iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** V **Month of publication:** May 2018

DOI: http://doi.org/10.22214/ijraset.2018.5195

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

Human Pulse Monitoring and Alert System

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Abstract: ***Wearable technology with its diverse use application has become an important contribution in healthcare and in the betterment of individual lifestyle. This paper works on the unique challenges in wearable technology by using a continuous heart rate monitoring and temperature sensing system fitted on a wrist band to continuously monitor a patient's pulse, and alert the required individuals in case of a medical emergency such as a cardiac arrest. The values of the heart rate and temperature of the patient would be displayed in a graphical format through an android App for convenient monitoring of the patient's health. All the data sensed by the device gets stored in the cloud by using cloud computing. This data is kept as a record for hospitals to refer and schedule regular appointments and to take proper care of the patients.***
Keywords: Wearable technology, heart rate, temperature sensing, wrist band and alert.

I. INTRODUCTION

Wearable connected devices are becoming one of the key enablers in today's growing technology. Wearable technology is a term that describes smart electronic devices worn on the body as accessories or implants. Wearable tech represents the intersection between digital technology, design, engineering, and fashion – and the possibilities are endless.

Wearable technology has become a major boon to the healthcare field. There are certain life threatening health conditions that are completely unpredictable and need medical attention at the earliest. Heart-failure has become one such health condition which has gone on to be ranked number one in the list of the top leading causes of death. According to CDC (Centers for Disease Control and Prevention), every 43 seconds, someone in the United States has a heart attack. In this paper, we aim to discuss about a solution to reduce the number of deaths caused by a heart failure. We propose a concept in this paper that can be taken up by a health care center, where the healthcare center issues our proposed smart band to patients who have already had a history of heart problems and to elderly people who are prone to get a heart attack. This smart band uses an Ardiuno along with various sensors to continuously sense the heart rate and body temperature of a person. Theses sensor data are continuously sent to the cloud using an open source Internet of Things (IoT) platform. This platform offers a graphical representation of separate charts showing a patient's pulse and temperature status. This data can be used by the hospitals to easily monitor and access a person's heart rate and hence schedule appointments with doctor when required. All this data from the cloud is sent to an android App which is designed to display the heart rate values at any point of time to the patient as well as the patient's guardian. This way the patient and his caretakers are well aware of the patient's health status at any point of time. In case of any emergency where the patient's pulse behaves abnormally and in case of a cardiac arrest, an alert message along with information about the person's location is sent immediately to a hospital as well as to the patient's caretaker to notify them and to get immediate help. This way we provide a smart monitoring system for continuous monitoring and an immediate alert system in case of an emergency.

II. PROTOTYPE CONSTITUENTS

The components of the device are chosen such that they have a minimum size in order to incorporate within a compact wrist band keeping in mind the efficiency and reliability factors. The components are also very cost efficient and easily available.

A. Arduino Nano

The *Arduino Nano* is one of the smallest user friendly Arduino boards which makes it ideal for our prototype. It is a small, complete and breadboard-friendly board based on the ATmega328 microcontroller, which offers the same connectivity as the UNO board in a smaller form factor. It works with a Mini-B USB cable instead of a standard one. The Arduino Nano (atmega328) has a 32KB flash memory, 2KB SRAM, 1KB EPRAM, a clock speed of 16MHz, 14 digital I/O pins, 8 analog input pins and an operating voltage of 5V. The output from all the sensors is given to the Arduino for further processing. The Arduino uses the Arduino IDE software for writing the Arduino code and programming it.

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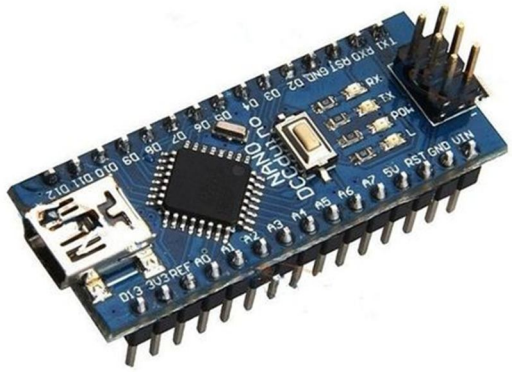

Figure-1 Arduino Nano

B. Pulse Sensor

The pulse sensor is used to measure heart pulses in beats per minute (bpm). It has a 3 wires connection- ground, VCC and an analog input. The LED present in it absorbs the blood flow and the IC processes the data.

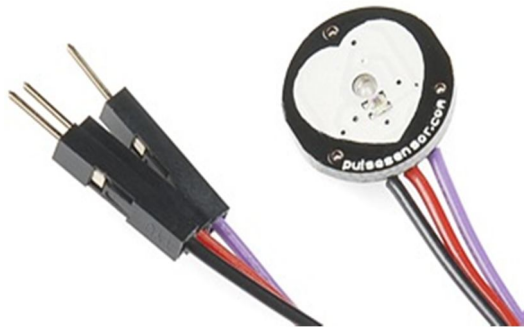

Figure-2 Pulse Sensor

C. Temperature Sensor

The temperature sensor used is DHT22. It measures from -40 to 80 degree Celsius. It is a low cost, light weight, small and accurate sensor. It gives its output in degree Celsius as well as Fahrenheit.

Figure-3 DHT22

D. GPS MODULE

Here we are using Ublox Neo 6M which is an I2C compliant GPS module. GPS stands for Global Positioning System which can be used to determine the position of the patient. It gives the longitudinal and latitudinal values of the person, from which the position of the person can be determined.

Figure-4 GPS Module

E. Wifi Module

ESP8266 Wi-Fi module is used in this model. This small module allows microcontrollers to connect to a Wi-Fi network. This device is used only because we need a module to access the internet in order to send the data acquired from the wearable band to the cloud. It can access the Wi-Fi from a mobile hotspot in case the patient is outdoors, or from a home Wi-Fi connectivity if the patient is at home. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to the Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers. The ESP8266 module is a cost effective board.

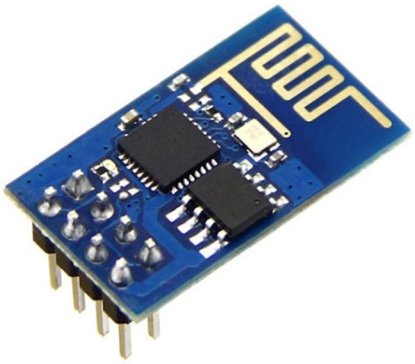

Figure-5 Wi-Fi module

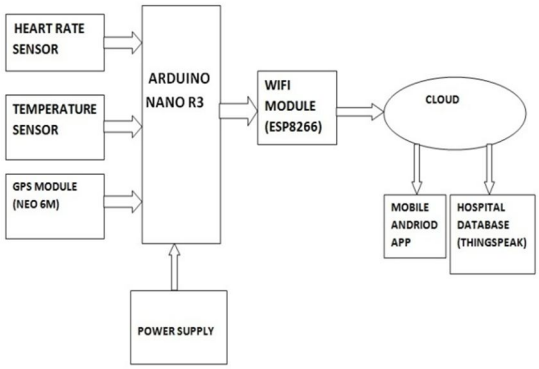

Figure-6 Block Diagram

The above figure-6 shows the block diagram of the proposed system.

III. WORKING

Once the components are connected to the Arduino to make the proposed device, it uses the Arduino IDE (Arduino software) to code and program the Arduino to do the desired work. First the sensors (pulse and temperature) sense the parameters and gives data to the Arduino. The Arduino is programmed such as to read the sensor data and display the desired output of each sensor. Now the question arises on where the output has to be displayed. Ideally the Arduino IDE only allows the sensor outputs to be displayed on the serial monitor of the software. But practically in our prototype, we need the sensor outputs to be displayed on the hospital computer for hospital reference and on an Android App for the patient's personal reference. In order to do this we need to use an open source Internet of Things (IoT) platform. Here we are making use of "Thingspeak" to manage our outputs through cloud computing using IoT. Now in order to send information from the Arduino to the cloud, we need to use a separate module. This is where the Wi-Fi module comes into picture to play its important role. The Arduino uses the Wi-Fi module to connect to a network and sends all the sensors outputs over the internet to the cloud. The data is retrieved from the cloud and displayed on the Thingspeak webpage. Thingspeak is easy to use and convenient to design. It consists of an auto-generated API key which is a distinctive key meant for each band. The hospital that issues these bands can thus use a different API for each patient's band and give an ID number or add a description to identify each patient's band. Figure-7 shows the Thingspeak web page with the API key.

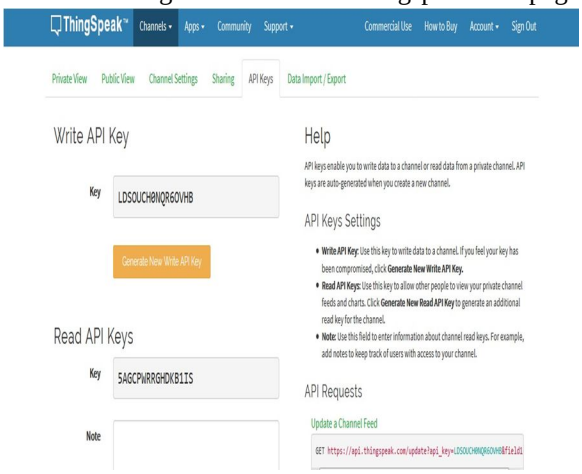

Figure-7

An android App is developed to link with Thingspeak to view all the sensor readings in a graphical format through the App. The program is maintained to have a particular threshold value set for each sensor. If a sensor value crosses its set threshold, the alert system is activated, which immediately notifies the hospital and sends a text message mentioning the details of the health issue along with the location of the patient to the patient's relative/caretaker and to the hospital. Thus in case of emergency, help is sent to the patient in need as soon as possible.

IV. PROTOTYPE RESULTS

The below figure shows the graphical representation of the outputs of the various sensors used, at any given time, on the Thingspeak web page. Figure-8 shows the outputs of the temperature sensor in a graphical representation. Here the time is displayed on the x-axis and temperature measurement on the y-axis.

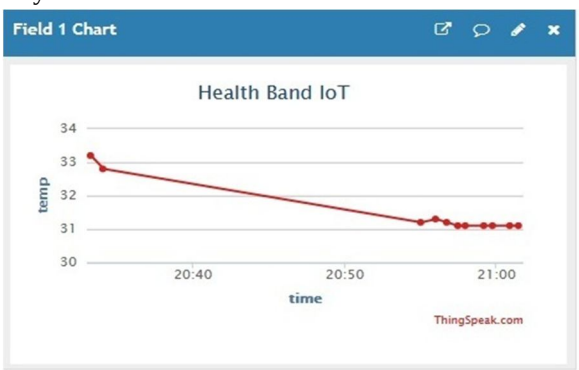

Figure-8

Figure-9 shows the outputs of the pulse sensor in a graphical representation. Here the time is displayed on the x-axis and pulse readings on the y-axis.

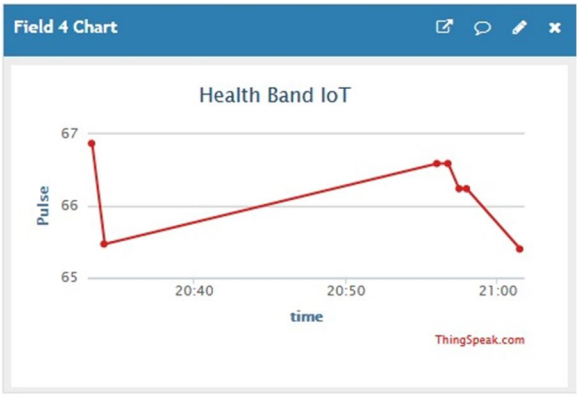

Figure-9

Figure-10a and 10b show the outputs of the GPS module which represent the longitude and latitude of the location of the particular patient respectively. These values are used to determine the location of the patient at any given time. This is used to track the patient in case of an emergency.

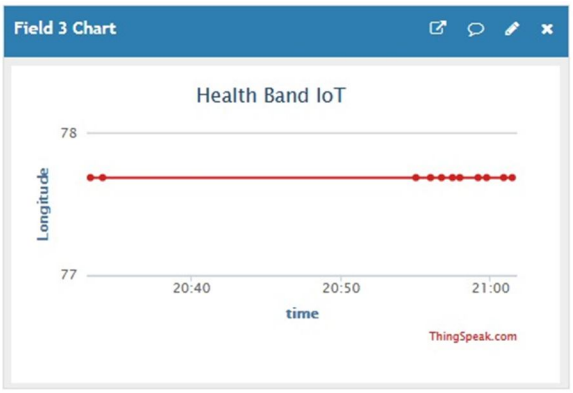

Figure-10a

Figure-10b

V. CONCLUTION

This proposed prototype uses wearable technology to implement a wireless sensor network and alert system. The device uses various sensors to detect a patient's heart rate, temperature and location, and continuously monitors the vital parameters of the patient. These sensor values are viewed by the hospital through a cloud computed IoT platform called Thingspeak. An android App

displays all the sensor data in the form of a graphical representation for the patient as well as the patient's caretaker/guardian's reference of the patient's health condition. This way the prototype helps people to monitor their loved one's health condition at any point of time through a simple android App. This prototype also focuses on the major aspect of saving a person's life in case of an emergency such as a heart attack, by getting medical aid to the person at the earliest. This is done by sending a message and notifying the hospital as well as the patient's guardian immediately when the patient's health parameters behave abnormally. The prototype uses a cloud based approach where all the data is stored as a record, which can be used by the hospitals to monitor and analyze a patient's health over a long period of time, and help in scheduling doctor's appointments when required.

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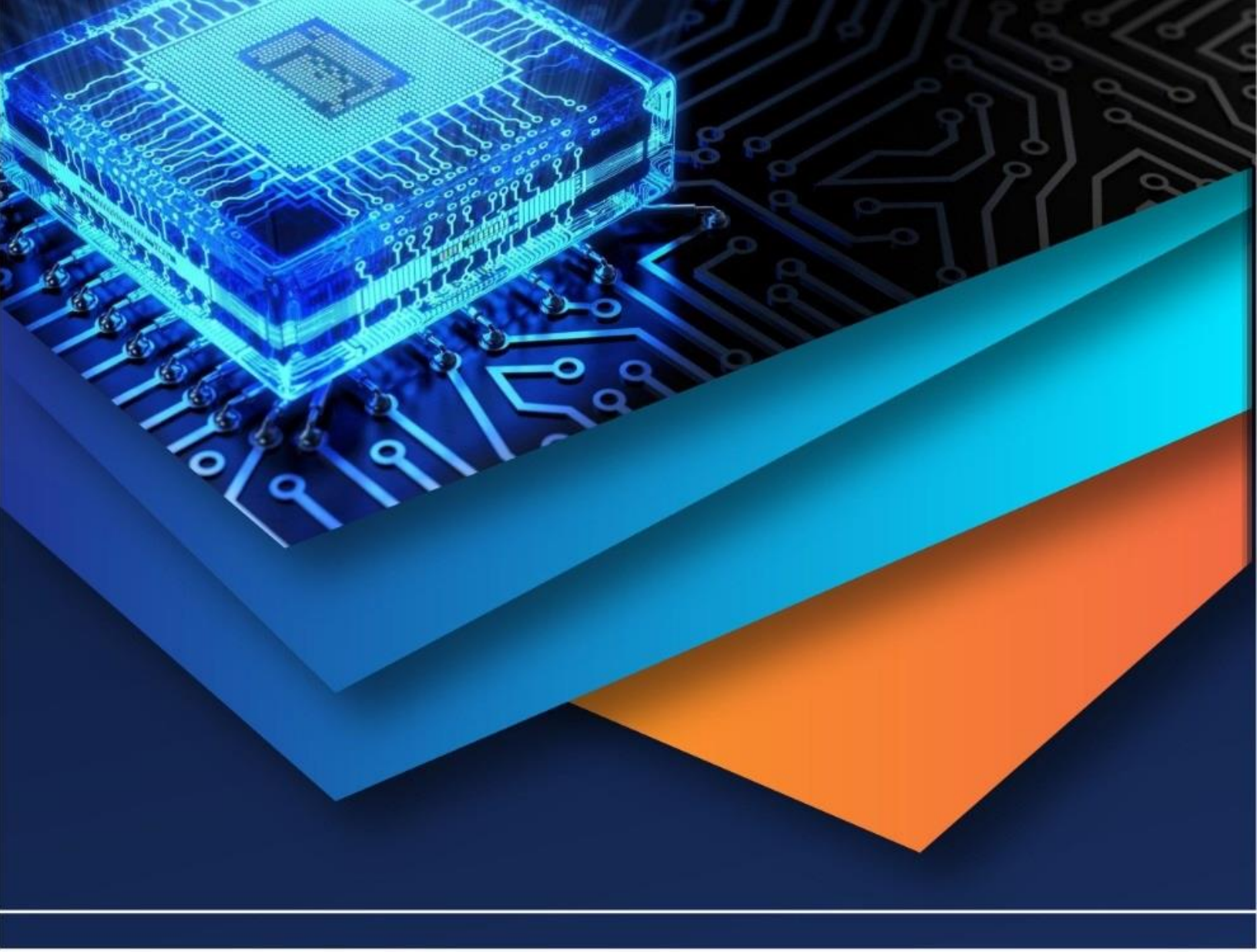

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