Heart-Rate Monitoring System Using Node MCU

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Abstract: This paper describes the design process of a low cost and portable microcontroller based heart-rate counting system for monitoring heart condition that can be implemented with off-the-shelf components. The raw heart-rate signals were collected from finger using IR TX-RX (Infrared Transmitter and Receiver pair) module which was amplified in order to convert them to an observable scale. Extending the concept we have replaced Arduino board with NODE MCU. In this extension we have used Thing Speak and created a private channel. In that channel updating of heart rate at regular intervals is done. If it crosses a particular limit or threshold limit it will be send to a concern doctor. This technique can be used in remote areas. The results obtained using the developed device when compared to those obtained from the manual test involving counting of heart rate was found satisfactory. The proposed system is applicable for family, hospital, clinic, community medical treatment, sports healthcare and other medical purposes.

***Index Terms* – NodeMCU, Thing speak, Pulse Sensor**

I. INTRODUCTION

Heart rate data can be really useful whether you're designing an exercise routine, studying your activity or anxiety levels or just want your shirt to blink with your heart beat. Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an Electrocardiography. Heart rate is the number of heart beats per unit of time, typically expressed as beats per minute (bpm).Heart rate can vary as the body's need to absorb oxygen and excrete C02 changes, such as during exercise or sleep .The measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions. It is also used by individual, such as athletes, who are interested in monitoring their heart rate to gain maximum efficiency from their training.

Manually the heart rate measurement can be done through two ways.

Carotid Pulse (neck): To take the heart rate at the neck, place the first two fingers on either side of the neck. Be careful not to press to hard, and then count the number of beats for a minute

Radial Pulse (wrist): Place the index and middle fingers together on the opposite wrist, about an inch on the inside of the joint, in line with the index finger. Once find a pulse, count the number of beats feel for a minute. To estimate the beat per minute by counting over 10 seconds and multiplying this by6 or count over 15 seconds and multiply by 4, or over 30 seconds and doubling the result. There are obvious potential errors by using this shorthand method. Hence the heart rate monitor gives an accurate reading.

Figure1: CAROTID PULSE AND RADIAL PULSE

But the more easy way to monitor the heart rate is to use a "Heartbeat Sensor". It comes in different shapes and sizes and allows an instant way to measure the heartbeat. Heartbeat Sensors are available in Wrist Watches (Smart Watches), Smart Phones, chest straps, etc. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is contracting or expanding in a minute.

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy. In order to measure the body temperature, we use thermometers and a sphygmomanometer to monitor the Arterial Pressure or Blood Pressure. Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor.

In this paper , we discussed a Heart Rate Monitor System using Arduino and Heartbeat Sensor. You can find the Principle of Heartbeat Sensor, working of the Heartbeat Sensor and Arduino based Heart Rate Monitoring System using a practical heartbeat Sensor.

II. DESIGN & IMPLEMENTATION

The principle behind the working of the Heartbeat Sensor is Photoplethysmography. According to this principle, the change in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ. With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor. In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver. Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensors.

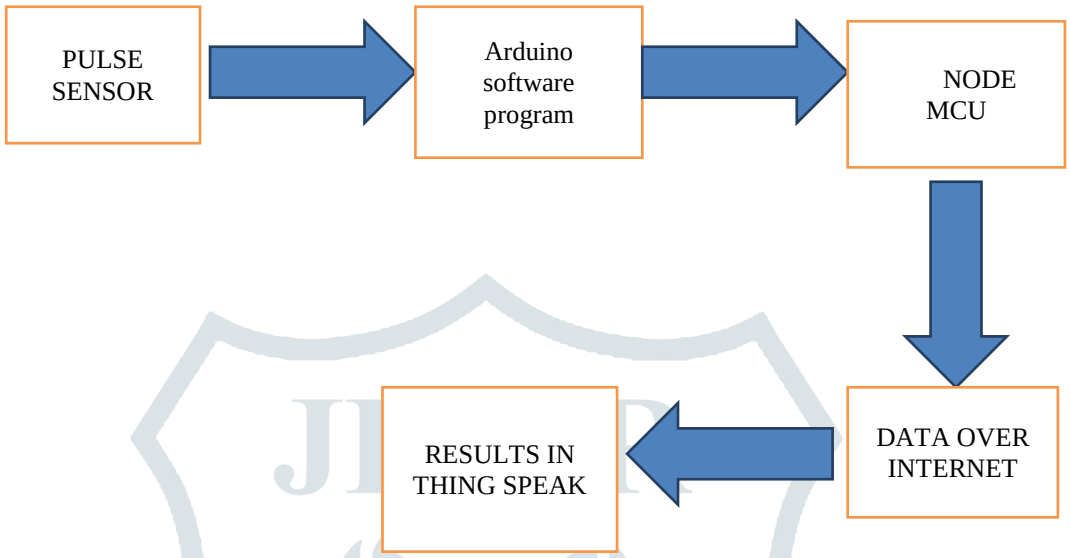

Figure 2: BLOCK DIAGRAM

The input for this circuit is taken from finger tip whenever the finger is placed on the pulse sensor it calculates the heart rate based on amount of blood flowing, then this data is send to the thing speak website with the help of NodeMCU, it will store the data for the further use for the doctor reference. This circuit is used for people in remote areas.

2.1 Pulse Sensors

Heart rate can be difficult to measure. Luckily, the Pulse Sensor Amped can solve that problem! The Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Also, it sips power with just 4mA current draw at 5V so it's great for mobile applications.

Figure 3: Pulse Sensor Module.

Simply clip the Pulse Sensor to your earlobe or finger tip and plug it into your 3 *or* 5 Volt Arduino and you're ready to read heart rate! The 24" cable on the Pulse Sensor is terminated with standard male headers so there's no soldering required. Of course Arduino example code is available as well as a Processing sketch for visualizing heart rate data.

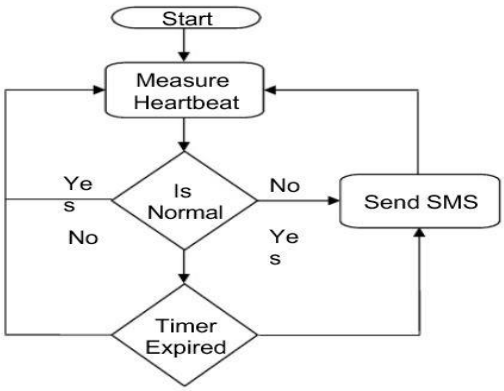

Figure 4: Flow chart for software sensor module.

2.2 .NODE MCU

Node Microcontroller Unit is named as NodeMCU which is open source software and firmware that is built around System-on-Chip (SoC) called the ESP8266. The ESP8266 is designed and manufactured by Express. It contains the crucial elements like CPU, RAM, networking (Wi-Fi), modern operating system and SDK. The NodeMCU aims to simplify ESP8266 development. It has an operating voltage of 3.3v. It has an operating temperature range of - 40˚c ~ 125˚c. Figure 4 shows the NodeMCU development board.

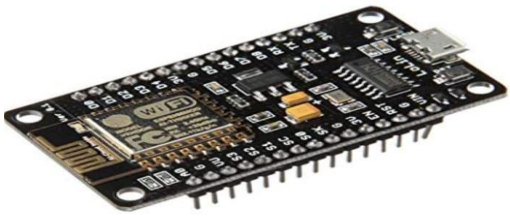

Figure 5: NodeMCU

ESP8266 Wi-Fi SoC is embedded with the memory controller, including SRAM and ROM. Micro Controller Unit can enter the memory units through iBus, dBus, and AHB interfaces.

2.3 ThingSpeak

According to its developers, ThingSpeak is an open source of Internet of Things application and API to store and restore and retrieve data from things using HTTP protocol over the internet or via Local Area Network (LAN). ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

ThingSpeak was originally launched by ioBridge in 2010 as a service in support of IoT applications. ThingSpeak has integrated support from the numerical computing software MATLAB from Mathworks allowing ThingSpeak users to analyze and visualize uploaded data using Matlab without requiring the purchase of a MATLAB license from Mathworks.

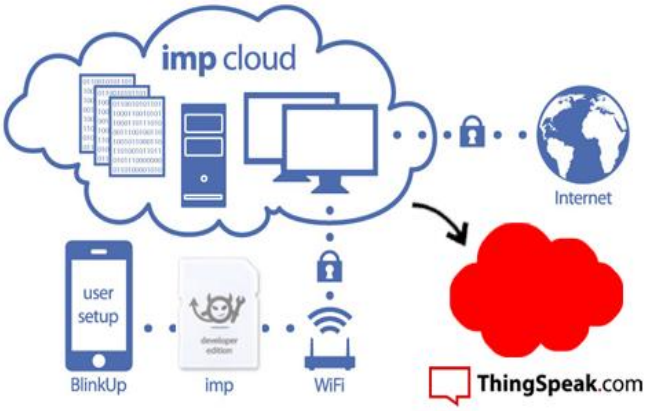

Figure 6: ThingSpeak Protocol.

ThingSpeak has a close relationship with Mathworks. In fact, all of the ThingSpeak documentation is incorporated into the Mathworks. MATLAB documentation site and even enabling registered Mathworks user accounts as valid login credentials on the ThingSpeak website.

Figure 7: Different models of ThingSpeak.

2.4 Working of the circuit diagram

The circuit diagram consists of 2 Parts – NODE MCU and PULSE SENSOR Upload the code to NodeMCU and Power on the system. The NodeMCU asks us to place our finger in the sensor and press the switch. Place any finger (except the Thumb) in the sensor clip and push the switch (button). Based on the data from the sensor, NodeMCU calculates the heart rate and displays the heartbeat in bpm.

While the sensor is collecting the data, sit down and relax and do not shake the wire as it might result in a faulty values. After the result is displayed on the ThingSpeak, if you want to perform another test, just push the rest button on the circuit board and start the procedure once again. Connections is as follows NodeMCU 3.3v is connected to positive terminal of the pulse sensor and ground of the NodeMCU is connected to negative terminal of pulse sensor.

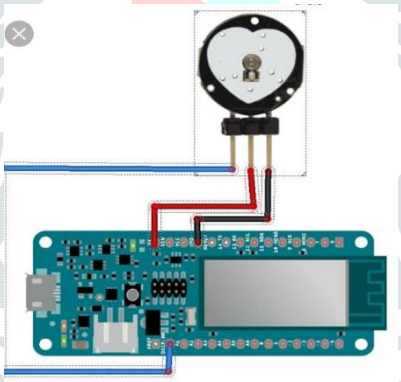

Figure 8: Circuit Diagram

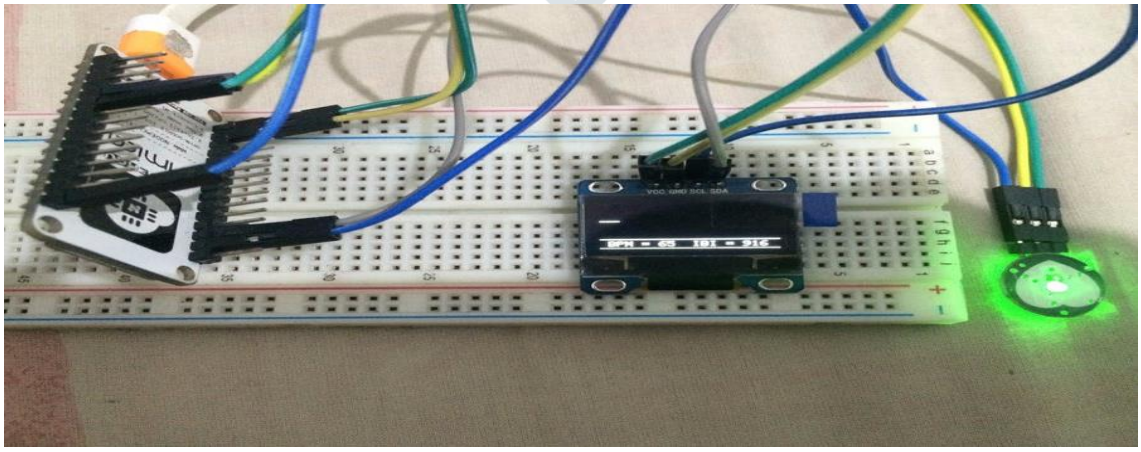

Figure 9:Circuit Design of Interfacing Heart sensor with NODE MCU

IV. RESULTS

4.1 Results

Bio medical Engineering (BME) is the application of engineering principles and techniques to the medical field. It combines the design and problem solving skills of engineering with medical and biological sciences to improve patient's health care and the quality of life of individuals. A medical device is intended for use in the diagnosis of disease, or in the cure, treatment, or prevention of diseases. Thus in Implementation of Wireless Systems for Patient Monitoring System, the heart beat and body temperature are successfully sensed. Temperature is measured usingDS1820, where it follows on board proprietary temperature measurement technique. Heart beat is measured using LED, LDR and operational amplifier. Hence both parameters are displayed on THINGSPEAK channel. Then both the parameters are transmitted and displayed in a distant location. This will eventually reduce man power in the very near future.

In the extension we have replaced Arduino board with NODE MCU and we have used ThingSpeak website to display our results . The following picture shows the heart rate of person of age group 21 years old at different time instants.

Figure 10: Pulse Rate output

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