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IoT BASED HEART MONITORING SYSTEM

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Abstract - In this article, a novel approach for measuring ECGs based on Internet of Things (loT) systems that enable long-term monitoring is suggested. A wearable observing node made up of a pulse oximeter sensor MAX30102 and an ECG sensor AD8232 is used to collect the necessary ECG data. Wi-Fi technology is used to send the conditioned ECG signal and pulse level to the loT cloud. We'll send the ECG data to the Internet of Things cloud using the Node MCU ESP8266 wi-fi module. The programme code was designed to acquire ECG waves together with significant characteristics that can be utilised to identify arrhythmia disorders, such as the R-R interval, QRS duration, PR interval, QT interval, HRV, heart rate, and pulse level. When the data is transferred to the cloud, it can be structured, and specific readings may be compared and medically analyzed, which may provide the urgent medical aid that is required. The doctor and patient whose numbers are already registered will receive the obtained results. The patient can virtually access his or her health info as a result to this technology.

Key Words: ESP8266, AD8232, MAX30102, SIM800L, ThinkSpeak, IoT

1.INTRODUCTION

The demand for health monitoring systems has grown significantly, and efficient care of patients with COVID-19 disease has become a burden for hospitals[1]. The COVID-19 pandemic is one of the most serious issues facing the modern world today due to its extremely detrimental effects on public health[2]. With the new COVID-19 pandemic taking into account the growing population of the elderly and people with severe underlying diseases, as well as the high cost of caring for these patients, the growing need for remote health monitoring has become a crucial issue in today's life.

An ECG is a written or digital log of the electrical activity of the heart. An electrocardiogram, or EKG, is another term for it. Heart rate, heart rhythm, and other details about the health of the heart are all determined by the ECG. Heart arrhythmias, heart attacks, pacemaker functionality, and heart failure can all be diagnosed with ECGs.An IoT-based health monitoring system is the subject of the study presented in this paper. In particular, there are fewer doctors in rural parts of a country territory than there are in urban areas for COVID-19 patients, high blood pressure patients, hypertension patients, diabetic patients, etc. Except for government medical facilities, medical equipment is scarce in rural regions. In comparison to government hospitals, these clinics see a higher proportion of patients. In a similar vein, the apparatus has largely come to an end. As a result, if an emergency occurs, this hardware component will send a report as soon as possible to the doctors or medical experts. Doctors will complete the final work based on their reports.

The patient's health status will be recorded by a sensor in this health monitoring device. It is quicker, more cheap, and smaller in size. The human body's temperature, heart rate, and oxygen saturation level can all be measured. It is a multiparameter monitoring system that will concurrently track temperature, heart rate, and oxygen saturation level.

Heart rate keeps track of how many times the pulse beats per minute. The heartbeat varies due to ongoing labor, security threats, and passionate responses. After the age of ten, a person's heart rate should be between 60 and 100 pulses per minute while relaxed. Exercise causes the heart to pulse more quickly. Depending on the person's age, a maximal heart rate is suggested.

In COVID-19-affected people, the SpO2 level changes very rapidly and, without continuous monitoring, can cause death as well. It is essential to keep continuous real-time monitoring of the SpO2 level of the patients. Body temperature is another vital physiological parameter of humans. People with illnesses find it very essential to monitor their body temperature. High fever is one of the main symptoms of COVID-19 patients. It is very important to monitor the body temperature of such patients continuously. An IoT-based real-time SpO2 level, heart rate, and temperature monitoring system is very helpful now in the modern age. Others in the network should call a medical care supplier in the event that they experience wind or when the estimated SpO2 is less than 95%.

This technique measures the pulse as an instantaneous percentage of the heart. Adults over the age of ten, particularly the elderly, typically have pulse rates between 60 and 100 beats per minute. (bpm).

In the paper , the author used the ESP32 to connect the sensors, not the Arduino Uno.The measurements will be displayed in the mobile application that we are creating as part of the paper to determine the heart rate, body temperature, and respiration rate.

2. Literature servey

Smart remote health monitoring systems have improved patient care quality in recent years as a result of the development of the IoT and wearable sensor technologies in relation to medical devices[5].Remote health and medical tracking systems frequently use IoT hardware[6,7]. These Internet of Things (IoT) gadgets are used to monitor the health state of cardiovascular patients and transmit this information to the

doctor and clinic. These data are then used for disease analysis and early abnormal event detection[3].For patient care and health monitoring services that accurately extract physiological data from patients to identify disease, wearable sensor-based IoT devices are more valuable[4]. Each type of arrhythmia causes a unique type of ECG change, which gives the doctor information about structural heart abnormalities, the impact of medications on heart rhythm and electrical conduction, high blood pressure, kidney issues, or hormonal issues that affect the heart's electrical pattern along particular pathways[8]. Even though an abnormal ECG signal does not necessarily indicate heart disease, there is typically confidence that it can be used to identify CVD and its abnormal events[9]. According to research[10], heart disease—primarily recent arrhythmias—is the top cause of death for seniors in European nations. The most critical measurement needed for the ICU is body temperature, which is measured using an Arduino Uno-based system in Khan et al's system for IoT-based real-time health tracking. They also measure pulse rate and oxygen saturation.

This is the reason why I am presenting you with this great IoT project. In this project, I will show you how you can interface AD8232 ECG Sensor with NodeMCU ESP8266 Board and monitor the ECG Waveform on Serial Plotter Screen. Similarly, you can send the ECG waveform over the IoT Cloud platform and monitor the signal online from any part of the world using the PC or simply using the Smartphone. There is no need for staying in the Hospital to monitor heart activity/behavior just because you can monitor it online from anywhere. Thus it can be said advancement in Patient Health Monitoring System.

3.HARDWARE ASPECTS

3.1. ESP8266

In Fig.1 showed NodeMCU(ESP8266) in which features are described below:

- Processor: L106 32-bit RISC microprocessor
- 17 GPIO pins
- 10-bit ADC
- Serial Peripheral Interface Bus
- I^2Sinterfaces with DMA

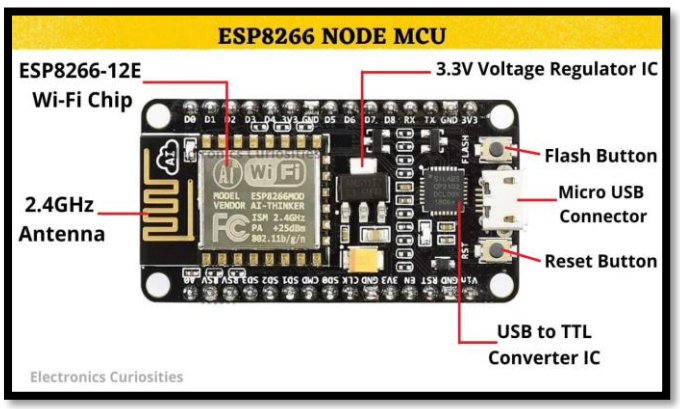

Fig.1.ESP8266

3.2. MAX30102

In Fig.2 showed PluseOximeter(MAX30102) in which features are described below:

- Real-Time Monitoring
- Flexible PCB Design
- USB-Powered
- On-Board Accelerometer
- Proven PCB Layout
- Fully Assembled and Tested

Fig.2.MAX30102

3.3. AD8232

In Fig.3 showed ECG Sensor(AD8232) in which features are described below:

- Common-mode rejection ratio: 80 dB (dc to 60 Hz)
- Two or three-electrode configurations
- Qualified for automotive application
- Single-supply operation: 2.0 V to 3.5
- Fast restore feature improves filter settling

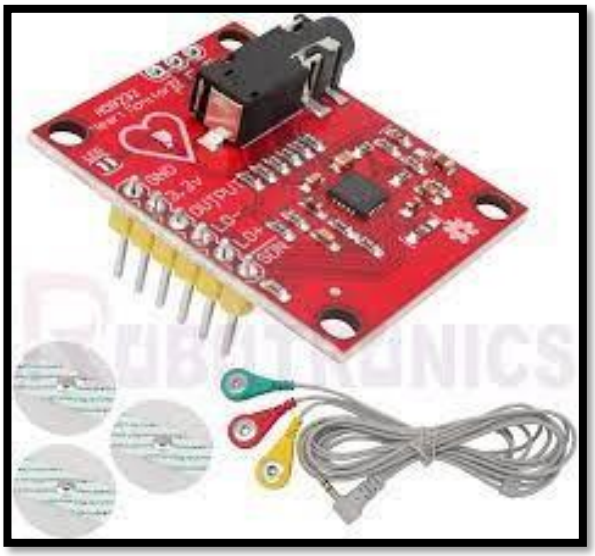

Fig.3.AD8232

3.4. SIM800L

In Fig.4 showed GSM MODULE(SIM800L) in which features are described below:

- Quad-band 850/900/1800/1900MHz.
- Make and receive voice calls using a headset or an external 8 speaker and electret microphone.
- Send and receive SMS messages.
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts.
- AT command interface with "auto baud" detection.

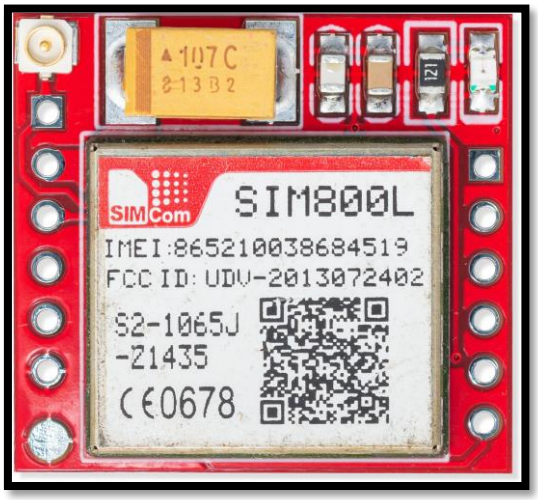

Fig.4.SIM800L

4. METHODOLOGY

4.1. Firstly, the connections are made among AD8232, ESP 8266 and pulse oximeter sensor. For this connected ones GSM module connection is also made.

4.2. The ECG electrodes are fitted to the patients body at correct positions and then the electrodes common point pin is connected to ECG sensor.

4.3. The power supply is given to the GSM module. Then the Led in GSM blinks very fast until it receives a signal. If the GSM module receives a signal then it blinks for 3 seconds. Then the patient will get message as Your registration was successful.

4.4.if ESP 8266 was connected to the wi-fi provided then we can observe the values that we require for our monitoring. The ESP 8266 sends the received data to the IoT cloud. Here the IoT platform we are using is Thing Speak.

4.5. If the patients acquired heart rate was abnormal then the patient was sent a message "You need an appointment".

5.CIRCUIT DIAGRAM

In Fig.4 showed circuit diagram as below:

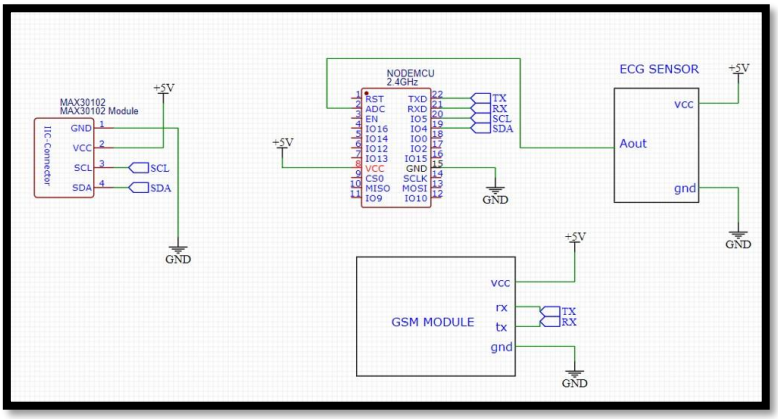

Fig.5.circuit diagram

6.PROPOSED METHOD

6.1. System architecture of healthcare monitoring using IoT

The sensing layer, the transport layer, and the application layer can be considered the three main architectural tiers of IoT apps. We base the system architecture on that general paradigm because it is simple and adaptable enough for our monitoring system. The architecture of the IoT-based monitoring system for individuals with heart diseases is shown in Fig.6.1. System architecture of healthcare monitoring using IoT

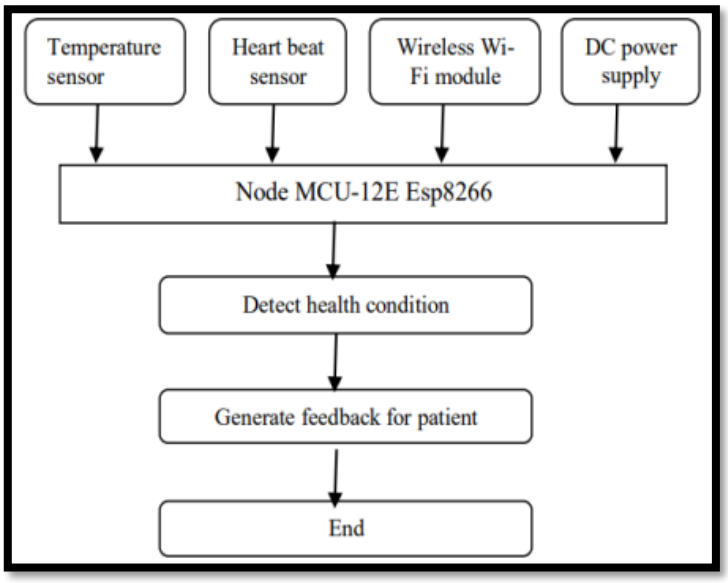

Fig.6.1.System architecture of healthcare monitoring using IoT

6.2.ThinkSpeak

Fig.9.showed the ThinkSpeak Platform. For IoT-based tasks, ThingSpeak offers a very useful tool. Using the Channels and web pages offered by ThingSpeak, we can watch our data and manage our system remotely by using the ThingSpeak website. You must first register with ThingSpeak. Create an account by going to https://thingspeak.com.

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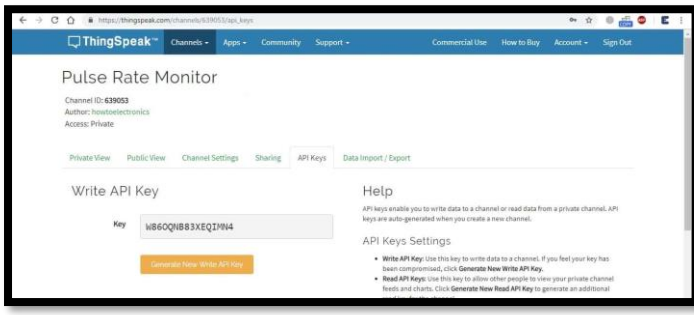
Fig.9.ThinkSpeak

Make the API credentials next. This key is necessary for data setup and programming changes.



After that, put the circuit above together and send the code to the Arduino UNO. When you open the serial monitor, everything will immediately connect to Wi-Fi and to be configured

7.RESULTS AND DISCUSSION

Now click on channels so that you can see the online data streaming, i.e IoT Based Patient Health Monitoring System using ESP8266 & Arduino as shown in the Fig.10 shows Readings of Temperature and HearRate. Fig.11 shows Spo2 and ECG.Fig.12 shows ADC values of an ECG of a person. Fig.13. shows ADC values of an ECG for a steel.Fig.14. shows messages sent to dactor's mobile.

The readings from different persons were taken during testing,and several readings were recorded.

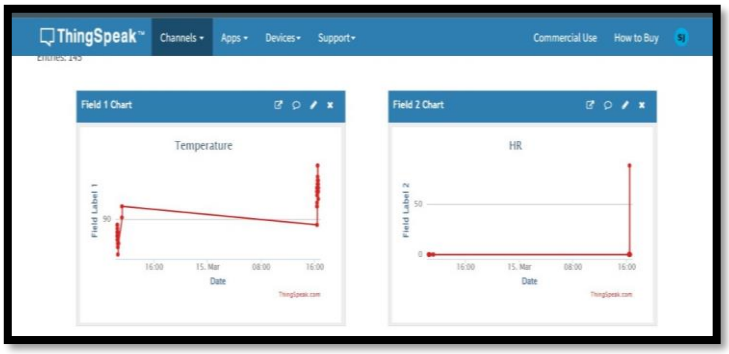


Fig.10.Temperature and HR

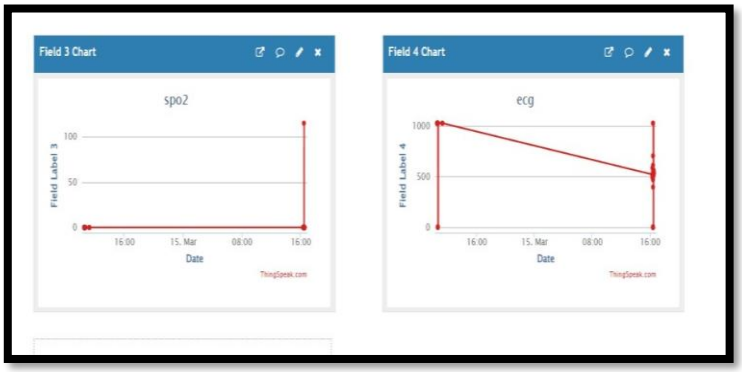


Fig.11.Spo2&ECG

Fig.12.ADC values of an ECG of a person

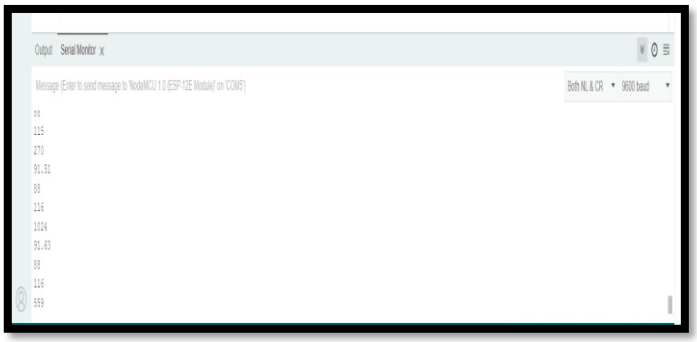


Fig.13.ADC values of an ECgC for a steel

Fig.14 Messages sent to Dactor's Mobile

8.CONCLUSION

The IoT-based system health monitoring system has thus been successfully integrated, in our opinion. We have examined how the Node MCU-12E Esp8266's sensors are used to compute the patient's body temperature and heart rate and to refresh the data. Later, the data may be accessed by the doctor thanks to IoT deployment. As a result, the system would save patients from dying critically and assist the doctor in acting appropriately at the appropriate moment.
We want to incorporate Data Stream Management System (DSMS) technology soon to enhance the system's capabilities, including continuous query, windowing, aggregation, and other features. After that, technologies for data stream mining and context awareness are also thought to offer patients more potent pervasive healthcare services like early warning and in-the-moment knowledge support.

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