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Iot-Powered Real-Time Soldier Retrieval And Surveillance System For Intervention In Critical Combat Environments

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Abstract

It is to a huge extent the safety of civilians in any country, that the safety of the country's border security system is.Constantly watching for hostile neighboring country schemes and challengers, soldiers have been assigned to guard certain regions of the entire nationons of the entire nation are constantly monitoring for hostile neighboring country schemes and challengers. Because they run the risk of being killed or attacked by strangers, they need to have a safety system in place to alert them as well as encourage them to stay alive. To solve this problem, the proposed system is based on IOT and ZigBee technology in this article to keep track of the soldiers' precise location in real time and continuously monitor their health parameters that are to be sent to the control station.The main purpose of this article is to enhance soldiers' safety by using sensors to periodically check the health of the soldiers and detect life threatening signals. There are two components which make the safety mechanism system, these are the Soldier Unit and the Control Room Unit. The ESP8266 based approach that we suggest in this paper is through the use of the body sensor network to track soldiers' health indicators and transmitting their location data to an IOT web server so that it can be used to solve real time problems in the military. The web server can also be protected by a password. This web portal can be accessed by both Android devices and the system. They happen periodically on the predefined time interval set by control officials and regardless of data anomalies. The proposed system is a holistic approach to solving the problems that are most prevalent in the military field.

Index Terms— IOT, GPS, Zig bee,Real time health monitor, Body sensors

I. Introduction

With sensors, the Wireless Body Area Sensor Network System (WBANS) measures body temperature, heart rate and other vital signs on a regular basis. Moreover, GPS navigation will pinpoint the soldiers' exact location. The gas sensor is to keep an eye on what is going around us so that we could inform the soldiers that attack on us with poisonous gas. Communication between commanders and soldiers is done by GSM/IOT. Any deviation of the wireless body sensors (WBASNs) measured values from their known corresponding base station values has to be registered as mobile triggers, in order to establish a connection between the soldiers and the base station to send the recipient's location and recent status.

This is why biosensors are a tool to monitor health. Additionally, a GPS tracking technology is used to find the soldiers. Further, alert messages are sent via a GSM modem. In case of erroneous observed values from the wireless body sensors (WBASNs), the soldiers and base station have to send an emergency alert message. With this clause, we are planning to provide our soldiers a primitive protection system to be placed on their shoes or jackets. It's a lightweight and compact portable device.

II. Related Work

The author [1] designed a system to monitor SpO_2, heart rate and body temperature and display the results on an LCD. The essential measures are transmitted by means of Bluetooth module to Android mobile, and using Wi-Fi module to the internet, forming internet of things platform for the designed embedded system of sensors. The embedded sensor system can be used to monitor key health parameters of patients in hospitals or at home. The proposed affordable medical technology sensor system can be used as wearable wireless sensor which can be used as a plug and play sensor with Arduino to monitor human key health parameters.

The system comprises several sensors for the data acquisition, NavIC**[2]** as the tracking unit, Cortex M4 as the controlling unit and LoRaWAN 02module as the networking unit. In this paper, They have been discussed about the implementations, methodologies, architectures and the enhancements of the application of Soldier health monitoring and tracking systems.The heart rate, temperature and the humidity level, GPS position should be constantly monitored in the desired situations to provide quick and active medical or tactical support in case of any kind of emergency. We have proposed a wireless system that will be capable of collecting the vitals and the position of the soldier and send the data directly to a base station for monitoring.

In this article[3], with the help of the Internet of Things (IoT) and GPS, tracking and monitoring the health conditions of the soldiers can be done by using live track applications. The proposed device, which uses GPS for monitoring the health of soldiers and their current position, can be placed on the soldier's body. This data will be sent to the control room based on the live track program. And the proposed system is made up of small physiological devices, sensors, and transmitting modules that can be worn on the body. A low-cost, high-reliability simple lifeguard using these sensors is necessary for soldiers. In the present scenario, the countries' security depends on the army. In this aspect, their respective more solid health and tracking are more crucial to defend themselves.

Warfare[4] is an important factor in any nation's security. One of the important and vital roles is played by the army soldiers. There are many concerns regarding the safety of soldiers. So for their security purpose, many instruments are mounted on them to view their health status as well as their real time location. Bio-sensor systems comprise various types of small physiological sensors, transmission modules and processing capabilities, and can thus facilitate low-cost wearable unobtrusive solutions for health monitoring. This paper 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 control unit 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

will be transmitted wirelessly using ZigBee module among the fellow The author[5] 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 alsouses 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.

III .PROPOSED SYSTEM

The proposed system is a complete strategy to tackle the problems that are basically there in the military sector. The aim of this article is primarily to reduce the risk of harm to soldiers by periodically overseeing the state of health of soldiers using sensors to monitor the vital signs of the life. Reports are sent to control station from their health which assesses and check for any kind of abnormality and take such steps to mitigate it. The two segments in the safety mechanism system are known as Soldier Unit and Control Room Unit.

3.1 Soldier unit:

The Soldier Unit is built using a microcontroller board; an Arduino microcontroller is suggested for prototyping. It is in control of all decision-making and processing within the system. The author additionally possess a temperature sensor, a pulse sensor, a GPS receiver, a Wi-Fi module, a Zigbee module, and a fire/gas sensor. The former main sensors also measure things like body temperature and heart rate and are used to detect nearby explosions.

The GPS receiver's job is to determine the soldier's precise location and direction in real time with respect to latitudes and longitudes. Here smoke/fire sensor acts as a secondary deterrent against masked intruders breaking in at night.

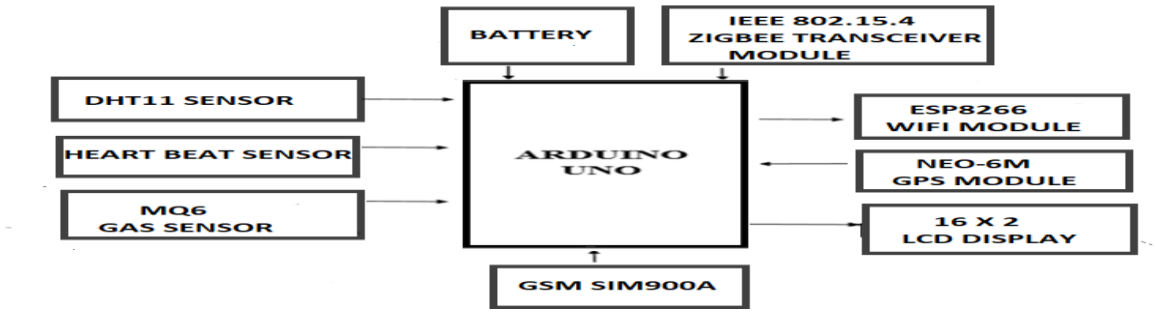

Figure 1.1 Block diagram of Soldier unit

These are the main issues that our comrades go through while doing their duties and will need to be properly published to the control room unit so they can help their mates in need of rescue.This is because our comrades are injured, get stuck in trenches and their health declines as a result of the unwholesome environment. Intruder attacks include smoke screens, explosive blows to soldiers and fire charges. Active fire charges can be detected by a smoke sensor. It is clear therefore that we should keep continually observing the soldiers' health.

The block diagram of Soldier unit consisting of a Microcontroller board preferably an Arduino microcontroller, Temperature sensor (DHT11), Heart Beat sensor, MQ6 Gas sensor, NEO-6M GPS Module, ESP8266 Wi-Fi module and Zigbee transceiver module is shown in figure 1.1.

Prototyping is done using Arduino microcontroller. This part controls the entire processing and decision initiation part of the system. Since continuous power supply to device is not feasible, this unit requires a 12V battery for powering.The vital signs of life like as temperature by DHT11 sensor, & heart rate by heart beat and to sense any kind of explosion near them, we are using MQ6 Gas sensor as a secondary line of defensive mechanism to combat attacks that take place at night by camouflaged intruders. These are all issues that need to be fully reported to control room unit so that they are able to take out their comrades who would need resucue. The GPS module is used to identify the real time location and orientation of the soldier(in latitude and longitude). GPS is used to track the site and orientation of a soldier to further action and data is processed using Arduino microcontroller. ESP8266 is a used to send the processed location of the soldier over internet (From portable handheld Wi-Fi) periodically to the cloud, but if any of the vital parameter falls below the prescribed threshold limit, the data is transmitted continuously so that the actual latitude and longitude coordinates of the soldier is known and can be used to rescue him. Data can still be transmitted to control station through Zigbee RF communication in case of cellular network failure and the soldiers could be rescued there is a primary cellular communication in terms of GSM SIM900A.

Figure 1.2 shows that the block diagram of Control Room Unit, which has a power supply, Data visualization as message to GSM receiver, Zigbee Receiver and cloud server. The information is sent periodically to Control Room Unit through the cloud server and data is visualized in PC and viewed by military control station and have to check for an undesirable parameter.When there are complications with the soldiers the values and aid to rescue their target because incase of any complications faced by soldiers an alert message is sent through the GSM receiver and also through the Zigbee receiver so in case cellular communication fails we can receive the information through Zigbee receiver in the PC , and this data is progressively monitored by military control station and they must check for undesirable parameter values and aid to rescue their target,incase of any complications faced by soldiers an alert message is sent through the GSM receiver and also through the Zigbee receiver the information is sent so when cellular communication fails we can get information through Zigbee receiver.

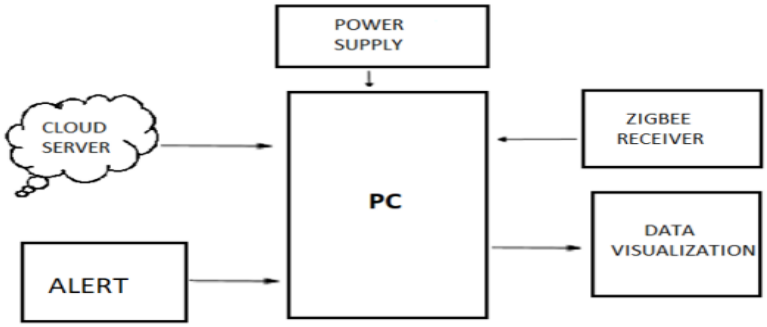

Figure 1.2. Block diagram of Control Room Unit.

3.3 FLOW CHART OF HEALTH MONITORING AND LOCATION TRACKING UNIT

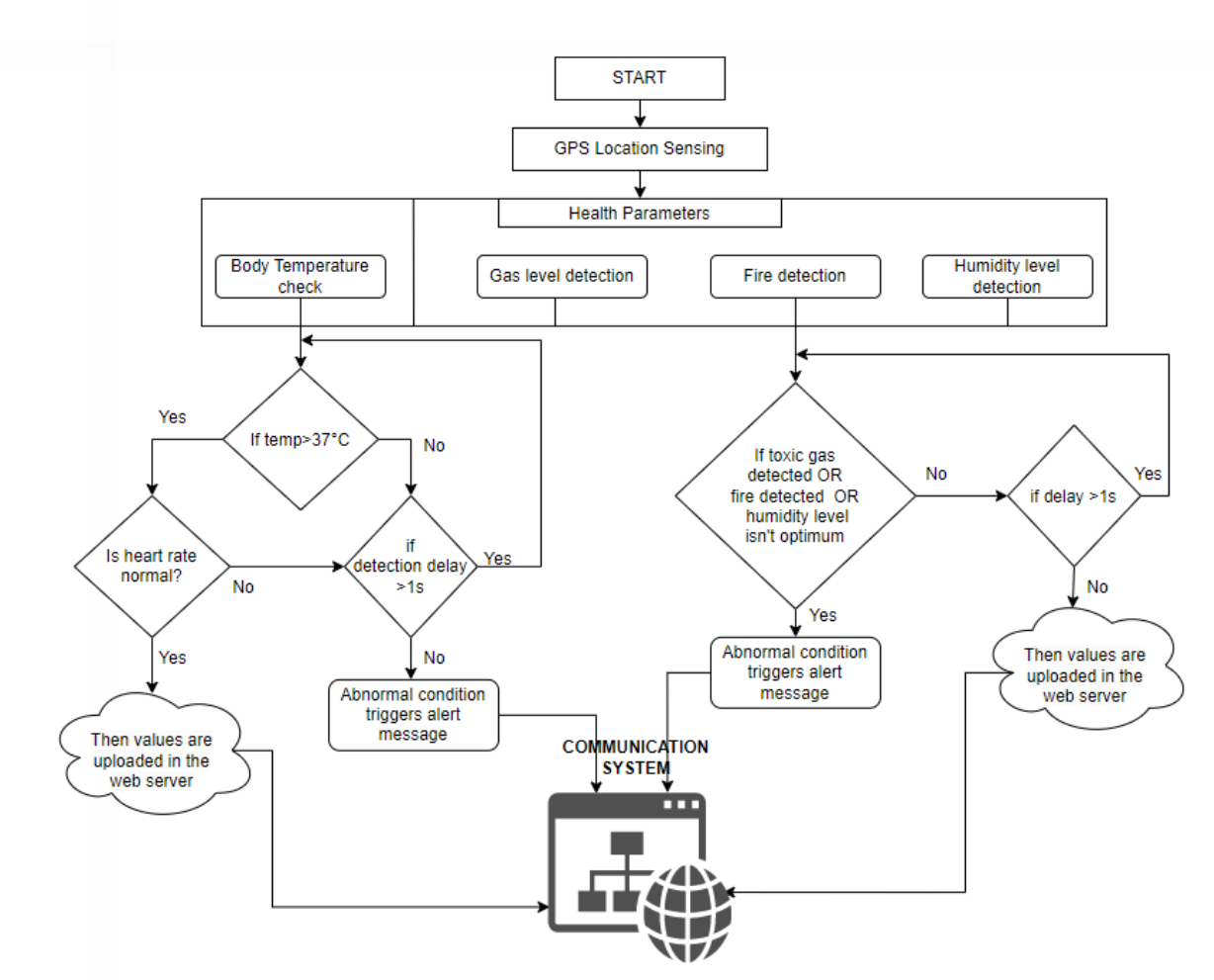

Figure 1.3 Flow Chart Of Health Monitoring And Location Tracking Unit

The proposed flow chart Of Health Monitoring And Location Tracking Unit is shown in Figure 1.3.The primary process for tracking soldiers' locations and assessing their health in their units

is soldier health parameter evaluation. The DHT11, heart rate, MQ6, and infrared flame sensors comprise the body sensor network, which keeps an eye out for nearby explosions, dangerous gas concentrations, and anomalies in body temperature. It is important to take note of these anomalies and notify the control center. The soldier's unit's NEO 6M GPS Module periodically tracks the coordinates, but it only sends this data to the control station when it is required in the case of unusual circumstances. First they are comparing the sensor data with the normal or the ideal value, if a substantial deviation from the normal range is found, they are sending the alarming message to the number registered in mobile device via GSM SIM900A module.

Since heart rate sensor takes few seconds to compute beats per second (bps), we devise it such that only when temperature value exceeds normal it activates pulse sensor. Then heart rate is checked and if its normal it's updated in web server using ESP8266 Wifi module and if the values exceed normalcy then alarm messages are sent to registered mobile no. as well as to the control room zigbee transceiver unit through IEEE02.15.4 Zigbee technology (CC2500 module). Similiarly the other sensor values are monitored and decision is made so that whenever it points out an issue, rescue help can be sent to the appropriate comrades. Sometimes there may be a case where the parameter values points to neither abnormality nor ideal case, it may occur due to sensor's sensing delay or malfunctioning and this case has also been carefully taken care of in this methodology.

3.4 Flow chart of Communication System

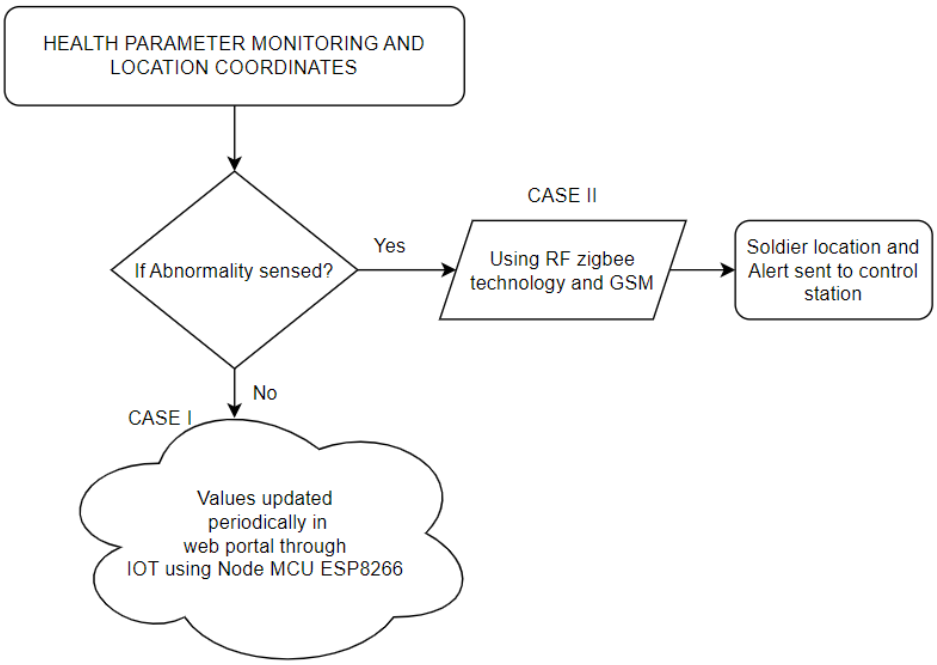

Figure 1.4 Flow diagram of Communication System

The basic flow diagram of communication system is shown in figure 1.4. The communication system comprises of Web server, zigbee transceiver and GSM module. The sensor parameter values are periodically entered in web server every second using the IOT module ESP8266. If

any abnormality is sensed then alert message is sent through GSM as well as to ZIGBEE transceiver thus making this system independent of cellular networks.

In normal case the data is sent to web server. When cellular connection fails, alert can be sent to control station through ZigBee technology which uses simple RF Communication. Though this ZigBee technology is mainly used for short range communications we can employ multiple nodes on mesh network to increase coverage range.

Case I : IOT can ne enabled When Cellular signal exists.

Case II : ZIGBEE can be enabled When Cellular signal fails.

IV. RESULTS AND ANALYSIS

4.1HEALTH PORTAL:

It stores the received sensor readings and location of soldiers in the portal which is secured by a password and can be accessed only by the military professionals.

WEB PORTAL

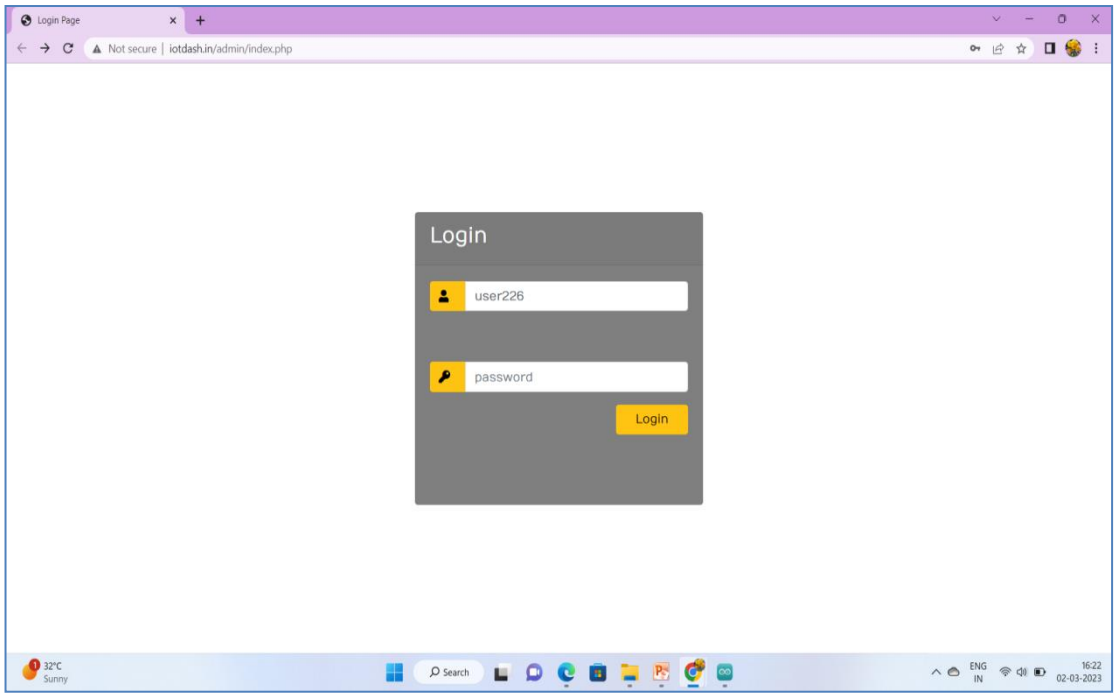

Figure 2.1 Login page

Fig 2.1 is Login page. Each soldier unit has unique user ID and password which can be securely logged in either as app or web server to get all the stored and current soldier health parameters and location coordinates along with time and date of entry.

4.2 ARDUINO SERIAL MONITOR

Case I explains about the parameters obtained with normal as well as case II says about abnormal conditions of the soldier

CASE I : NORMAL CONDITIONS

Figuer 2.2 shows the output obtained when every parameter is under normal range

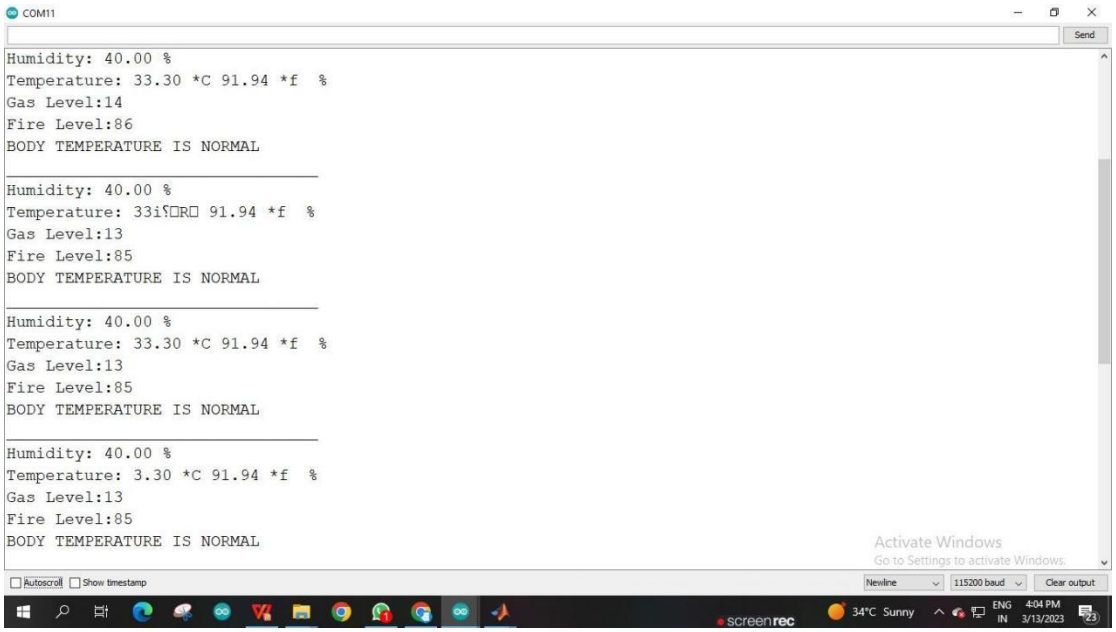

Figure 2.2 Output obtained in Normal Conditions

Table 1.1 contains normal or optimum range values for each parameter. The first column gives the normal range and any value that is out of this range is classified as potential abnormality in the code developed so that proper output can be sent to control station.

Table 1.1 Boundary cases for sensor parameters

PARAMETERS	**OPTIMUM RANGE**	**ABNORMALITY**
HUMIDITY	<60 %	>80 %
TEMPERATURE	<36°C	>37°C
GAS LEVEL	< 70 ppm	Above 90 ppm
FIRE LEVEL	> 80 %	< 50 %
HEART RATE	>50 &&<100 beats	<50 &&>100 beats

CASE II : ABNORMAL CONDITIONS

The alert message has been sent and the values are updated in portal if (fire level <50) || (gas ppm >70) || (humidity level > 65) || :else the values are updated in portal with normal conditions.

Flame sensor senses abnormality when fire level < 50 which is shown in figure 2.3 and also senses abnormality when gas ppm >70 which is shown in figure 2.4

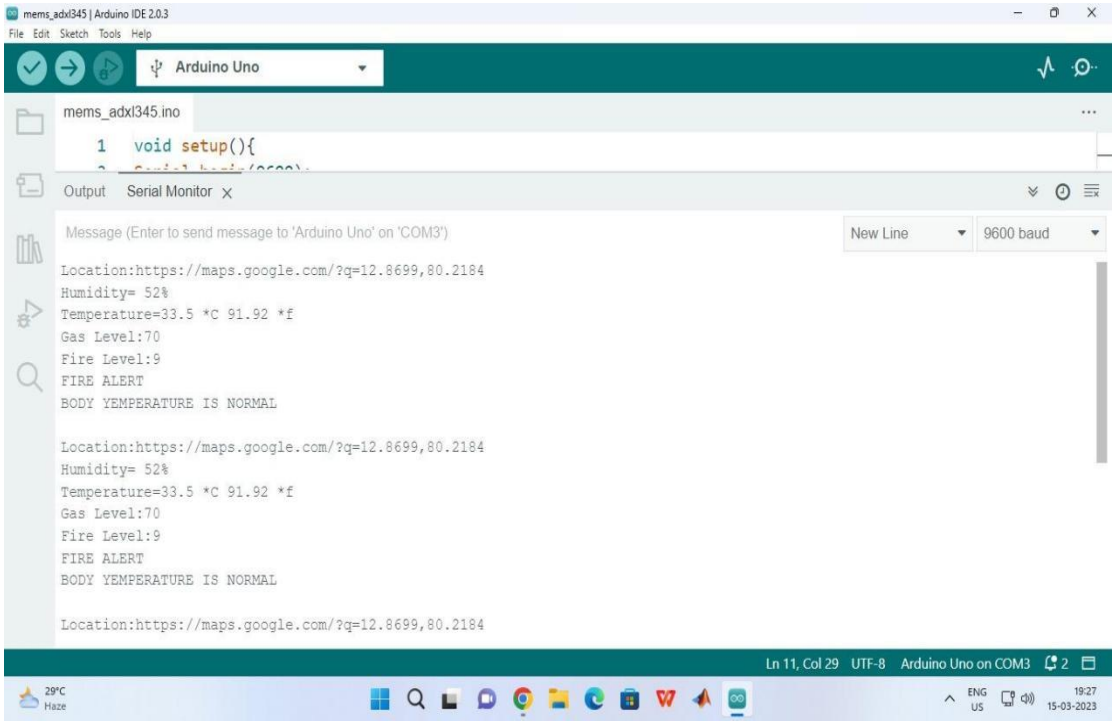

Figure 2.3 FIRE ALERT

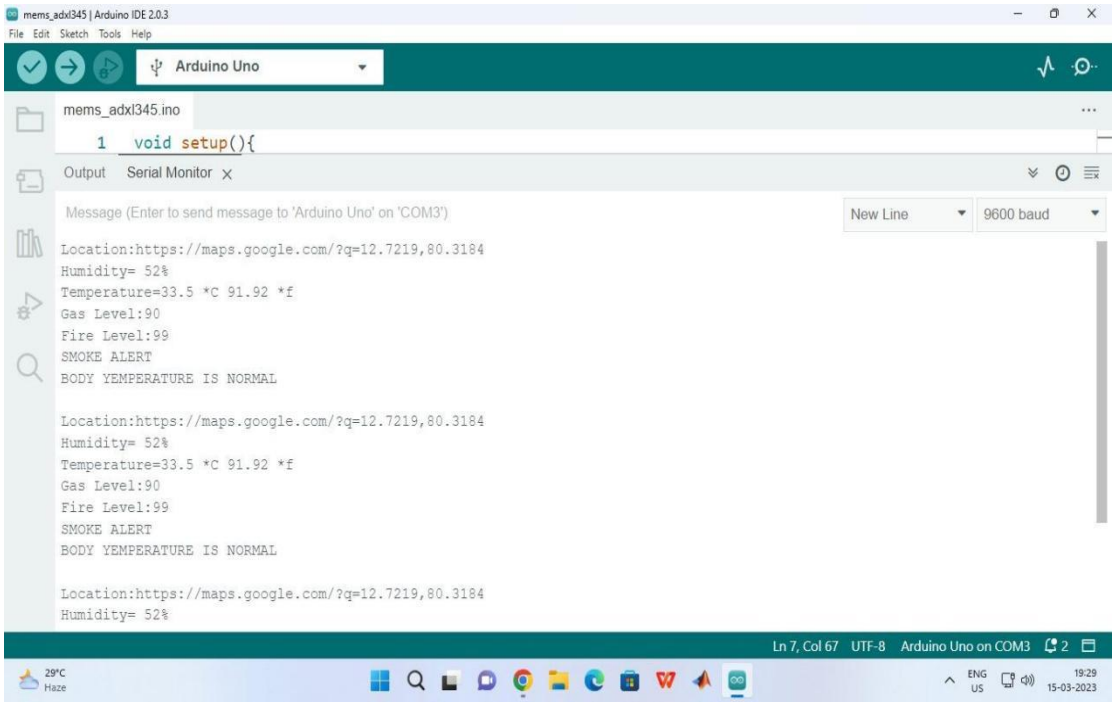

Figure 2.4 SMOKE ALERT

When temperature is greater than 37°C then it is deemed as abnormal temperature and only heart rate sensor will detect pulse rate. Figure 2.5 shows the output obtained as abnormal temperature and heart rate detection.

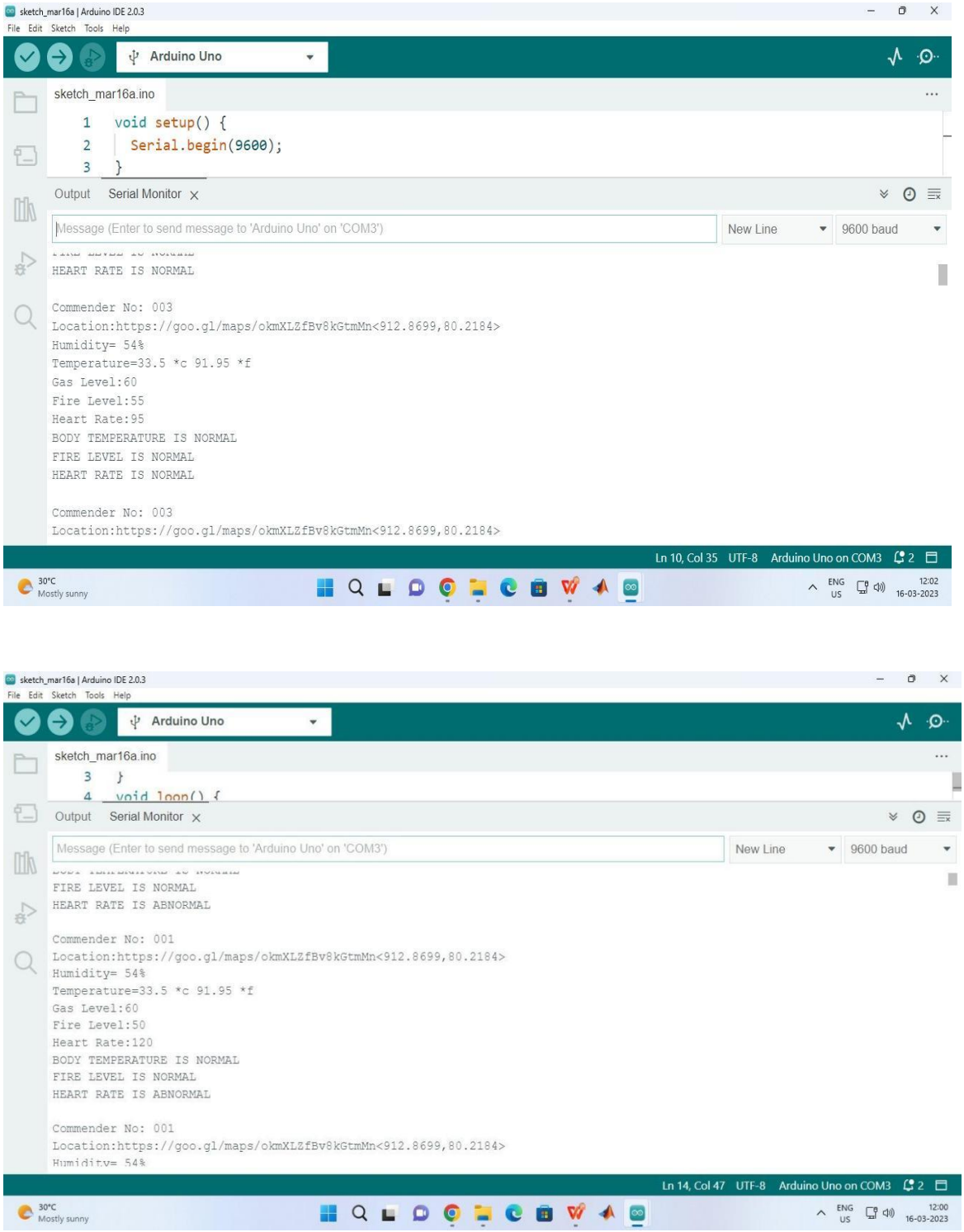

Figure 2.5 ABNORMAL TEMPERATURE AND HEART RATE DETECTION

Table 1.2 with sensors measuring humidity and temperature under various conditions. This table will show the type of sensor, the situation or condition being monitored, the collected data and observed outcomes, any anomalies, and any notes pertaining to the analysis.

Table 1.2 SENSOR DATA ANALYSIS FOR VARIOUS SITUATIONS

PARAMETERS	Situation	Observed Outcome(in percentage and celsius)	Comments
HUMIDITY	Indoor Climate	50 %	No issues
	Patient Monitoring	55 %	Within normal range
	Greenhouse Monitoring	65 %	Slightly high
	Industrial Site (Air Quality)	44 %	Within normal range
	Fire Safety (Building)	60 %	Within normal range
TEMPERATURE	Indoor Climate	23°C	Normal range
	Patient Monitoring	37.2°C	Normal body temperature
	Greenhouse Monitoring	28°C	Slightly high for comfort
	Industrial Site (Air Quality)	22°C	Within acceptable range for industrial environments
	Fire Safety (Building)	30°C	Slightly elevated, could indicate fire risk

V. Conclusion

GPS tracks the position of soldiers anywhere on the earth and also Sensor Unit monitors the soldier's vital health parameters and environmental situation which ensure safety of soldiers to a certain extent. Less complexity of the device due to the use of an arduino microcontroller leads to reduction in overall power usage of the system. These modules used are smaller in size and lightweight so that they can be easily carried around. Implementation of this device leads to real-time monitoring of soldiers on battlefield by control station as well as to rescue injured soldiers at medical emergencies.

In future, it is necessary to develop an integrated data management system and web portal suiting to multiple devices (transmitters). Also we aim to introduce soldier-to-soldier communication incorporating ZigBee mesh network thus increasing the range of coverage to maximum. Also instead of batteries, we may produce power supply for the system from natural renewable resources like wind energy.

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