MONITORING OF HUMAN BODY PARAMETERS USING WEARABLE WIRELESS SENSOR NETWORK

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***ABSTRACT*:** Remote monitoring technique that could precisely monitor human body parameters is useful in Biomedical application. Most of the existing systems used for monitoring human body parameter requires wiring that restrains the natural movement. To overcome this limitation, a wearable wireless sensor network (WSN) using Accelerometer sensor, Pulse Oximeter and Heart-Rate Sensor, Temperature sensor and Blood Pressure sensor have been used for monitoring physiological human body parameters. The person is remotely monitored with his own location. The attached sensors on the person's body from wireless Body Sensor Network (WBSN) network and they are able to sense the Physiological parameters. This system can detect all the data from sensors and finally send it to Internet of things (IoT) in the form of SMS/Email. The idea of the project came so to reduce the headache of patient to visit to doctor every time. With the help of this proposal the time of patient and doctor are saved & doctors can also help in emergency scenario as much as possible.

IndexTerms - **Remote Monitoring, Wireless Body Sensor Network, Internet of Things, Temperature Sensor, Pulse Oximeter & Spo2 Sensor, Blood Pressure Sensor.**

I. INTRODUCTION

Tracking of human body parameters has attracted significant interest in recent years due to its wide-ranging applications such as rehabilitation, virtual reality, sports science, medical science, surveillance, in recent times, wireless sensors and sensor networks have become a great interest to research, scientific and technological community. Though sensor networks have been in place for more than a few decades now, the wireless domain has opened up a whole new application space of sensors. The objective is to allow the person to be monitored in a natural environment. The proposed approach uses the wireless sensor network concept with all the sensor nodes communicated to the coordinator wirelessly using Wi-Fi network protocol. The coordinator acts as a router which makes connectivity between sensor nodes and end device via internet, end device may be computer or mobile. Each sensor node is may equipped with accelerometer, temperature sensor, pulse oximeter SpO2 & heart-rate sensor and blood pressure sensor. The sensor nodes are attached to the human body and operate completely untethered. They are powered by battery. The small form factor and lightweight feature of the sensor nodes allow easy attachment to the body.

II. ANALYSIS OF PROBLEM

Healthcare is one of the most important issues in human being's life. Thus, this developed system helps us to solve some of the problems related to healthcare. This system is use for diagnosis the patient which may at home or at a distance from home. It will provide the secured and private data transmission. So, we can take care of that person or patient accordingly. Some of the problems may occur during the transmission of data that's taken into consideration. In this system the wireless network (WSN) is create the problems during the transmission of such information. the wireless sensor network is defined the large no. of low coast, low memories, low processing capable and distributed embedded small sensor nodes. They communicated through a channel to collect the data from the surrounding interest, process it .and report to sink.

The use of wireless sensor network (WSN) of healthcare application is growing fast. the security and privacy issue are among major area to concern. due to direct involvement of human also increases the sensitivity. Whether the data gathered from patient or individual are obtained with the consent of the person or without it due to need by the system. The communications in sensor network application in healthcare are mostly wireless in nature. This may result in various security threats to this system. these threats can create serious problems. Any security issues must be resolve while designing the healthcare application for sensor network. Privacy is also among major concern in wireless sensor network with regards to healthcare application. The health-related data are always private in nature. Sensing data out from a patient through wireless media can create serious threat to the privacy of individuals. All communication over wireless network and internet are required to be protect the user's privacy.

III. SYSTEM DESIGN CONFIGURATION

The bio-signal sensors and a microcontroller are the major components of the system. The data is collected from the bio-signal sensor and transmitted to the server. The proposed system consists of a body sensor network that is used to measure and collect Physiological data of patient. This system is used to monitor the blood pressure, temperature, Pulse rate, SPO2 and, posture of a patient. With the help of this system, a doctor can easily monitor the patient and can diagnosis accordingly. The same data can be accessed by the patient's relative by using IoT platform.

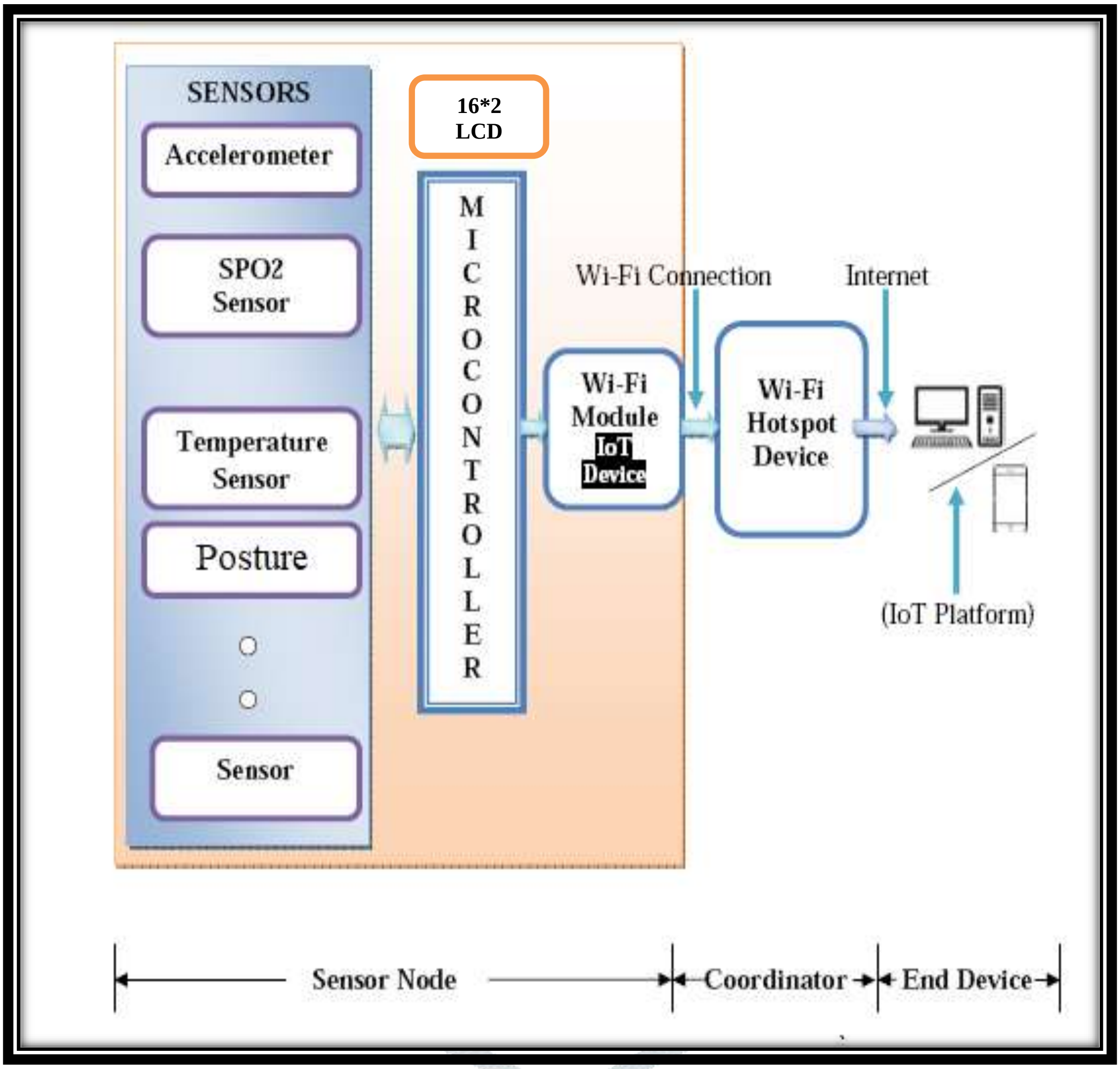

figure 1: functional block diagram of system

Figure 1 shows the functional block diagram of the system. The system has been designed to take several inputs from sensors to measure physiological parameters of human body such as temperature sensor for body temperature, SPO2sensor for monitoring of Heart rate and Blood Oxygen level, Accelerometer that can be used to detect body position. The inputs from the sensors are integrated & processed by microcontroller, then microcontroller send processed data to Wi-Fi IoT device. The IoT device forward received data from microcontroller towards the end device with the help of coordinator via internet and finally we can monitor all the parameters on IOT platform running on the end device, which may be computer or mobile. The coordinator acts as a router and it may be Wi-Fi Mobile or Modem. Once the sensor node has connected to the host computer, data is automatically updated on the IoT platform. The design is modular which makes it rather easy and straight forward to add extra sensors for measuring and monitoring other parameters.

➢ CIRCUIT DIAGRAM OF SYSTEM

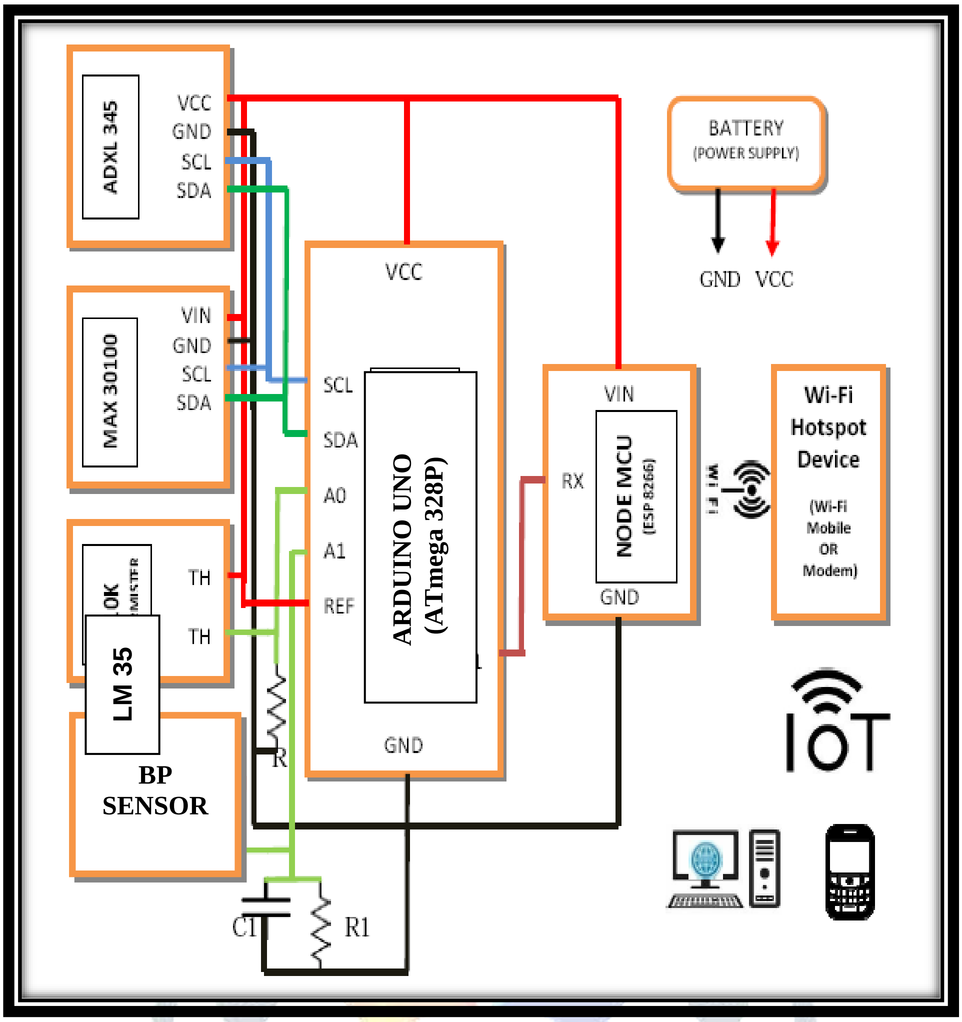

figure 2: circuit diagram of system

The circuit diagram of the system is as shown in the Fig. 2 The system consists of a Microcontroller, Wi-Fi Module and different sensors.

➢ ARDUINO UNO ATMEGA 328P MICROCONTROLLER

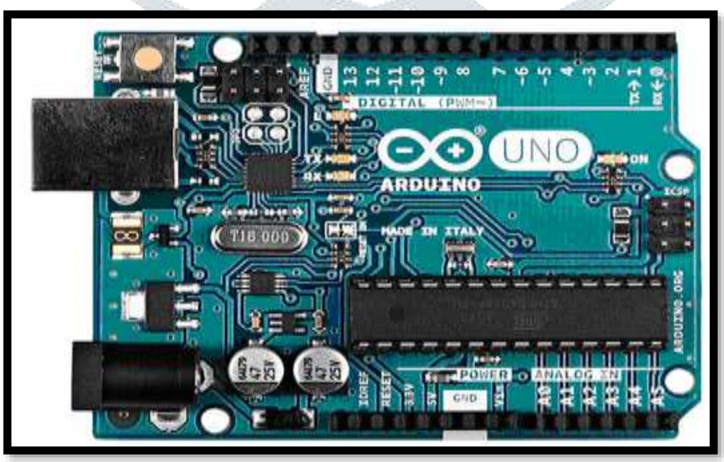

figure 2.1 : Arduino UNO Atmega 328p microcontroller

The Arduino Uno is a microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. The Arduino UNO can be powered via the USB connection or with an exeternal power supply.The power is selected automatically.External (non-USB) power can come from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and VIN pin headers of the POWER connector. The board can operate on an exeternal supply of 6 to 20 volts. If supplied with less than 7v, however, the 5v pin may supply less than five volts and board may be unstable. If using more than 12v, the regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

➢ **NODEMCU ESP 8266 WI-FI MODULE**

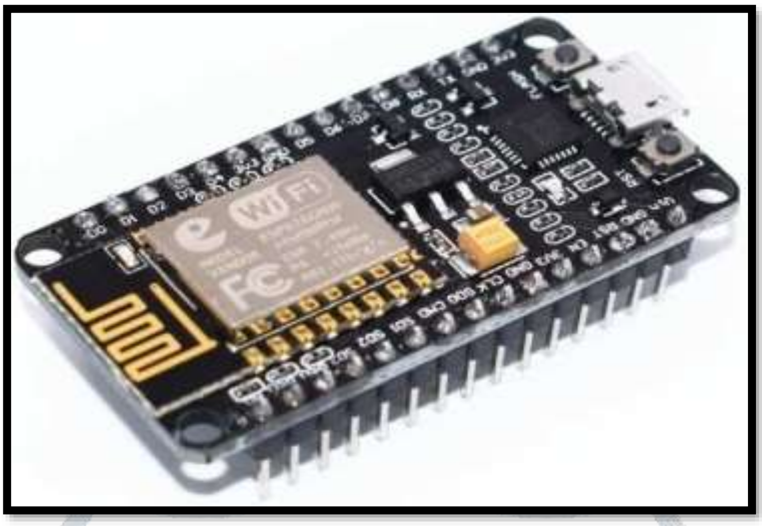

figure 2.2 : NodeMCU ESP 8266 Wi-Fi module

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module NodeMCU. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design is based on the ESP-12 module of the ESP8266.

➢ **SENSORS**

1. ADXL 345 SENSOR

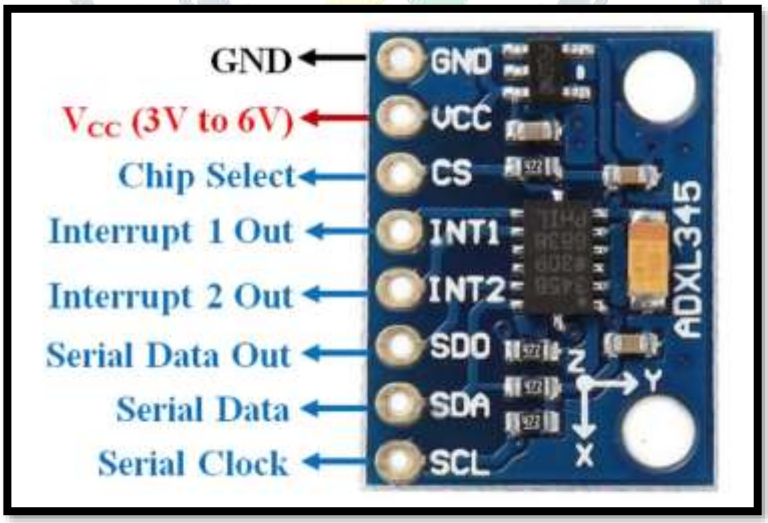

figure 2.3 : ADXL 345 Accelometric Sensor

The ADXL345 is a small, thin, ultralow power, 3-axis accelerometer with high resolution measurement. It is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. The ADXL345 is supplied in a small, thin, 3 mm × 5 mm × 1 mm, 14-lead, plastic package.

2. MAX30100 SENSOR

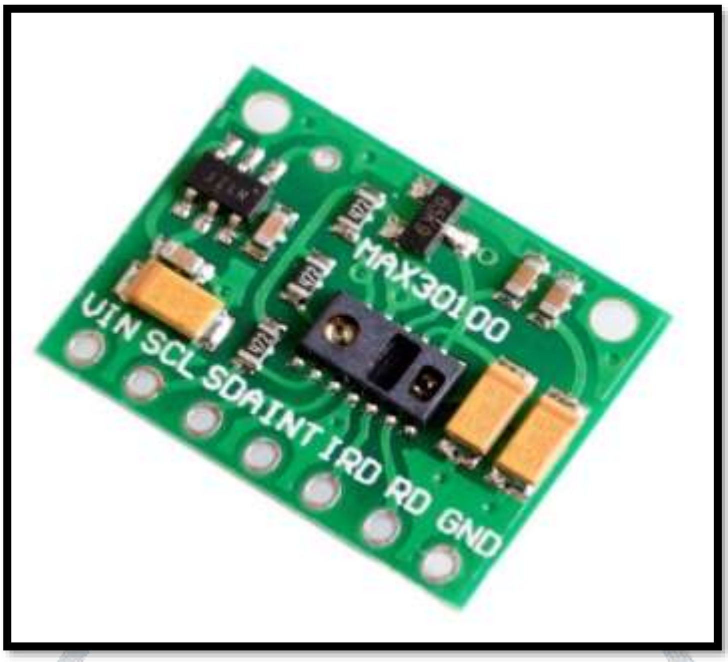

figure 2.4 : MAX30100 Heart Rate & SPO2 Sensor

The MAX30100 is an integrated pulse oximetry and heart-rate monitor sensor. It combines two LEDs, a photo detector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.

3. BP SENSOR

figure 2.5 : Blood Pressure Monitoring Sensor

The Blood Pressure Sensor is a non-invasive sensor designed to measure human blood pressure. It measures systolic, diastolic and mean arterial pressure utilizing the oscillometric method. In the non-invasive method, no piercing is required and is easy to use. It is similar to sphygmomanometer but instead of the mercury column, a pressure sensor is used to detect the blood pressure. This sensor is very important for High Blood Pressure patients, as it is also available as 'at-home' solid-state Blood Pressure Monitor. This system is portable. It is easy to carry and operate and highly useful in remote areas where medical facilities are not available.

4. LM 35 SENSOR

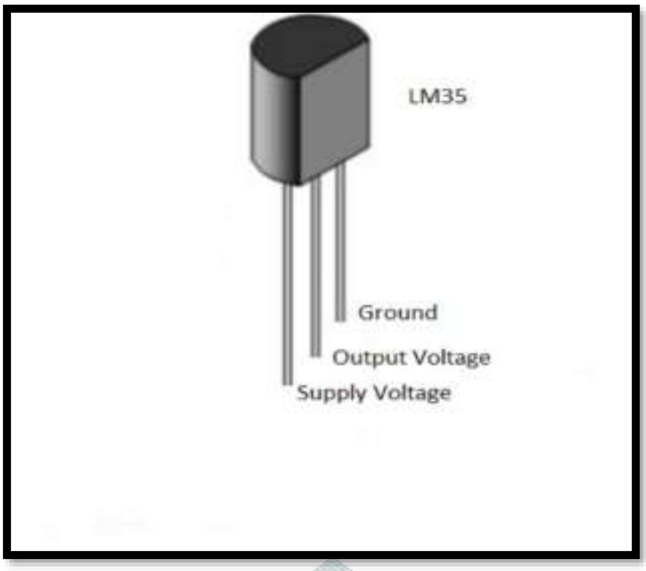

figure 2.6 : LM 35 Temperature Sensor

The LM35 series are precision integrated circuit temperature device. The low-output impedance, linear output and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature. The advantage of LM35 over thermistor is it does not require any external calibration. The coating also protects it from self-heating. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range Low cost and greater accuracy make it popular.

IV. GRAPHICAL USER INTERFACE OF IOT PLATFORM

A graphical user interface (GUI) is a type of user interface through which users interact with electronic devices via visual indicator representations. We have created such interface for our IoT platform which includes Account Login section, Console Dashboard, List of connected devices to IoT, etc.

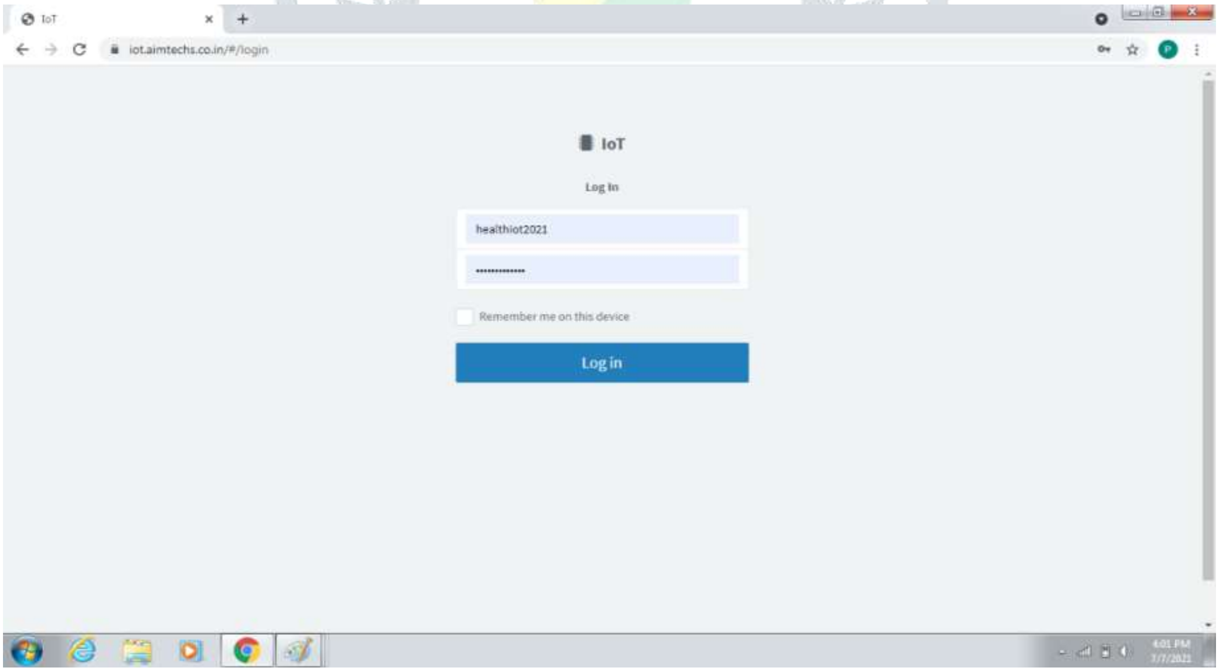

figure 3.1 : Account Login Interface

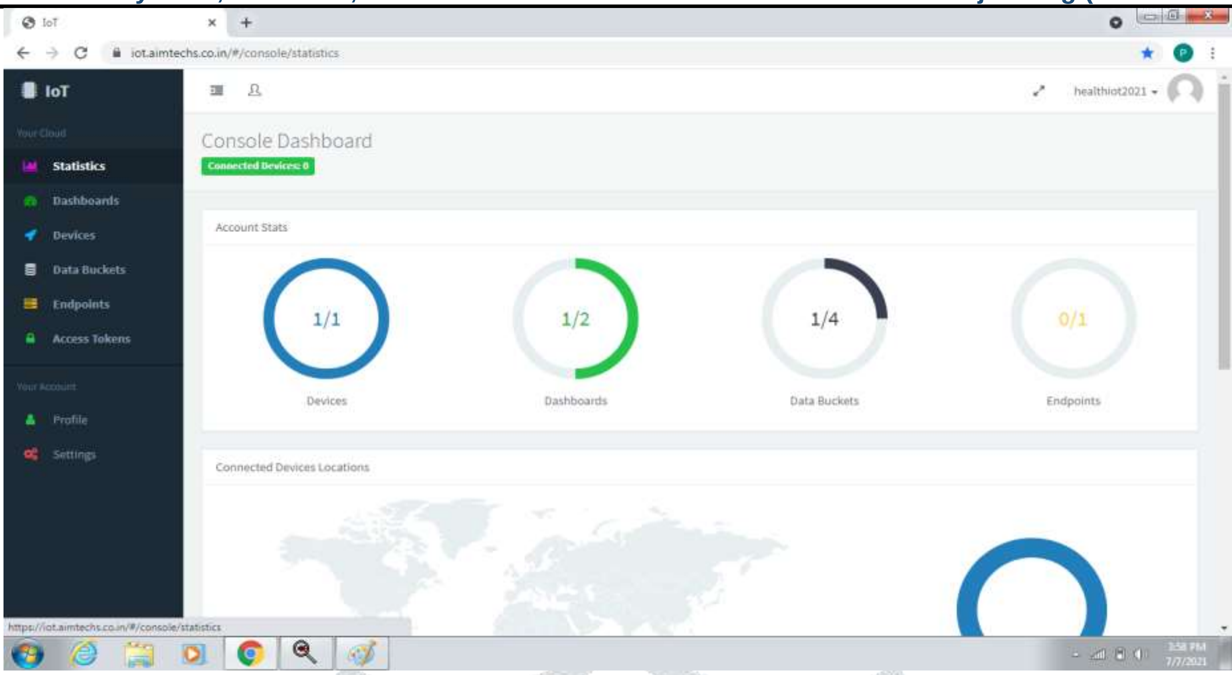

figure 3.2 : Console Dashboard

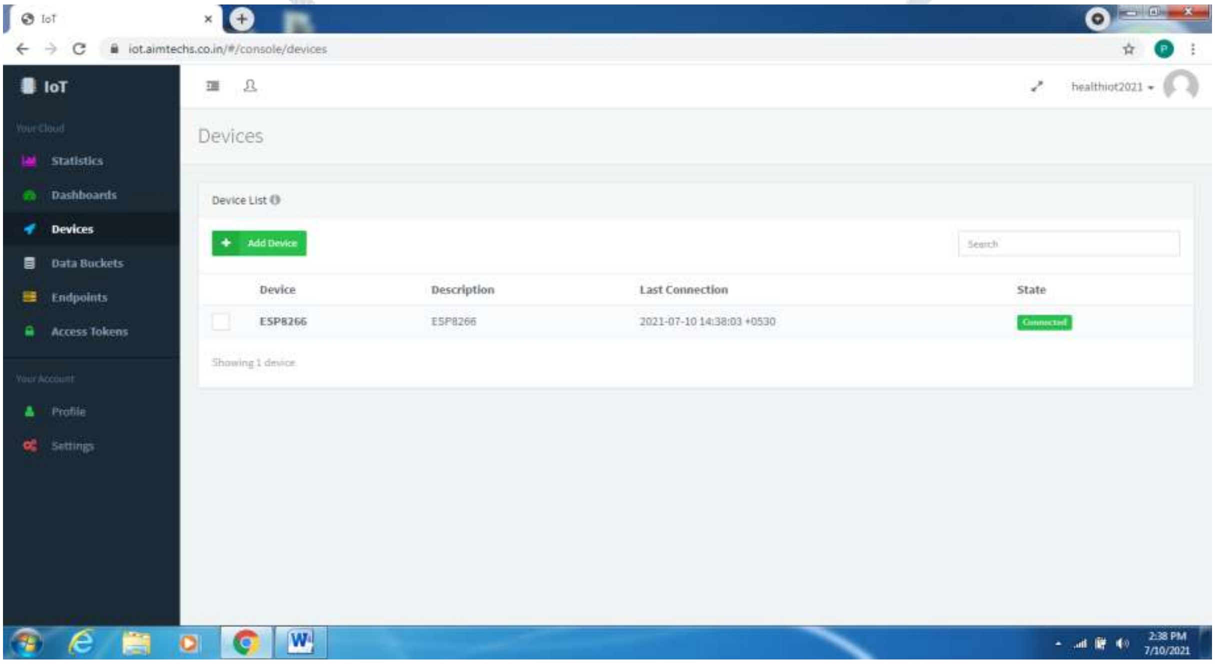

figure 3.3 : Connected Devices

V. EXPERIMENTAL RESULT

The project result from sensor node ESP8266 of patient 1 is shown in the figure 4.1. The screen shot of result which displays body parameters in the form of text values and graphical format. Figure 4.2 shows the Data stored in the Data Buckets which includes previous readings.

figure 4.1 : Various Body Parameter Readings

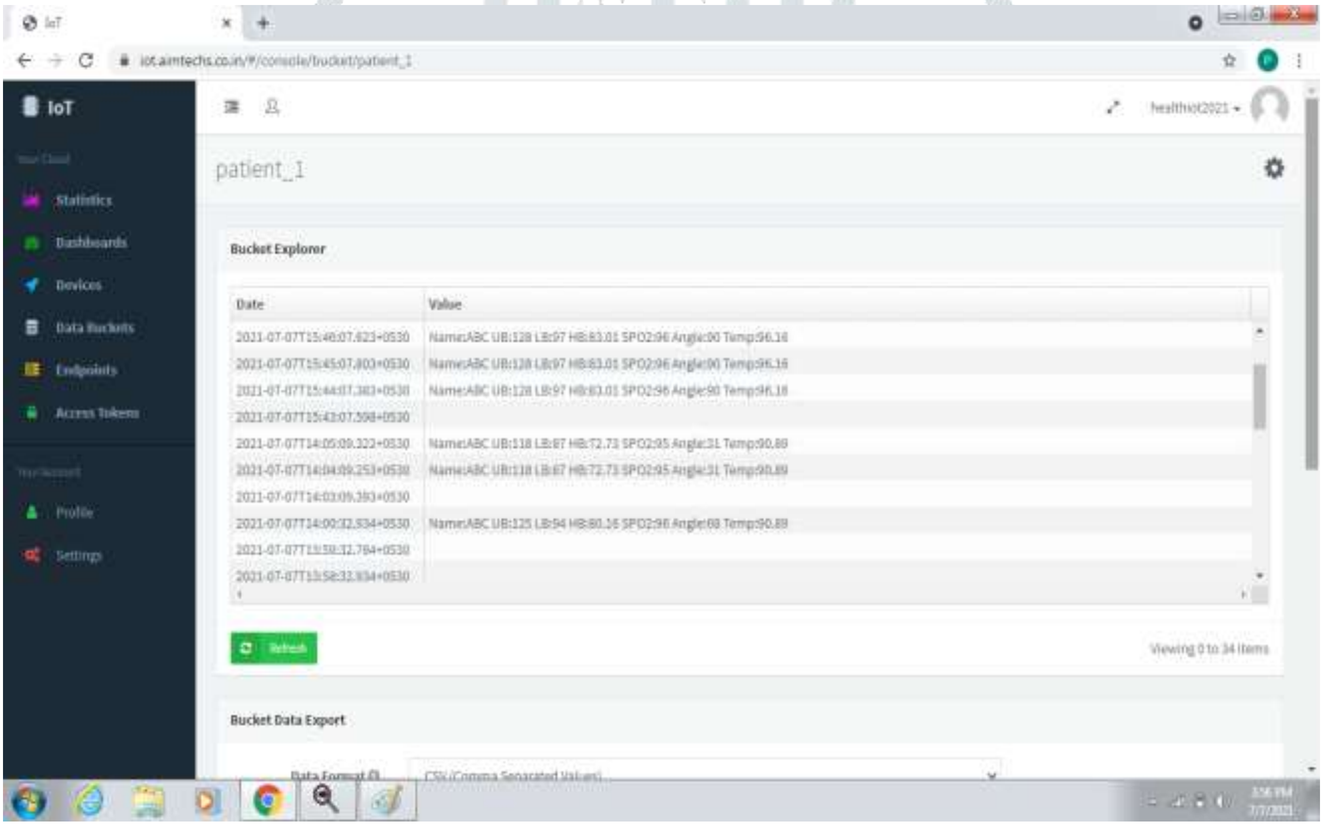

figure 4.2: Data Stored in Data Buckets

VI. CONCLUSION

A new approach for the measurement and remote monitoring of the human body parameters based on a wearable wireless sensor network has been presented. The proposed design will be able to effectively measure and monitor human body parameters collectively. The system uses wearable sensors, Wi-Fi standard wireless communication protocol for data transfer between the sensors node and coordinator. The coordinator allows transfer of data from sensor nodes to the IoT cloud environment, which will allow monitoring of all human body parameters on IoT platform effectively.

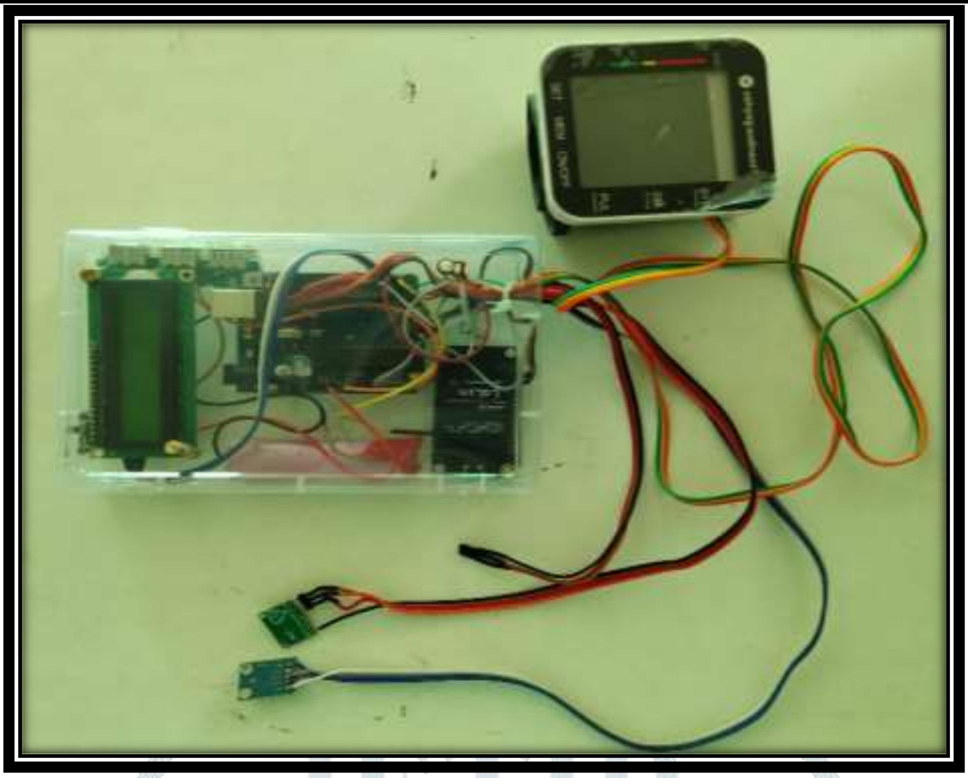

figure 5 **:** Experimental Setup

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