IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

"IoT Based Remote Patient Health Monitoring System UsingNode MCU"

1. Kushal Masarkar 2. Gracy Shivankar 3. Nikita Dhole 4. Shivam Tidke 5. Chandrakumar Katre

TULSIRAMJI GAIKWAD PATIL COLLEGE OF ENGGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION

Abstract: Nowadays numerous persons are mislaying their life owing to heart attack and shortage of medical attention to patient at correct stage. Hence, in this project we are implementing heart rate monitoring and heart attack recognition system using iot. The patient will carry hardware having sensors with android application. The heartbeat sensor will allow checking heart beat readings and transmit them over the internet. The user may set the high and low level of heartbeat limits. Once these limits are set the system can start monitoring the patient's heartbeat and as soon as the heart beat readings goes above or below the limit set by the user the system will send an alert about high or low heartbeat as well about chances of heart attack. Health is fundamental need and it is human right to get quality health care. Nowadays india is facing many health issues because of less resource. This review paper presents the idea of solving health issues using latest technology, internet of things. It presents the architectural review of smart health care system using internet of things which is aimed to provide quality health care to everyone. Using this system architecture, patients' body parameters can be measure in real time. Sensors collects patients body parameters and transfers that data to arduino uno which further transfer that data to cloud with the help of wifi module.

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Keywords— WEMOS Microcontroller ESP8266, OXIMETER MAX30100, Clock Generator, Buzzer Image

I. INTRODUCTION

These days a number of people are losing their life due to heart attack. Heart attack can occur when the flow of blood to heart is blocked. Owing to late diagnosis of heart attack we are inadequate to save the lives of many humans. In this paper, we suggest a system that will detect heart attack by monitoring the heart rate based on IoT (Internet of Things). For a healthy adult, ordinary heartrate is 60 to 100 bpm (beats per minute). Athlete's heart beat generally range from 40 to 60 bpm depending upon their fitness. If a person's heart rate is constantly over 100 beats per minute then the person is said to be having higher heart rate which is also notorious as tachyarrhythmia. It can diminution the efficiency of heart by letdown the amount of blood pumped through the body can result in chest pain and lightheadedness. With the advancement in technology, it is easy to monitor the patient's heart rate even at home. IoT is dexterity of network mechanism to intellect and gather information from world ubiquitously us then share the information athwart internet anywhere it can be managed for some tenacity. The Internet of Things (IoT) is interred communication of embedded devices using networking technologies. The IoT will be one of the important trends in future, can affect the networking, business and communication. IoT typically expected to propose the advanced high bandwidth connectivity of embedded devices, systems and services which goes beyond machine-to-machine (M2M) context. The advanced connectivity of devices aide in automation is possible in nearly all field. Everyone today is so busy in their lives, even they forget to take care of their health. By keeping all these things in minds, technology really proves to be an asset for an individual.

II. BACKGROUND

In this system, the sensors are collecting the health data from the patients for data acquisition. Communications in the hardware part can be done by Arduino UNO and ESP8266 module for sending data to the server. The ThingSpeak server can be identified with the help of an API key. Data processing is done at the ThingSpeak server. the sensed data are stored in the database of the ThingSpeak. If patients want to know their health-related information's was shown on the web page of the Thing speak. Here Thing speak plays and Arduino UNO plays the major role. Because the Arduino collects the data from each sensor. And transfer to the thing speak IoT platform. With the use of an API key, we can transfer the data to the specified space in the cloud. Here we can access these data at times and also documentation available. We can download the data in .CSV format. But in the free version, we can only access some limited storage. IoT Based Health Monitoring System 197. The processor processes the data sensed by the sensors and processed data transferred to the ThingSpeak cloud through the ESP8266 module. The sensed data from the patient body can be seen on the webpage using the PC or mobile. The sensors sense and transfer the data every 20seconds. if any data of the vital parameters of the patient will exceed the threshold values, then the doctor will receive an alert message. So, he will take immediate action to the patient. controller takes the necessary action and decides on sending the data. The data is sent using a Wi-Fi Module and it is stored in ThingSpeak..

The system used for health monitoring is the fixed monitoring system, which can be detected only when the patient is in hospital or in bed. Recently accessible systems are huge in size and available only in the hospitals in the Intensive Care Unit. In existing system, patients need to get hospitalized for regular monitoring of the patient. It is not possible once he/she is discharged from the hospital. This system cannot be used at home. The system which we prefer to develop would not only help in monitoring the health of the patient when he is in bed but also when he is out of bed. The main idea of the system is to transmit the information through the web page to continuous monitoring of the patient over the internet. Such a system would continually detect the important body parameters like temperature, pulse rate and would compare it against a predetermined range set and if these values cross the specific limit, it would immediately alert the doctor and the patient.

III. PROPOSED WORK

An extensive research on the topic related to the system shows a very few of the related works could actually build their own preliminary framework and prototype of the system. Some of the works like the research conducted on the ambient assisted living (aal) actually did more of a literature survey of the state of its present condition of the monitoring system via iot. They also tried to identify and highlight the critical issues and the quality of service as well as the user driven experiences in their work. Some, other worked on showing or highlighting the importance of iot in the health sector and some proposals for the health monitoring architectures.

Some related findings used specific models for the health monitoring aspect. Like the abstraction of model driven tree reference model (mdtrm), where they explained the necessity of this model in the health field as well as identifying the complexities of the models. They also benched marked the models which came really handy for the initial phase of this research. Some other related model we found are general domain model architecture (gdma), the health monitoring and sensing with cloud processing was also a helpful source behind the research, as it was useful for generating ideas to get raw data's from wearable devices which are compatible and capable of measuring many physical value which we can use to obtain meaningful results. Masimo radical-7, a health monitor for clinical environment helps to collect data and wirelessly transmits it for ongoing display.

This provides high resolution display of information with higher graphical capabilities. It also has a touch based user interface. But as it can be already assumed how cost effective it is, it can't send an alarm message to notify for any emergencies. Free scale home health hub reference platform store patient data to cloud via various sensors, where the people related to the patient can have an access. This platform too can't notify for any alarming situation to the people engaged with the patient.

Block Diagram:-

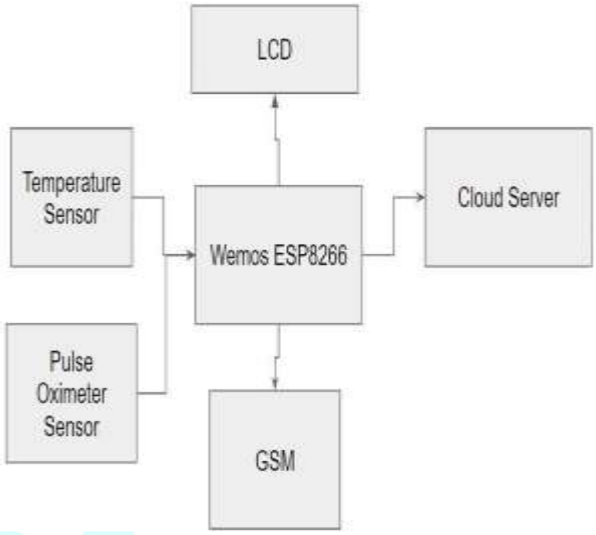


Fig 1. Block Diagram of IOT Based Health Monitoring System

Flow Chart:-

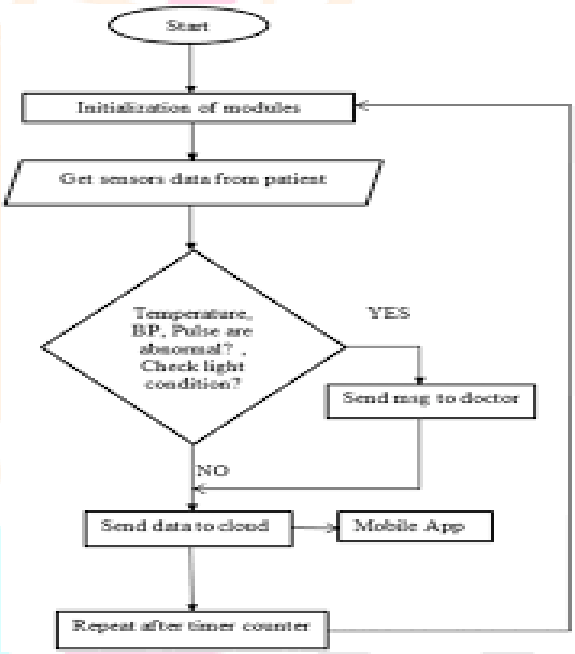


Fig 2. Flow Chart on the IOT based Health Monitoring System

IoT-based health monitoring system differs from the nor-mal healthcare system in a very ancient way. Therefore, it becomes a bit challenging to achieve the required results and performances through IoT. Working with IoT is related to the embedded world as the sensors use electronic data signals. Initially, devices such as sensors, detectors, moni-tors and microcontroller are connected altogether for synchronization. The sensors and detectors detect the signals in analog form, which needs to be further converted into digital form. The inbuilt analog to digital conversion is performed through the microcontroller to get data in proper digital for-mat. perform the detection and a dense neural network at the end as the classifier.

Show Result:

Code:

```
#include "MAX30100_PulseOximeter.h"
#include <ESP8266WiFi.h>
#include "Wire.h"
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);
#include <ESP8266HTTPClient.h>
#define REPORTING_PERIOD_MS 1000
int cloud=0;
boolean newData = false;
int i=0;
WiFiServer ESPserver(80);//Service Port
float vref = 3.3;
float resolution = vref/1023;
const char* ssid = "patient";
const char* password = "1234567890";
PulseOximeter pox;
float temperature, humidity, BPM, SpO2, bodytemperature;
void setup()
{
Serial.begin(115200);
Serial.println("Connecting to ");
Serial.println(ssid);
lcd.init();
lcd.backlight();
lcd.setCursor(0,0);
lcd.print("Initializing..");
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
delay(1000);
Serial.print(".");
}
ESPserver.begin();
if (!pox.begin())
{ Serial.println("FAILED");
}
else
{ Serial.println("SUCCESS");
pox.setOnBeatDetectedCallback(onBeatDetected);
}
lcd.setCursor(0,0);
lcd.print(WiFi.localIP());
delay(3000);
lcd.clear();
}
void loop()
{
pox.update();
if (millis() - tsLastReport > REPORTING_PERIOD_MS)
{
 BPM = pox.getHeartRate();
SpO2 = pox.getSpO2();
temperature = analogRead(A0);
temperature = (temperature*resolution);
temperature = temperature*10-2;
if (BPM>30 and SpO2>50 ) {
newData = true;}
lcd.setCursor(0,0);//2nd line
lcd.print("T:");
lcd.print(temperature);
lcd.setCursor(6,0);//2nd line
lcd.print("BPM:");
lcd.print(BPM);
lcd.setCursor(0,1);//2nd line
lcd.print("SpO2:");
lcd.print(SpO2);
tsLastReport = millis();
i=i+1;
 if(newData==true and i>=15 and i<28)
{
pox.shutdown();
x=x+1;
}
if(x>1){
x=0;
//upload();
}
if(i>18) i=0;
newData=false;
pox.begin();
}
}
```

List of Required Components:

- Wemos ESP8266
- Pulse Oximeter Sensor
- Cloud Server
- GPS Module
- LCD I2C
- Buzzer
- NTC Thermistor
- Battery

• Wemos ESP8266

Espressif's esp8266ex delivers highly integrated wi-fi soc solution to meet users' continuous demands for efficient power usage, compact design and reliable performance in the internet of things industry. With the complete and self-contained wi-fi networking capabilities, esp8266ex can perform either as a standalone application or as the slave to a host mcu. When esp8266ex hosts the application, it promptly boots up from the flash. The integrated highspeed cache helps to increase the system performance and optimize the system memory. Also, esp8266ex can be applied to any microcontroller design as a wi-fi adaptor through spi/sdio or uart interfaces. Esp8266ex integrates antenna switches, rf balun, power amplifier, low noise receive amplifier, filters and power management modules,

The board we are using is called "Wemos D1 Mini" and has an esp8266 module on it, which we will be programming. It comes with the latest version of micropython already setup on it, together with all the drivers we are going to use. The d0, d1, d2, … numbers printed on the board are different from what micropython uses – because originally those boards were made for a different software. Make sure to refer to the image below to determine which pins are which. It has a micro-usb socket for connecting to the computer. On the side is a button for resetting the board. Along the sides of the board are two rows of pins, to which we will be connecting cables.

• NTC Thermistor

NTC stands for "negative temperature coefficient". Ntc thermistors are resistors with a negative temperature coefficient, which means that the resistance decreases with increasing temperature. They are primarily used as resistive temperature sensors and current-limiting devices. The temperature sensitivity coefficient is about five times greater than that of silicon temperature sensors (silistors) and about ten times greater than that of resistance temperature detectors (rtds). Ntc sensors are typically used in a range from −55 to +200 °c. The non-linearity of the relationship between resistance and temperature exhibited by ntc resistors posed a great challenge when using analog circuits to accurately measure temperature. However, rapid development of digital circuits solved that problem through enabling computation of precise values by interpolating lookup tables or by solving equations which approximate a typical ntc curve.

• Oximeter Max30100:

The max30100 is fully configurable through software registers, and the digital output data is stored in a 16-deep fifo within the device. The fifo allows the max30100 to be connected to a microcontroller or microprocessor on a shared bus, where the data is not being read continuously from the device's registers. Spo2 subsystem the spo2 subsystem in the max30100 is composed of ambient light cancellation (alc), 16-bit sigma delta adc, and proprietary discrete time filter. The spo2 adc is a continuous time oversampling sigma delta converter with up to 16-bit resolution. The adc output data rate can be programmed from 50hz to 1khz. The max30100 includes a proprietary discrete time filter to reject 50hz/60hz interference and low-frequency residual ambient noise. Temperature sensor the max30100 has an on-chip temperature sensor for (optionally) calibrating the temperature dependence of the spo2 subsystem. The spo2 algorithm is relatively insensitive to the wavelength of the ir led, but the red led's wavelength is critical to correct interpretation of the data. The temperature sensor data can be used to compensate the spo2 error with ambient temperature changes.

• Cloud Server

Cloud servers function similarly to traditional servers since they both deliver processing power, applications, and storage. However, since cloud servers are remotely accessed, they're generally more stable and secure than traditional servers.

The primary difference between a cloud server and a traditional server is that a cloud server can be shared among many users over an accessible platform, often through a network such as the internet. A traditional (dedicated) server is only accessed by a given company or entity. While cloud servers perform the same functions as physical servers, cloud servers are hosted and delivered over a network rather than set up and managed on site. Another difference between cloud servers versus physical servers is that cloud servers offers unlimited compute capacity, but physical servers are limited to their existing infrastructure or computing capacity.

- **GPS Module**

Sim800l is a miniature cellular module which allows for gprs transmission, sending and receiving sms and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login automatically. On board led displays connection state (no network coverage - fast blinking, logged in - slow blinking).

- **Buzzer**

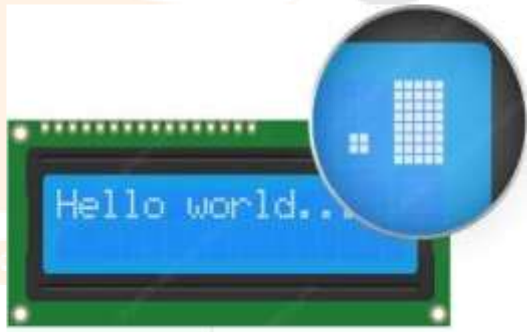
An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through dc voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell and siren.

- **Battery**

A lithium-ion battery (Li-ion battery) is a type of rechargeable battery commonly used in consumer electronics, electric vehicles, and renewable energy systems. Li-ion batteries have become popular due to their high energy density, long cycle life, and low self-discharge rate compared to other rechargeable batteries. The basic components of a Li-ion battery are the cathode, anode, electrolyte, and separator. The cathode and anode are typically made of a metal oxide and carbon respectively, while the electrolyte is a lithium salt dissolved in an organic solvent. The separator is a porous membrane that prevents the cathode and anode from coming into contact with each other.

- **LCD 12C**

LCD (Liquid Crystal Display) screen is an electronic display module and finds a wide range of applications. A 16x2 LCD display is a very basic module that has 2 controllers with 16 Pins which is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi-segment LEDs as they are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations. The status of the system is displayed using LCD.



Conclusion

Implementing pulse and oxygen monitoring using nodemcu and integrating it with thingspeak for data visualization and analysis can provide valuable insights into an individual's health status. Pulse rate and spo2 data are visualized on thingspeak in real-time using line charts or gauges, allowing for easy monitoring of vital signs over time. Doctor can access the thingspeak dashboard from any internet-enabled device, facilitating remote monitoring and accessibility. Continuous monitoring over extended periods enables the tracking of trends and fluctuations in pulse rate and spo2 levels. Analysis of the data on.

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