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Biometric Gloves for Health Monitoring

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Abstract: ***Global health, defined by the access to healthcare in every region, is symbolized by its demands to be economical and easily accessible. IOT based remote health monitoring system, advancing in the health care sector, is one of the most up-and-coming technological interventions. A serious concern world over, has been perilous work environment that pose health and safety hazards. With the advancements in technology, it is now possible to supervise individual health parameters and provide comprehensive information on health conditions. Users vital information can be monitored from anywhere with access to a specific control centre where the information is stored in real time. In this paper we present a remote health monitoring system that uses an IOT based smart edge technology, where wearable vital sensors transmit data to the cloud using a Wi-Fi module.***

Keywords: Internet of Things; Wearable Sensors; Activity monitoring; Health sensing; Pervasive Healthcare

I. INTRODUCTION

Our lifestyle, social interactions and work environment have undergone a lot of transformation because of the advancement in information and communication technology. Information technology has had a great impact on healthcare and its wellness management. Uniqueness of modern healthcare techniques is that it is developing steadily. It includes identification of a health problem in the early stage itself, prevention and managing it for longer durations. We need to track the health situations of an individual and manage his or her well-being based on this information [1]. To illustrate, the cardio condition of a patient during his normal routines can be continuously monitored using an ECG or PPG through wearable sensors, which assists detection of variation in blood pressure, fluctuation in stress levels and depression. These recorded biomedical signals can be analyzed automatically to help physicians manage patients and also develop warning systems [7]. Several benefits emerge from this, such as improved collaboration among doctors, efficient care of patients and more importantly reduction in health care costs. Patients stand to benefit the most because early detection of any abnormal health condition is possible by such continuous monitoring, which improves diagnosis and their health.

The development of a mobile based health monitoring system using the principle of BAN is an advancement in personalized healthcare. In a health televised monitoring system, a WBAN equips multiple light-weight micro sensors [10]. These help in the measurement of parameters such as ECG, body temperature, etc. These values are dispatched to an external storage device through wireless transmission, and are then sent to a health tele-monitoring station via the Internet. The use of wearable technology and its implementation along with the Internet Of things is more of a necessity than luxury these days

The need for such specific technology in health monitoring sector for workers working in hazardous conditions like the miners are in great demand [2]. Information can be transmitted through IOT from a particular device to the cloud and can be accessed through a web-page [14].

II. SYSTEM MODEL

A. Proposed System

A temperature sensor and a pulse oximetry sensor are connected through the analog ports of the Arduino Nano. The GPS module and WiFi module are also connected to the Arduino through its digital I/O pins.

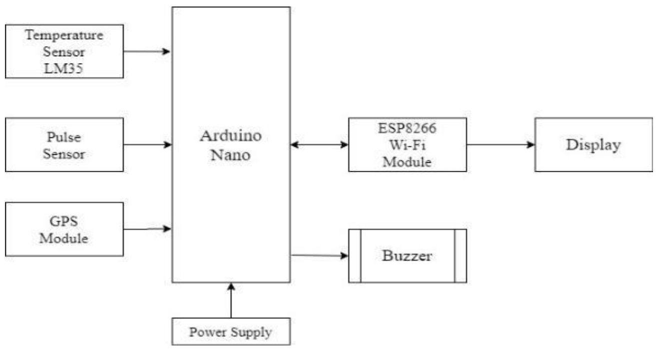

Fig. 1. Block Diagram

These data are transferred to the Wifi module through an in-built micro controller. The WiFi module has been used to store and display the outputs of the sensors and the GPS module through the internet. A feedback system is also implemented in order to alert the user and the concerned supervisors. The IOT web page, can be used to monitor the user from everywhere.

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III. METHODOLOGY

A flexible pulse oximetric sensor is sewn into the glove, around the finger, which is a non-invasive way to determine the pulse and the level of oxygen in the blood. Blood oxygen saturation data are particularly important for determining injuries affecting the user's respiratory system.

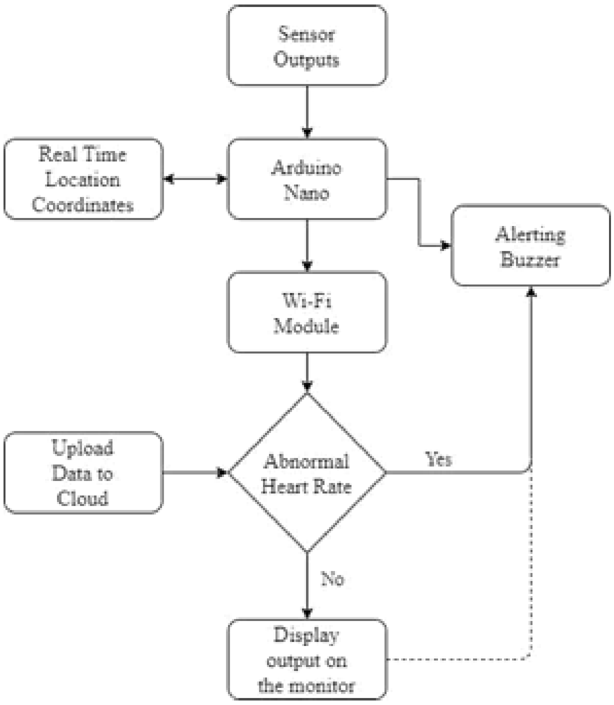

Fig. 2. Flow chart

Temperature sensor is attached at the back of the hand on the glove. The GPS module provides the current location of the user in real time. The Wi-Fi module transmits real-time data using a small battery with inductive charging integrated into the glove. The Information sent to the system is analyzed using IOT and if any issue detected related to the user's health is immediately alerted back through the inbuilt feedback system of the Wi-Fi module and the GPS module.

IV. RESULTS AND DISCUSSION

A. Pulse Sensor Output

The pulse rate is monitored by a pulse sensor module. The 3rd pin (signal) of the sensor is linked to the arduino input pin (analog). The micro-controller detects the changes in the values of the pulse sensor and stores it into the memory. The detected output in form of electrical pulse signals is a DC signal with the AC component superimposed in it. The ac signal will consist of the pulse rate values that are in synchronous with the heartbeat. The micro-controller detects the changes in the values of the pulse sensor and stores it into the memory.

Fig. 3. Configuration of Pulse Sensor

The below figure shows the output of the pulse sensor obtained in the Ardiuno IDE. The BPM is calculated using the formula: " BPM (Beats per minute) = 60*F, where F is the pulse frequency". The BPM calculation is included in the code. There will be minor fluctuations existing in the range of +/- 20 bpm.

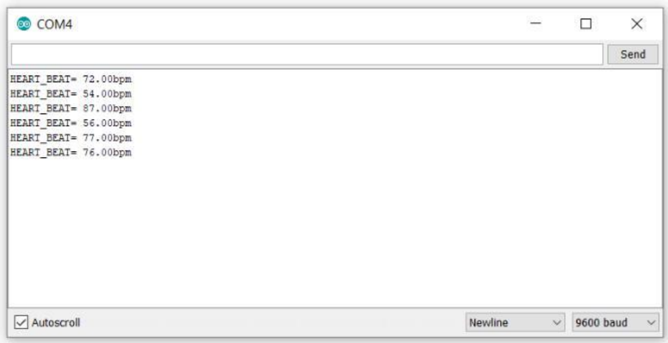

Fig. 4. Pulse Sensor Output

B. Temperature Sensor Output

The LM35 sensor has been attached to get the current body temperature output. It can be used in two circuit configurations. Only the positive temperature output is being recorded and calculated. The center pin in the LM35 is attached to the 2nd pin of arduino nano. The microcontroller detects the voltage fluctuations and stores the values in its DRAM.

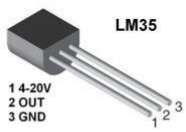

Fig. 5. LM35 Pin Configuration

The values obtained are to be calculated and converted using the formula:
Centigrade Temperature =(voltage)/(10 mV). This will give the accurate temperature values in degree Celsius.

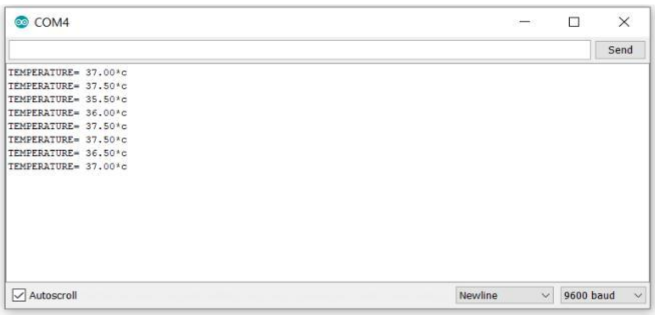

Fig. 6. Temperature sensor output

C. GPS Module Output

The GPS module is connected to the Arduino Nano through the digital pin. The module works well with a DC input in the range of 3.3- to 5-V. The NEO-6M module has a serial communication interface, wireless data transmission interface for providing the connection through satellites. GPS receivers, which are designed to find out where the GPS satellites are positioned at a given point, can pinpoint how far they are from the satellites. Signals transmitted from these satellites divulge their positional information and the particular time it is being used at. The GPS receiver computes the distance of the satellite by analyzing the time to receive the signal from each satellite.

By collating such data from a minimum of three satellites and their location outside of the earth's atmosphere, it can identify our position on land, sea or air. The transmission slot of the GPS module is attached to the Digital I/O slot of the Nano. The antenna in the module establishes transmission with the satellite and acquires the location coordinates. This data is transferred to the control chip of the GPS module which is in-turn transferred to the arduino nano. The data consists of many components, but we use only the Latitude and Longitude coordinates. This is achieved using the code:

```
gps.read();
lat=gps.readStringUntil(',');
gps.read();
gps.readStringUntil(',');
gps.read();
longi=gps.readStringUntil(',');
```

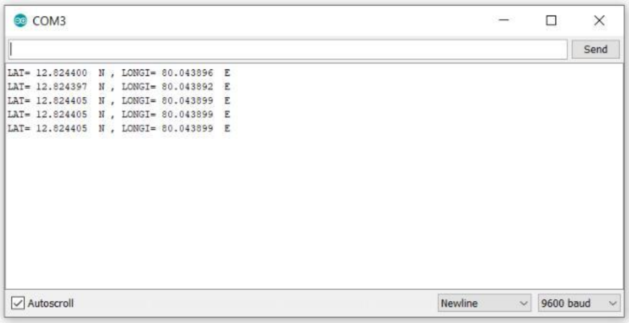

Fig. 7. GPS Module Output

The Longitude and Latitude values obtained can be used to obtain the current location through Google maps.

D. Proposed Prototype Outputs

The proposed prototype is where we place the sensors and modules on a glove so that the user health conditions can be monitored while they wear the glove. After connecting each of the sensors and modules with the Arduino nano, and placing them onto a glove, we obtain a prototype as shown below.

Once the arduino nano is provided with power, it runs the code saved inside its memory. When we place our finger on the pulse sensor and the temperature sensor we obtain the corresponding outputs on the monitor. Once the arduino nano is provided with power, the sensors and modules will light up and the arduino will start running the code that is saved in its memory. Initially the output displayed will have abrupt and random values. When we place our finger on the pulse sensor and the temperature sensor we obtain the corresponding relevant outputs on the monitor. The pulse sensor will display the heart rate in BPM. The normal heart beat rate for adults had been found to be in the range of 60-100 beats per minute (bpm).

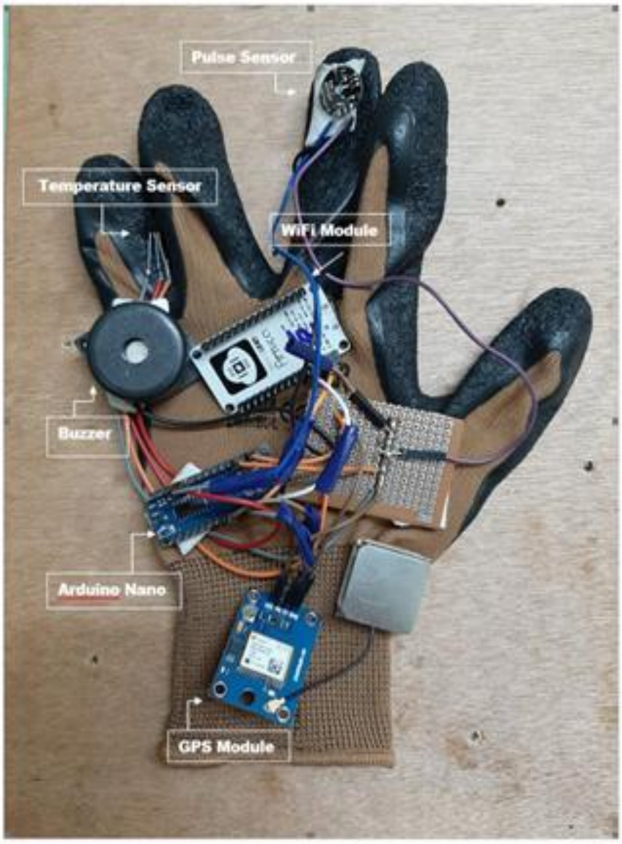

Fig. 8. Proposed Prototype of Bio-Metric Glove

The output displayed will have fluctuations in this range. If the heart rate goes above 100bpm, the concerned people can be alerted using the inbuilt buzzer or the feedback system. The Temperature sensor will display the body temperature of the user. The average normal body temperature is generally around 37°C. This value is also bound to fluctuate from person to person. If the value is above normal, the buzzer will ring alerting the concerned users. The GPS module will provide the current location of the user. This will be displayed in terms of latitude and longitude values. Once it is integrated with Google maps, we can see the location directly on the maps. The Wi-Fi module is connected to the arduino nano in-order to provide IOT facilities. The data collected from the sensors that is stored in the arduino nano can be displayed on a server with the help of the Wi-Fi module. The Wi-Fi module is set up in such a way that it can access the internet and the browser through a hotspot connection.

Once a connection is made between the module and the monitor, the private server can be accessed. The server we used here is an open-source IOT cloud data storage platform. The output that is viewed on the offline Arduino IDE is displayed below.

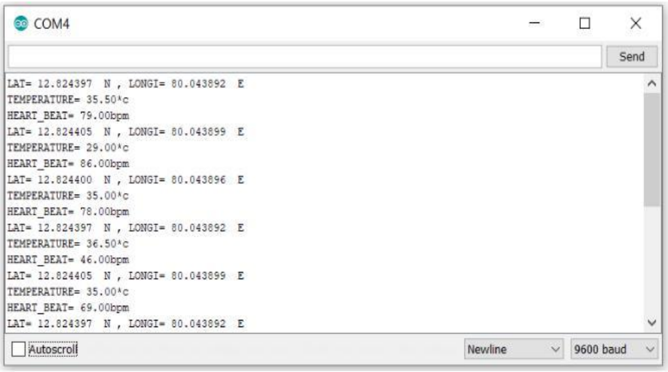

Fig. 9. Output of the Prototype in the Offline Monitor

This output is then uploaded to the server using the WiFi module and can be viewed on a webpage. The data seen in the offline server will be simultaneously uploaded in the server without much delay.

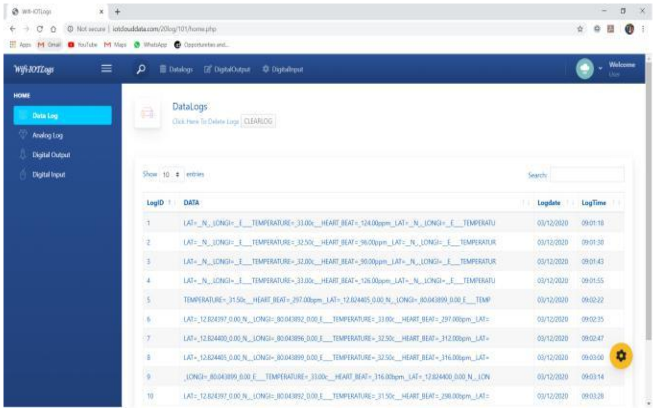

Fig. 10. Output of the Prototype in the IOT Server

V.CONCLUSION

The demand for a health monitoring system that helps users working in adverse conditions to monitor their vitals is on the rise. Bio-metric health monitoring is a booming industry and may take over many conventional medical procedures to diagnose and identify a health complication of an individual. The accessory used and the display used for each application can differ for different applications. For example for a motor-sport racer, a miner and a soldier, the best accessory which can be used is a glove which is mandatory in the respective professions and the display can be a simple monitor far away. Considering the drawbacks in the existing system of health monitoring prototypes, our given system provides a simpler yet better working principle.

These gloves are designed to be used in extreme weather conditions also providing precise outputs without any significant delay. Thus the use of the proposed system can help in removing additional equipment and present a rather fit and adjustable accessory (glove) in a health monitoring system.

VI. FUTURE ENHANCEMENT

Wearable devices which have been prevalent for many years, are useful to identify the possible hazards and to protect. This has opened up the scope of advanced research in the area of industrial wearable devices in extreme conditioned work environments. Voluntary sharing of details by individuals and their participation is a constraint now-days in health and safety analysis. This hinders estimation of the possible reason for different occupational health difficulties. At this point the acceptance of wearable health monitoring technology will be of great utility in additional analysis and understanding the flow of health hazards.

There can be improvements made on the prototype built. The sensors used can be replaced with smaller and advanced versions of the same. Also, the GPS module can be replaced with the GPS chips used in mobile phone devices. The glove can be made from more comfortable and higher heat resistance materials. Use of smaller components will further reduce the weight of the glove. A unique alerting system can be specifically added according to each and every user.

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