IOT BASED REMOTE PATIENT HEALTH MONITORING SYSTEM

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Abstract - Having good health is something everyone wants. It is inversely important to monitor a person's health on a regular base to avoid any kind of abrupt changes in the future. Also, simple monitoring of the health status of aged people is inversely necessary, and in this fast and ultramodern world, long hospital ranges and ambulatory monitoring is well known. These issues demand the system to develop an introductory health monitoring system that can be used in homes or wherever possible with primary health parameters.It transmits data through the internet, furnishing data interoperability methods. Capturing data and monitoring, assaying a series of data, recording storage, and display. We analyze parameters such as body temperature, blood pressure, palpitation detector or pulse sensor, and GPS to track the patient's current position in this design. We use Arduino Board as a processor where the collected data is transferred to Arduino and reused further. Furthermore, we use the Wi-Fi module to transmit data over the internet for analysis.

Keywords: *IoT,pulse-sensor,temperature sensor,ECG sensor,GPS, ESP32.*

1. INTRODUCTION

Nowadays, heart diseases cause more than a lack of deaths every year and are now the leading cause of death in the country. Usually, patients with heart disease live at home and ask for healthcare services when they feel sick or have transportation problems. However, usually, they won't feel sick until the very late stage of the disease, and it is so late that the harm has already turned irreversible. And the majority of people pass away before getting any treatment. Turning the passive healthcare mode into a pervasive approach is therefore the key to increasing heart disease healthcare performance and decreasing the death rate. If we lost plutocrat we lose nothing if we lose effects we lose nothing if we lose health we lose something. So health is veritably important to be covered constantly. It has veritably delicate for any doctor to cover cases in remote areas and nonstop monitoring would be a delicate task. currently, the IOT(internet of effects) enthralled numerous operations due to its advantages and by using it we can do numerous effects automate. originally we look at the IOT, it's an interrelated computing device that provides unique identifiers and non-stop transfer the data over a network without mortal commerce.

Helps to better to provide people with healthcare at any time in any region by eliminating geography, time and other barriers while increasing their coverage and efficiency at the same time. IoT is a structure that links everyone, wherever to all installations, flexibly, through connectivity and networking. Simply we can say that it's the interconnections of physical bias, similar to appliances and vehicles, that are bedded with software, detectors, and connectivity that enable these objects to connect and change data. so by this, we can cover the patient's health constantly or continuously irrespective of the place where he's located.

II. BACKGROUND

Costly health services and long waiting in the hospitals. home patient monitoring system has been increasing in the past years. This system collects the data of various body parameters using biosensors, wearable devices and smart textiles. It transmits the data to the central node or the servers, which in return shares the collected data to the hospitals for further, treatment-procedures are required[1]. This system monitoring the patient Pulse rate, Heart beat, Temperature, ECG with the help of pulse sensor, temperature sensor, ECG sensor, and also tracking the patient locality via GPS due to identifying that particular person[2].

A remote health monitoring system using IoT is proposed where the authorized personal can access these data stored using any IoT platform and based on these values received, the issues are diagnosed by the doctors from a distance. In pandemic situation peoples are facing so many problem like In such areas where the pandemic is spread, to overcome this issue we use IoT based health monitoring system is the feasible solution[3]. This system also allows access to the patient's loved ones to view the live data of the patient's heartbeat, temperature, Pulse with timestamps over the internet. The Patient Health Monitoring system grounded on the IoT helps to efficiently monitor and watch for patients, eventually saving lives[4].

. We have introduced an IoT architecture that has been specially designed for healthcare applications in this project. The primary goal of this project is to develop a remote health monitoring system using readily available local sensors in an effort to make it accessible to all[5].

.The system utilizes Message Queuing Telemetry Transport (MQTT) to transmit Electrocardiogram (ECG) data in real time from a proposed app to a web server, allowing doctors to access the data on their smart phones or computers[6].

.The goal of this research and proposal is to put into practise a solution that will help hospitals monitor patient health more effectively and deliver better, quicker treatment[7].

, the increased knowledge of software and applications, the advancement of mobile and the growth of the digital economy has contributed to the rapid-fire development of the IoT. IoT devices, such as sensors and actuators, have been integrated with other physical devices to exchange and monitor information using various communication protocols and algorithms[8].

The review contrasts the various systems' performance, efficacy, data security, privacy, and monitoring. Furthermore covered are the difficulties and unresolved problems in healthcare security, privacy, and quality of service (QoS). The study concludes by offering suggestions and directions for IoT healthcare applications, taking into account current technological trends[9].

The article suggests a ground-up approach to designing a simple patient monitoring system, which can detect one or multiple parameters. The multi-parameter monitoring system is proof that a patient is alive or recovering and is commonly used in high dependency units, intensive care units, surgery theaters, and post-surgery recovery units in hospitals[10].

III. Proposed system design

The prototype model consists of a NodeMCU ESP32 microcontroller-based unit integrated with a ECG sensor(AD8232 Heart monitor) is a digital recording of electrical signal that occurs in heart & EKG sensor requires no calibration., Temperature Sensor MLX90614 is a Contactless Infrared (IR) Digital Temperature Sensor used to measure the temperature of moving objects, Heart rate using pulse Sensor measuring the amount of reflected light with a APDS-9008 ambient light photo sensor, GPS is a satellite based navigation system that can be used to locate positions anywhere on earth, OLED used to display the status of the pluse sensor, ecg, temperature and latitude and longitude values &it is used to create excellent light source ,Buzzer or beeper is a signaling device

NodeMCU ESP32:

Fig 1 tells about. It is a 28 pins make up a structure. Safety features that are already built in, such safe boot and enable encryption. 8 bit 2 channel DAC pins and 12 bit 18 channel ADC pins are both present. SPI, I2C, UART, and other communication protocols are supported. clock frequency of up to 240 MHz. Additionally, it has built-in Bluetooth (V4.2 - Supports BLE and Classic Bluetooth) and Wi-Fi (802.11 b/g/n) or CAN capabilities combo chip connectivity, making it perfect for creating linked devices.

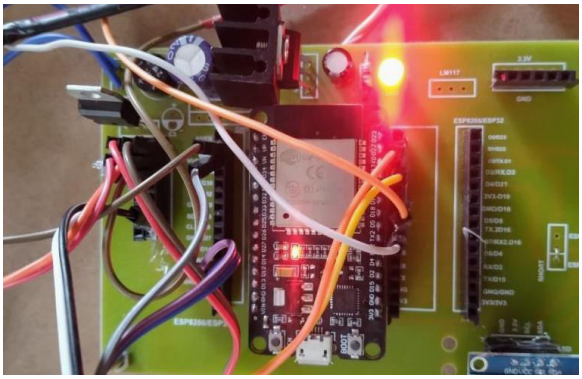
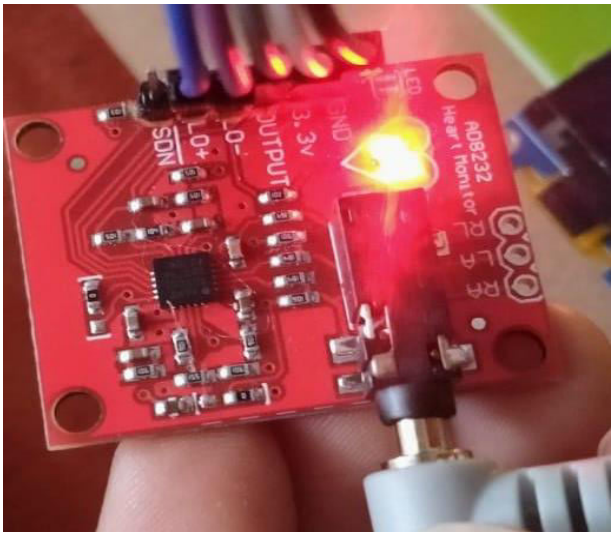


fig1

Boot Button: The fresh sketch or programmes are uploaded to the ESP32 microcontroller using this button. We must HOLD down the Boot Button during the upload.

Micro USB: An internal Micro USB port on the PCB is used to power it. The board and computer can be connected via this port in order to upload programmes.

ECG (Electrocardiogram sensor):



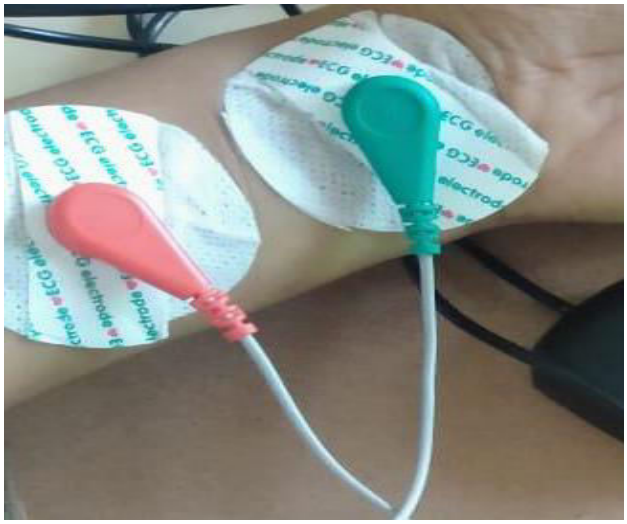


Fig 2: Connecting the ECG sensor to a person

Above Fig 2 shows. The heart works as a pump to circulate blood throughout the body by repeatedly contracting and enlarging. The body's heart contraction generates the cardiac electric potential. By increasing these electrical signals and leading them to different body positions, an electrocardiogram may be calculated. The electrodes patches can be reused, but they tend to absorb moisture. The EKG sensor requires no calibration. It is designed to produce a signal between 0 and 5 V.

Connecting the ECG sensor to a person steps:

Because the electrical signal produced by the heart and detected at the body's Surface is so small, it is very important that the electrode patch makes good Contact with the skin.

- Peel first electrode from the backing paper. Place it on the inside of the left wrist.
- Likewise second electrode is connected.
- Connect the clips from sensor to the tabs on the edges of the electrode patches.
- Connect red, green clips to the electrode patchs.

RESET Button: This button is simply used to reset the board

Temperature Sensor:

Fig 3: Temperature sensor

Above Fig 3 shows. The MLX90614 is a high-accuracy contactless infrared (IR) digital temperature sensor that may be used to determine the temperature of a specific object. The sensor uses IR rays to measure the temperature of the object without any physical contact with it. It uses the I2C protocol to communicate while converting the sensor's data to a digital value. It can

also be used in a variety of industrial, medical, and domestic applications,

III. EXPERIMENTAL RESULTS

A strategy for system testing integrates system test cases and design techniques into a well-planned series of steps that results in the successful construction of software. The testing strategy must co-operate test planning, test case design, test execution, and the resultant data collection and evaluation. A strategy for software testing must accommodate low-level tests that are necessary to verify that a small source code segment has been correctly implemented as well as high level tests that validate major system functions against user requirements.

Software testing is a critical element of software quality assurance and represents the ultimate review of specification design and coding. Testing represents an interesting anomaly for the software. Thus, a series of testing are performed for the proposed system before the system is ready for user acceptance testing.

Software once validated must be combined with other system elements (e.g. Hardware, people, database). System testing verifies that all the elements are proper and that overall system function performance is achieved. It also tests to find discrepancies between the system and its original objective, current specifications and system documentation.

IV. ALGORITHMS

Logistic regression

Logistic Regression uses a more complex cost function; this cost function can be defined as the 'Sigmoid function' or also known as the 'logistic function' instead of a linear function.

The hypothesis of logistic regression tends it to limit the cost function between 0 and 1. Therefore linear functions fail to represent it as it can have a value greater than 1 or less than 0 which is not possible as per the hypothesis of logistic regression.
-beat pulse reading.

Global positioning System:

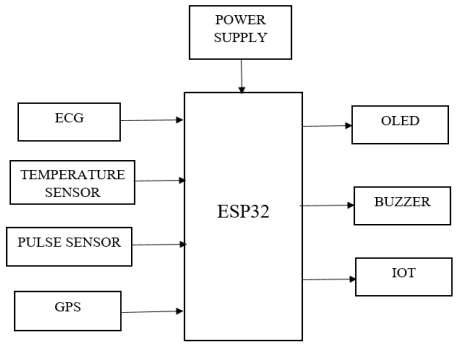
Fig 4: GPS

Fig 4 tells about. GPS is a satellite based navigation system that can be used to locate positions anywhere on earth.GPS receivers take information transmitted from the satellites and uses triangulation to calculate a user's location.GPS receivers to provide three-dimensional location plus time

To determine position, To navigate from one location to another, To create digitized maps. Google Earth is the famous application that uses the signals received by the GPS

POWER SUPPLY: Fig 5 block diagram and Fig 11 power supply unit, a power supply system that has been used to supply power to the devices, components, etc. consisting of several blocks. Step down transformer is used to convert the 240 V supply to 12 V and converted 12 V is given to the bridge rectifier which converts alternating current to pulsating direct current further which filters unwanted ripples and then it is fed to the voltage regulator which is used to supply a constant voltage to the entire device of 5 V. Out of 5v ,the NodeMCU take power 3.3V-5V, This NodeMCU gives 3.3V to all .

Block diagram:



System Implementation:

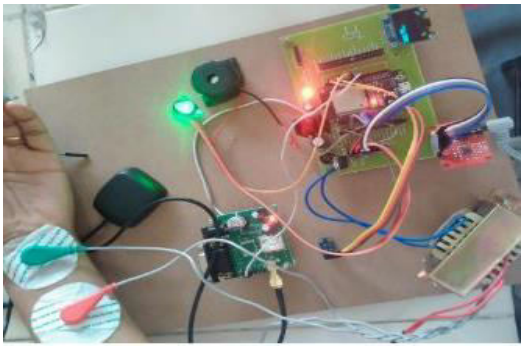


Fig 5: system operation

Interfacing of ecg with ESP32 NodeMCU:

- Interfacing of ECG sensor with ESP32NodeMCU by using comparator as an interfac between them for communication is shown in Figure 14. ECG Sensor 3.3 v supply pin and gnd pin is connected to vcc and gnd pin of ESP32 board,ecg output is connected to board pin, ECG LO minus pin connected to D12 pin of board and ECG LO plus pin connected to D13 pin of board. so this microcontroller reads Analog and digtal data.ECG heart rythms flucated in the range of 0-4096 approximately.
- It is a device that detects the electric currents generated throughout a cardiac cycle of contraction and relaxation by the heart muscle.
- It operates under the premise that when a muscle contracts, a little electric current is produced, which may be detected and measured by electrodes strategically positioned on the body.
- For a resting electrocardiogram, the subject is made to lie down and electrodes are positione on the arms, legs, and six different locations on the chest over the heart. A special jelly is used to adhere the electrodes to the subject's skin.
- The electrocardiograph's amplifier receives the current that is picked up by the electrode and sends it there. the current is then amplified by the electrocardiograph, which then records the results on paper.
- An electrocardiograph tracks variations in current on a moving piece of paper using a sensitive lever.
- In a cardiac cycle, the ECG creates a distinct pattern of three recognisable

waves. P wave, QRS wave, T wave, P-R interval, and S-T segment are these waves.

- P wave: The initial wave is a modest one that rises.it denotes atrial systole (depolarization).
- The QRS wave is the second wave, which starts off as a small downward wave, grows to a massive upright triangle wave, and then returns to being downhill wave.It symbolises the ventricular systole (depolarization).
- T-Wave: This third little wave has an upward deflection that resembles a dome.
- P-R Wave: This signal denotes diastolic ventricular repolarization.

Buzzer:

Fig 12

Above fig 12 shows. Buzzer or beeper is a signaling device,If any chronic suitations occurs sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.used in house and medical care also.The buzzer have two pins, one wire of Vcc connected to the Data (D5) pin in NodeMCU and another wire is connected to GND. When any critical condition apppeared the buzzer will be automatically beeped a sound to alert the patient condition. By this we can monitor the patient condition anywhere at any interval in the world.

OLED:

Fig 13

Fig 13 shows. A strong light is produced when electrical current is supplied. OLEDs are emissive displays without a backlight, making them smaller and more effective than LCD displays.

Enhanced image quality:- OLEDs can be used to provide superior light sources and have improved contrast and brightness. OLEDs provide superior lighting and may be flexible and effective. OLED displays the output as numbers and characters.

Directly connect signal to Microcontroller 3.3V and 5V without connecting through Voltage Regulator Circuit.

Display width with 128x64 Dot Resolution.
blue Display is used for the model OLED 1.3 I2C BLUE & Use I2C Interface

RESULTS AND DISCUSSIONS :

As the name of the project suggests, we are using some smart technologies to prevent the patient health and make automation possible. In present existing systems, there is no automation and we have to manually

long hosiptals visiting queue,transpatation and not continous monitoring that is not convenient in our modern life and there is a lot of time and money are lossed.Even if the patient visited the hosiptal with in time in critical suitation ,nut hosiptals were overcrowed,and there was no sufficent medical equipments top deal with patient health problem.The basic working of the given project is that we have used a power supply that converts 12 V AC to 5 V DC interfacing with the NodeMCu and with the inputs received from the ECG Sensor,Temperature sensor(to detect the patient temperature),Gps and PulseSensor, the output of the circuit is decided. If the pulse sensor signal is above (signal>threshold) "550", then "turn-on " this LED & it shows High pulse in display. otherwise & it shows Normal Pulse. Setup for leads off detection LO + & Setup for leads off detection LO - both are inputs only.If the digitalRead condition is satisfied it will print ECG value in display and ecg convert the elcrical signal such as heart rythms i.e shows in thinkspeak plafrom.If the signal is above (>36) ,LED is turn-onthen it shows high temperature otherwise normal temperature .In the present study, a prototype model has been developed using internet of things (IoT) as smart technology to reduce consumption of electricity that ultimately will reduce the eliminating the need for frequent hospital visits and transpotation issues. we can save time and money .we can automation in monitoring the patient health status without any human interventions. To access the information in the cloud we use open cloud server named “ThingSpeak” It is very secured and have specific channel Id and write key and also wifi and password facility.while checking the health results we must use respected channel ID, user name and password to acessed it .Output wavefrom are shown in below figure 17.

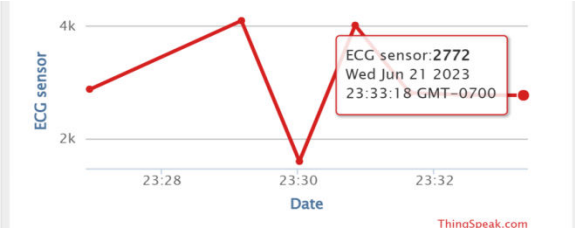
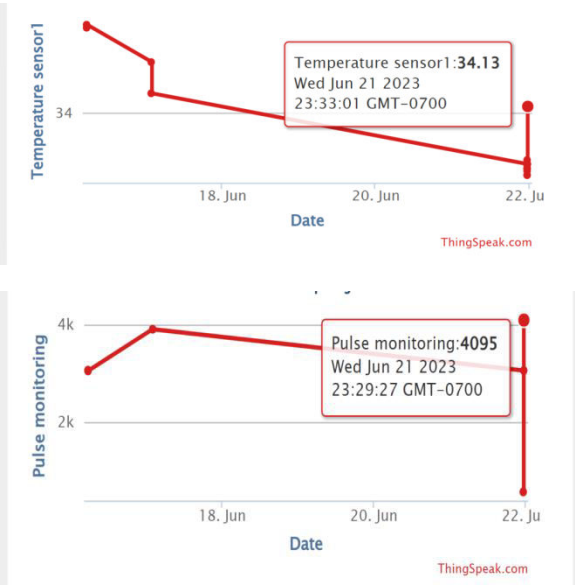


Fig 17: output wavefroms



Conclusion: The projected method aims at providing efficient and better health services using IoT. An efficient health monitoring system is deployed to examine patient’s health in the nonappearance of doctor. The health status is then updated to the doctor using IoT. The doctor can monitor the progress of patient’s health now and then to advise them about their health. Practical application of this scheme is beneficial in rural areas as the necessity for regular check-ups at the medical centers will be

reduced.This system is user-friendly and acts as a medium of communication for doctors and patients. potential to improve patient outcomes, increase efficiency, and reduce healthcare costs

Enumerated below is the part of the program code written in Embedded C language:

```
#include <SPI.h>
#include <Wire.h>
#include <WiFi.h>
#include "ThingSpeak.h"
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <TinyGPS++.h>
#include <HardwareSerial.h>
#include <Adafruit_MLX90614.h>
/* Create object named bt of the class SoftwareSerial */
HardwareSerial GPS_SoftSerial(2);
Adafruit_MLX90614 mlx = Adafruit_MLX90614();
#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64 // OLED display height, in pixels
// Declaration for an SSD1306 display connected to I2C (SDA, SCL pins)
#define OLED_RESET     -1 // Reset pin # (or -1 if sharing Arduino reset pin)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);
int PulseSensorPurplePin = 36;
int Signal;                // holds the incoming raw data. Signal value can range from 0-1024
int Threshold = 3450;
int ecgsignal;
const int buz = 5;
const char* ssid = " ";   // your network SSID (name)
const char* password = "    "; // your network password
unsigned long myChannelNumber = 2175636;
const char * myWriteAPIKey = "USG6UZ8IJY34R1JM";
WiFiClient  client;
TinyGPSPlus gps;
volatile float minutes, seconds;
volatile int degree, secs, mins;
  void setup()
```

Future scope

We intend to investigate and assess various kinds of disease-based classification and IoT-based healthcare monitoring systems in the future. We also plan IoT-based healthcare-monitoring systems to aim to be an introductory guide for those who will work in this field in the future, providing them with a detailed reference record related to the IoT and healthcare monitoring systems. In the existing method, the patient cannot be monitored frequently. It is critical to alert the doctor or care taker during the abnormal health condition of the patient. So,

it eliminates the need for manual monitoring by healthcare providers. The future scope of the research could be improving the performance using optimization models. We have anticipated a powerful health monitoring system that is intelligent enough to watch the patient automatically using IoT. These systems would gather the information status through these systems and would comprise the patient's heart rate, temperature, blood pressure, and ECG as well as the integration of a GSM module, which allows healthcare providers to locate patients location track in an emergency and transfer an urgent situation alert with the patient's recent status to the patient's doctor.

REFERENCES:

[1].Sasippriya Saminathan, K.Geetha,"A SURVEY ON HEALTH CARE MONITORING SYSTEM USING IOT", International Journal of Pure and Applied Mathematics , ISSN:1314-3395, Vol-117 No. 17 2017 , Special issue: pp. 249-254

[2]. SHETKAR AKHILESH, SHUBHAM MALLADAD, VINODA S TELI,KARTHIK N C "HEALTH MONITORING SYSTEM FOR COVID-19 PATIENT USING IoT", e-ISSN:2395-0056, Volume : 08 Issue:07 july 2021

[3].Prajoona Valsalam.Tariq Aarham Barhma,Ali Hussain Omar Baabood,"IOT BASED HEALTH MONITORING SYSTEM",Journal of critical Reviews,ISSN-2394-5125,Vol7,Issue 4,2020.DOI:I:http://dx.doi.org/10.31838/jcr.07.04.137

[4].Sanjay Balwani,Anil Bavaskar,Irfan Javed,Sarfraz Ali,"An IoT based Healthcare for Remote Patient Monitoring System"ISSN:1583-6258,Vol 24,Issue 2,2020,Pages.318-326 Received 24 October 2020;Accepted 15 December 2020.

[5].Patel,Tejas and Sharma,Pradeep and Yadav,Vikas ans Suman,Saurabh,"IOT Based Remote Health Monitoring System".Available at SSRN:https://ssrn.com/abstract==3536149or http://dx.doi.org/10.2139/ssrn.3536149.Issue :11 Mar 2020 pp.3

[6].Sidra Maqbool,Muhammad Waseem Iqbal,Muhammad Raza Naqvi,Khawaja Sarmad Arif,Muhammad Ahmed,Muhammad Arif,"IOT Based Remote Patient Monitoring System"https://www.researchgate.net/publication/348532549 Conference paper.november 2020,DOI:10.1109/DASA1403.2020.9317213

[7].Liew Yi Kent,Intan Farahana Binti Kamsin,"Implementation of IOT in Patient Health Monitoring and Healthcare for hospitals".proceedings of the 3rd International Conference on Integrated Intelligent Computing Communication & Security (ICIIC 2021) ,Atlantis highlights in Computer Science,Volume 4.

[8].Bikash pradhan,Saugat Bhattacharyya,Kunal Pal, "IOT-Based applications in Healthcare Devices",Hindawi Journal of Healthcare Engineering,vol.2021,article ID6632599,published:19 mar 2021 18 pages,2021.https://doi.org/10.1155/2021/6632599.

[9].Suliman Abdulmalek,Abdul Nasir,Waheb A Jabbar,Mukarram A M Almuhaya,Anupam Kumar Bairagi,Md AI-Masrur Khan,Seong-Hoon Kee,"IOT-Based healthcare-Moinitoring system towards improving Quality of life:A Review",*Healthcare* **2022**, *10*(10) 1993; https://doi.org/10.3390/healthcare10101993,published:11 October 2022.

[10]. Narasimha Rao Jasti Madhu "IOT based remote patient health monitoring System".