURVEY

[1] This paper share an idea of tracking the soldier and navigation between soldier to soldier such as knowing their speed, distance, height as well as health status of them during the war, which enables the army personnel to plan the war strategies. Base station gets location of soldier from GPS. It is similar to the [4]. It is necessary for the base station to guide the soldier on correct path if he is lost in the battlefield. The base station can access the current status of the soldier which is displayed on the PC as in [5]. And hence can take immediate action by sending help for the soldier or sending backup for threat ahead. Using various biomedical sensor health parameters of soldier's are observed, the position and orientation of soldier is trapped using GPS.

[2] In this paper ,the proposed system is on a vest, which consists of various health monitoring parameters and a bullet detection system. The health monitoring parameters include sensors such as temperature sensors (for both body and environmental temperature measurement), pulse rate, motion sensor, and accelerometer. The bullet detection system is devised from the method of matrix keypad as like as [8] the functional block diagram of the methodology. All the sensor data along with the bullet detection data will be processed and transmitted through GSM (Global System for Mobiles), where it will store all the values in the databases at the server side. Since the server side has high-speed processors, all the processing will be done at the server side only. Due to this, the limitations of the battery power consumed at the client side will be reduced. This is related to [9]. An efficient algorithm is developed, and threshold values are set based on the requirements. With the help of an MCU, a GSM/GPRS module and a Server, the soldier is efficiently monitored.

[3] is the paper which use technologies the tracking of soldier and navigation between soldier to soldier such as knowing their speed, distance, height as well as health status of them during the war, which enables the army personal to plan the war strategies. Base station gets location of soldier from GPS as in [6]. The base station can access the current status of the soldier which is displayed on the phone with the help of GSM and hence appropriate actions can be found.

III. PROPOSED SYSTEM

All the components collect the data such as heartbeat, body temperature, movement and location and sends them to the base station in a regular interval of time. These regular intervals of time are programmed using Arduino codes. These data received from the device consists of all the vital parameters of the soldier who is wearing it. There will be certain constant values for each one of the sensors. For all the constant values there will be slight lowest value and slight highest value. Both the lowest value and highest value will be saved in the code.

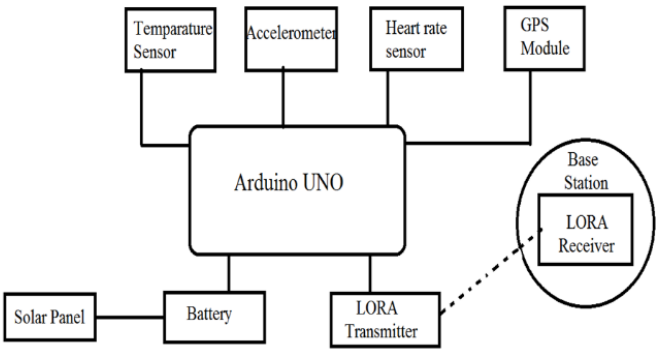

Fig: Block Diagram

This transmission of parameters is programmed in such a way that if there is any value going below or above the preset low and high values, this device will send an alert stating that something is wrong with the person wearing this device along with the location and health condition recorded through the sensors in this device at that particular instant of time. And here, sending the data in regular interval of time is a continuous process and we require a constant power source. And this is the answer for the use of LoRa module. LoRa is a RF module that can generate power while transmitting data. So, the power collected from this LoRa during transmission is stored in battery.Here you may get a doubt that why solar panel is used in this device. The answer to that is, as this is a wireless communication there may be least chances of transmission being interrupted due to some reasons. While in that case if the device is trying to establish a connection with the base station it uses power from the battery. And in this meanwhile the power may go low, because there is no power generation from LoRa. At this case the solar plates get the energy and feed the battery to work till the connection is established. So, this solar panels act as a backup power to the device.

As LoRa is a transceiver it can be used as Transmitter as well as Receiver. So, in device Lora is Used as Transmitter which sends the data and at the base station LoRa is used as receiver which receives the data. And Along with this device a switch is provided to press in case of emergency. When this switch is pressed it sends an alert stating that something is wrong with the person wearing this device along with the location and health condition recorded through the sensors in this device at that particular instant of time same as it sends automatically.

A. WORKING PROCEDURE

Step-1: Temperature sensor:

LM35 can measure from -55 degrees centigrade to 150-degree centigrade. The accuracy level is very high. The input voltage to LM35 will be from +4 volts to 30 volts. It consumes about 60 microamperes of current. The output is given to be +10 milli volts per degree centigrade. It means that with increase in output of 10 milli volts by the sensor v-out pin the temperature value increases by one. For example, if the sensor is outputting 100 milli volts at v-out pin the temperature in centigrade will be 10-degree centigrade. The same goes for the negative temperature reading. If the sensor is outputting -100 milli volts the temperature will be -10 degrees Celsius. This sensor can be configured in two ways

- Basic centigrade temperature sensing
- Full range centigrade temperature sensing

In the first configuration, we can only measure the positive temperature from 2 degrees Celsius to 150 degrees Celsius. In this first configuration, we simply power lm35 and connect the output directly to analog to digital converters.In the second configuration, we can utilize all the sensor resources and can measure the full range temperature from -55 degree centigrade to 150-degree centigrade. We have to connect an external resistor, in this case, to switch the level of negative voltage upwards.As we need both negative and positive temperatures, we use this sensor in second configuration.Centigrade Temperature = Voltage Read by ADC / 10 mV (milli Volt).

Step-2: Heart Rate Sensor

The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood, we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflected by the blood, this minor change in received light is analyzed over time to determine our heart beats. The sensor can operate both at +5V or 3.3V system.

Step-3: GPS Module

Global Positioning System (GPS) is a satellite-based system that uses satellites and ground stations to measure and compute its position on Earth. GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information to the satellites. GPS receiver uses a constellation of satellites and ground stations to calculate accurate location wherever it is located. These GPS satellites transmit information signal over radio frequency 1.1 to 1.5 GHz to the receiver. With the help of this received information, a ground station or GPS module can compute its position and time. GPS receiver receives information signals from GPS satellites and calculates its distance from satellites. This is done by measuring the time required for the signal to travel from satellite to the receiver.

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Where,

Speed = Speed of Radio signal which is approximately equal to the speed of light i.e.$3*10^8$

Time = Time required for a signal to travel from the satellite to the receiver.

By subtracting the sent time from the received time, we can determine the travel time.

To determine distance, both the satellite and GPS receiver generate the same pseudocode signal at the same time. The satellite transmits the pseudocode, which is received by the GPS receiver. These two signals are compared and the difference between the signals is the travel time. Now, if the receiver knows the distance from 3 or more satellites and their location (which is sent by the satellites), then it can calculate its location by using Trilateration method.

Step-4: Triple axis accelerometer

It is a three-axis accelerometer with I2C digital output and SPI interface. It has a wide sensitivity range and high resolution, operating with an internal 10- or 13-bit ADC. Built-in motion detection features make it easy to detect tap, double tap, activity, inactivity and freefall. There are two interrupt pins, and you can map all interrupts independently of each other. The sensor has three measuring axes, X Y Z, and pins that can be used as an I2C or SPI digital interface. We can set the sensitivity level to +-2g, +-4g, +-8g or +-16g. The lower range gives more resolution for slow movements, the upper range is good for high-speed tracking.

Step-5: Arduino UNO
All the three sensors and GPS module are connected to the Arduino and the connections are mentioned below.

Temperature Sensor
GND to Ground Pin
VCC to 5V or 3V Pin
Output to A0 Pin.
This analog voltage is converted to its digital form and processed to get the temperature reading.

Heart Rate Sensor
GND to Ground Pin
VCC to 5V or 3V Pin
Output to A1 Pin

Accelerometer
X-axis to A2 Pin
Y-Axis to A3 Pin
Z-Axis to A4 Pin
VCC, GND to 5V and Ground Respectively

GPS Sensor
GND to Ground Pin
VCC to 5V or 3V Pin
RX to D3
TX to D4

Grove-LoRa
MISO to D12
MOSI to D11
SLCK to D13
D100 to D2
D101 to D3VCC to 3.3 V
GND to GND
NSS to D10

Step-6: LoRa

LoRa is a robust, low-power, long-range wireless protocol developed by Semtech.LoRa entails a clever type of modulation similar to frequency modulation (FM) but is, in fact, a proprietary and patented chirp spread spectrum (CSS) modulation. The basic principle is that information is encoded using chirp (a gradual increase or decrease in the frequency of the carrier wave over time). Before sending a message, the LoRa transmitter will send out a chirp signal to check that the band is free to send the message. Once the LoRa receiver has picked up the preamble chirp from the transmitter, the end of the preamble is signalled by the reverse chirp, which tells the LoRa transmitter that is it clear to begin transmission.

IV. APPLICATIONS

1. Military:We often see soldiers die being not able to send his location to the others in order to acquire help. This is one of the best solutions. It will help to observe the different aspects of a solider like location, body temperature, heartbeat rate, motion of the person.

2. Health and Temperature monitoring: It will help to person enhancing the know the health conditions and temperature details.Sports. it gives more useful to a sports person calculates activity level and skin temperature.It enhances to know heat changes and health fitness also.

3. Emergency Situations: We frequently see women getting raped. In that situation if she is able to share his location to her well-wishers and for emergency callers such as police, fire, ambulance etc., the percentage of being saved will be high. This device will be a solution for this problem.

4. Rescue operations: The natural disasters like Tsunami, Earthquake etc., will occur all of a sudden. During those times all the communication sources will destructed. In that condition we can use this smart soldier armour for sharing location and health conditions of the affected people.

V. RESULTS\

Location:The GPS we use in this project will send the location of the soldier. So, that we easily find the place where the soldier has strucked, hijacked or kidnapped.

Body Temperature:LM35 Temparature sensor will send what is the body temparature of the soldier. By using LoRa this data will be shared.So that we know what is temapature. By that we can analyse the correct situation.

Heart Beat: By using pulse rate sensor we are calculating the beats per minute(BPM) of the soldier.This is also one of the expected outputs of the project. According to this we can know whether the person is alive or not.

Body movement: Body movement is also one of the expected outputs of the project. Triple axis accelerometer will calculate the velocity of the soldier.By looking at the velocity we will know exact position of the person.

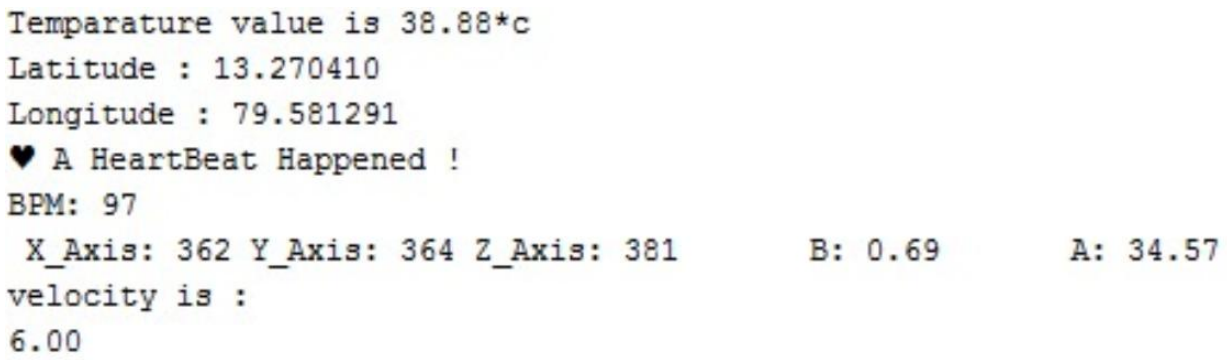

Fig: Measurement of various values of body

VI. CONCLUSION

The smart vest provides security and safety for the soldiers. GPS 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. 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 basestation so that they can get real-time view of soldier's on field displayed on PC.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 Indian Army.

VII. FUTURE SCOPE

We can add the nanotechnology fabric with tribo electric effect a jacket that powers the devices by our own movements to active using and also by use of Nanotechnology we can Improve the component stability and accuracy. In this case we have capability of generating electricity to the powering integrated electronics or sensors.CC1120 RF transceiver is device which communicate to long distances of nearly 140 kilo meters. So, we can use CC1120 RF transceiver to transfer data to long distances.

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