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IoT Based Health Monitoring System

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Abstract: ***The brand new outbreak of Coronavirus poses a primary threat and has been declared a global public fitness emergency. entire world is trying to stop the virus but no efficient device and approach is there to govern it. Tracking a patient's fitness remotely is genuinely essential, especially for patients affected by a long term disease. This necessitates the creation of a single platform where consumers may monitor data in real time. This paper discusses health monitoring systems that can be implemented with market sensors and allow patients to be tracked without needing to visit a doctor. Doctors need constant updates on the patient's health- related measures such as blood pressure, heart rate, and temperature in such crucial situations. For this type of situation, an IOT-based system can provide automation that keeps doctors up to current at all times via the internet .Heart disease has become a major concern in recent decades, and many individuals have died asa result of various health issues As a result, cardiac disease must be treated with caution. This disease can be averted if the ECG signal isstudied or monitored early on. So here's the deal: An AD8232 ECG Sensor and an Arduino with an ECG Graph are used to monitor the heart rate. The ARDUINO- UNO board is used as a microcontroller, and the Cloud computing concept is used in this system. In this design, we'll interface an AD8232 ECG Sensor to an Uno and use a digital plotter or the Programming IDE to observe the Ecg.***

Keywords: Body temperature, Heart Rate, Arduino, ESP8266, ECGSensor, Pulse Oximeter Sensor, Accelerometer Sensor.

I. INTRODUCTION

Technology is getting more and more important in our diurnal lives. The Internet of Things is crucial for managing and regulating our daily lives. Because it involves human life, health care is a delicate science to handle [1].The fundamental flaw of the existing patient monitoring system is that it requires the presence of a doctor in the patient's immediate vicinity, which is not always possible. As a result, a system that does not require the presence of a doctor for patient monitoring is required.

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The data gathering system, data processing system, hospital end-terminal, and communication network are the fundamental components of a monitoring device. A data collection system consists of different sensors or devices with embedded sensors that may communicate data wirelessly [2]. This study demonstrates a concept that combines five sensors into a single system: an ECG module, a pulse detector, a temperature detector, a room humidity sensor, and an accelerometer module. AD8232 [3] is the ECG module used. ECG visualization provides for the detection of focus of extensive research, tachyarrhythmias, and cardiac death. The ECG [4] shows an increase in heart rate and contractility, indicating that the heart is under severe physical stress. The LM35 was chosen because it can measure human body temperature over a wide range and with good accuracy [6]. The number of times the human heart beats per minute is called pulse. A heartbeat normally fluctuates in beats per minute from person to person. The average body temperature is 98.6 degrees
Fahrenheit ,however it can fluctuate significantly between 97.8 and 99.1 degrees Fahrenheit, or even higher.Arduino, an open source software, was used to code and build the model. Its coding language is a modified, user-friendly version of C++. The WiFi module on the NodeMCU ESP8266 enables data to be sent to the cloud over the Internet at a cheap cost [7]. Three cloud service models are Infrastructure as a Service, Platform as a Service, and Software as a Service (SaaS).Google, Windows Azure, Amazon Internet Service, IBM, HP, Salesforce.com, Appscale, and Cloud Letter of the Alphabet [ebra] are some of the cloud service providers. The proposed methodology additionally uses signal processing to reduce costs and improve the accuracy of received data.

II. LITERATURE SURVEY

Augustus E. Ibhaze et al [1]. E-health Monitoring System for the Elderly was designed. This system uses pulse and temperature sensors to measure a patient's heartbeat and temperature at the same time, sending readings to a centralized database at specified intervals. Affixed to the patient's figure are Arduino microcontroller sensors that measure temperature and heart rate. It's also meant to recognize where the patients are. Lakmini P. Malasinghe, et al [2]. investigated both with-contact and contactless remote healthcare and monitoring. It largely includes technology ranging from body-worn detectors to ambient detectors mounted on the ground, and new advancements include contactless monitoring, which only requires the patient to be present within a certain distance from the detector with wireless communication, as well as data mining in the field of specific health care. Gifari et al created a single-channel moveable ECG device based on the AD8232 chip platform [3]. A 12-lead ECG accession technique is also being tested to increase the capabilities of an ECG mobile device.

The results revealed that a single channel ECG module with a new 12-lead ECG accession fashion can serve as an ECG Homecare gadget, making ECG determination accessible. A Wireless Patient Monitoring System employing Integrated ECG module, Pulse Oximeter, Blood Pressure, and Temperature Detector has been built by Sachi Marathe et al [4]. Using Arduino, the detectors will be combined into a single system. The information gathered by the detectors will be sent to a Wi-Fi module. Abhilasha Ingole et al [5]. published a paper titled "Implementation of Healthcare Monitoring System Using Raspberry Pi." This model is used to check the body temperature and heartbeat of patients in real time. Its primary goal is to collect physical parameters, which are then made available to numerous users. The Raspberry Pi B+ model was utilized. It interacts with several parameters and units of measurement. Basic health criteria are examined and tracked in this system. Ebrahim Al Alkeem et al [8]. developed a "Smart healthcare monitoring system" to collect patient physiological parameter information and determine their health status. The emergency app in the monitoring system is used to notify the guardian or family members of the patient's emergency situation [9]. Hasan and Ismaeel suggested a system, with the purpose of developing an IoT-based ECG healthcare system for people suffering from a cardiac condition Blynk is a free application. The technology uses IoT to keep track of a patient's heart rate automatically. The system's key advantages are its capacity to Anyone can connect and use it, and it is portable and remote capacities, cost-effectiveness, and ease of installation This system could be improve to include more in the future electrodes for ECG sensors and blood pressure sensors heartbeats and blood pressure Creating a cloud database to store all of the patient's health information will be quite valuable including their medical background The doctor, on the other hand, performs a fresh ECG reading, the data is saved immediately into the cloud database's patient record [10].

III. BLOCK DIAGRAM AND WORKING PRINCIPLE

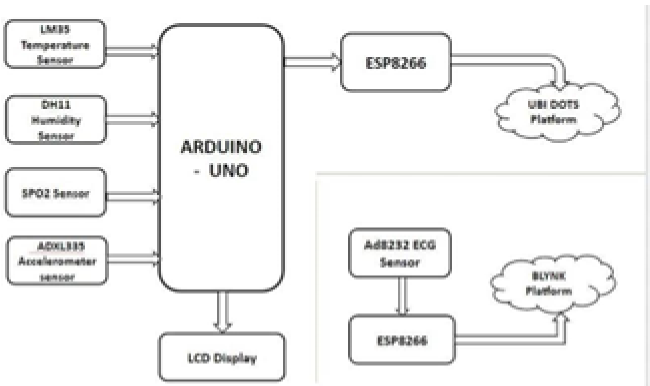

Figure 1. Block Diagram of Health monitoring system

Figure 2 depicts the fundamental components of a remote body temperature and pulse rate monitoring system. A 5V power supply, a temperature sensor (LM35), a pulse sensor, an Arduino UNO, a GSM Module, and a mobile phone are all represented in the block diagram.

Arduino is an open-source platform for electrical projects. It consists of a micro controller, which is a physical programmable circuit, and an IDE, which runs on our laptop and is used to build and submit program to the board. Sensors are used to track vital indications such as body temperature and heart rate.

The temperature sensor, the LM35, will sense the patient's body temperature and send it to the Arduino. When a finger is placed on the heart rate sensor, it produces a digital output of heart rate.

The readings from the sensors are displayed on a 16x2 LCD [Liquid Crystal Display].

IV. COMPONENTS USED IN THE PROJECT

A. Ardunio (Atmega 328)

Figure 2. Arduino UNO

Arduino UNO helps in high-speed programming. It has 28 Pins in total. 20 I/O ports are available to user in which 14 are digital and 6 are analog inputs. The ATMEGA 328 is an open- source 8-bit microcontroller that can handle eight data lines in a single clock pulse.

Specifications:

- Voltage level is 5V, with a suggested input voltage of7-12V.
- Flash memory is up to 32KB, with the Bootloaderusing0.5KB.
- Clock input required is 16MHZ
- EEPROM data memory is up to 1KB

B. Temperature Sensor (Lm35)

Figure 3. Temperature Sensor (LM35)

It is a Semiconductor-based integrated circuit. The letters LM stand for Linear Monolithic. It's an integrated temperature sensor with high precision. It generates a linear analogue output. From a reference voltage, this sensor produces a 10.0Mv output voltage for each degree of temperature.

Specifications:

- It was capable of operating between 4 and 30 volts.
- There is no need for external calibration. It is directly calibratedin centigrade.
- This device can withstand temperatures ranging from -60C to150°C.
- It uses only 60 amps from the power source and has a modestself-heating capacity.

C. Pulse Oximeter Sensor

Figure 4. Pulse oximeter sensor

A pulse oximeter is a device that measures and displays oxygen saturation in the blood vessels. Pulse oximeters were first utilized in hospital operating rooms, then in intensive care units, and finally in patient clinics. Pulse oximeters are small, battery-powered devices that must be lightweight and compact. A light source and a detector are the two major hardware components of a probe. The light source must provide pulsed, high-intensity light of the desired wavelengths; light-emitting diodes (LEDs) are commonly used since they are tiny, inexpensive, and capable of emitting light at the appropriate wavelengths. Due to their modest size, standard solid-state photodetectors such as photodiodes are sufficient to detect light that has passed through tissue their sensitivity is enough, and their reaction is linear enough. Pulse oximeters can be made to work with either light transmission or light reflection. The detector is placed opposite the light source in transmission pulse oximetry, with the examined tissue in between (see Fig. 4A). They are the most widely utilized probes since they are small, clip-on devices that can be worn on the finger or earlobe. The detector is placed close to the light source in reflection pulse oximetry, and the measurement is based on the light's backscatter (see Fig. 4B). They are typically worn on the brow. The nose, cheeks, mouth, and neonatal foot can all be used for pulse oximetry.

D. Humidity Sensor (Dh11)

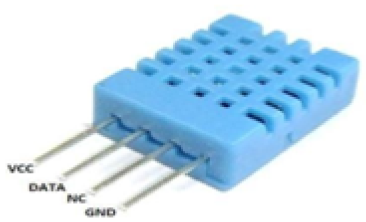

Figure 5. DH11 Humidity Sensor

The DH11 Sensor is a simple, ultra-low-cost digital temperature & humidity sensor. DHT11 Sensor consists of a capacitive humidity sensing element and a thermistor for measuring temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. This sends the data in digital form so analog pin is required. The DHT11 sensor has four pins vcc, ground ,data pin. A pull up resistor of 5k to 10 k ohms is provided for communication between sensor and microcontroller.

E. Ecg Sensor (Ad8232)

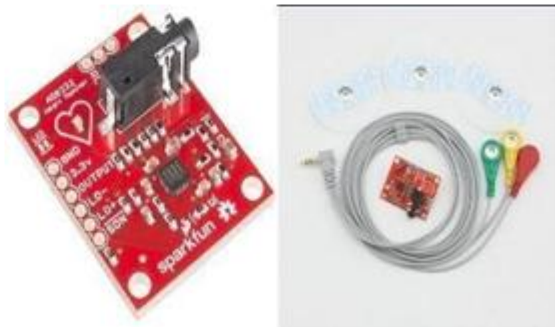

Figure 6. ECG Sensor (AD8232)

It's an ECG signal conditioning block with integrated signal conditioning. In noisy situations, it can also extract, amplify, and filter tiny bio-signals. A two-pole high-pass filter can be used to remove electrode half-cell potential and motion artefacts. It has an excellent 80dB Common Mode Rejection Ratio. Pins such as SDN, LO+, LO-, OUTPUT, 3.3V, RA, LA, RL, and GND are included for connecting custom sensors.

F. Accelerometer Sensor (Adxl335)

Figure 7. Accelerometer Sensor (ADXL335)

The accelerometer is a device that uses analogue inputs to measure the acceleration of objects in three dimensions, such as X, Y, and Z. It is a device with low noise and low power consumption. It's an analogue accelerometer that works on the capacitive sensing method. When it moves in any direction, the capacitance changes, causing the analogue voltage to change, which is sensed by the interface controller.

G. Wifi Module (Esp8266)

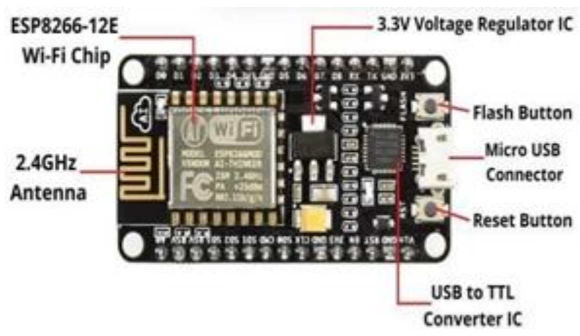

Figure 8. Wifi Module (ESP8266)

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The PC is connected to the internet by WI-FI or wireless fidelity module for continuous patient monitoring. NodeMCU is an enhanced LUA form firmware for the ESP8266 Wi-Fi chip that is open-source. It features Analog and Digital pins and is made up of 30 pins. UART, SPI, and I2C are the serial communication protocols supported by NodeMCU.

Flash Mode: When GPIO-0 and GPIO-1 pins are active high, then the module runs the program, which is uploaded into it. **UART Mode:** When the GPIO-0 is active low and GPIO-1 is active high, then the module works in programming mode with the help of either serial communication or Arduino board.

This module provides sufficient on-board processing and storage to allow it to be integrated with sensors and other application- specific devices via its GPIOs with minimal development and loading during runtime. The ESP8266 module is a low-cost board with a large, and rapidly increasing, community.

H. 16x2 Lcd Display

Figure 9. LCD Display

It's a simple module that can only display 16 characters per line. It's utilized to show the results of the temperature and pulse sensors.

V. IMPLEMENTATION

The mechanism for monitoring vital metrics is as follows, which will be explored more in this section. The following are the important requirements:

A. Hardware requirements:

- Arduino Uno
- 16X2 LCD Display
- ECG Sensor
- LM35 Temperature Sensor
- Pulse Sensor
- Accelerometer Sensor
- WIFI Module
- Jumper Wires

B. Software requirements:

- Arduino IDE
- BLYNK Platform
- UbiDots Platform
- Temperature, Pulse oximeter, ECG, and Gyro Sensors are used in the proposed system to track the patient's general health. The Arduino-Uno is used to link all of thesensors.
- Arduino is connected to an LCD display and a wireless connection to deliver data to a web server in order to follow the patient's health.
- This system uses a web server to display live ECG and heartbeat data with timestamps.
- If there are any sudden changes in heart rate or body temperature, an alert is issued via IOT.
- GYRO Sensor monitoring that uses sensor technology todetect patient movement and fall detection.
- We'll connect an AD8232 ECG sensor to an ESP8266 to show data and an ECG graph over the internet, which can be seen from anywhere in the world.
- We will be interfacing AD8232 ECG sensor with ESP8266 to display the data , ECG graph over internet and it can be seen from anywhere around the world.
- We'll deliver the data to them via syntax codes using theIoT Cloud platform UbiDots.
- Before utilizing these, keep in mind that because this is done over the internet, there will be some latency delaysbetween the device and the cloud when the data is displayed on the graph.
- To access the dashboard, open UbiDots and login or create a new account after uploading the code.

After that, the heart rate and temperature are calculated. The pulse can be felt in some blood vessels that are very close to the skin surface, such as the wrist, neck, upper arm, and so on. The heart rate is counted for roughly 30 seconds before being translated to beats per minute. The body temperature is also monitored simultaneously.

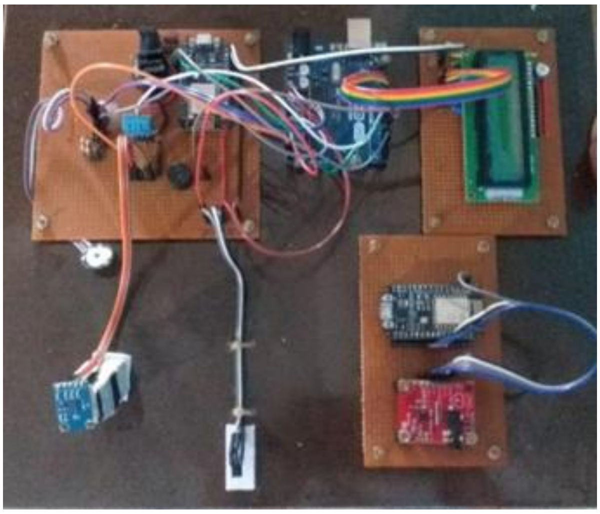

Figure 10. Hardware Setup

Because the sensors are attached to the Arduino board's pins, the values collected from the sensors are sent to the Arduino. If the readings received from the sensors reach critical levels, the code developed in the Arduino Software displays information about the patient's health status. Assemble all of the necessary components, then begin connecting the model and initializing all of the ports, then dump the code from the Arduino IDE to the Arduino UNO, verifying and uploading the code. The LCD will display the message "Given input." Touch the temperature and pulse sensors to count and read the temperature and heartbeat biological data. The output will be shown on the LCD, and the GSM model will send the pulse rate and temperature readings to the registered mobile number through SMS. After sending the message, the received message will be displayed on the LCD, and the procedure will be complete.

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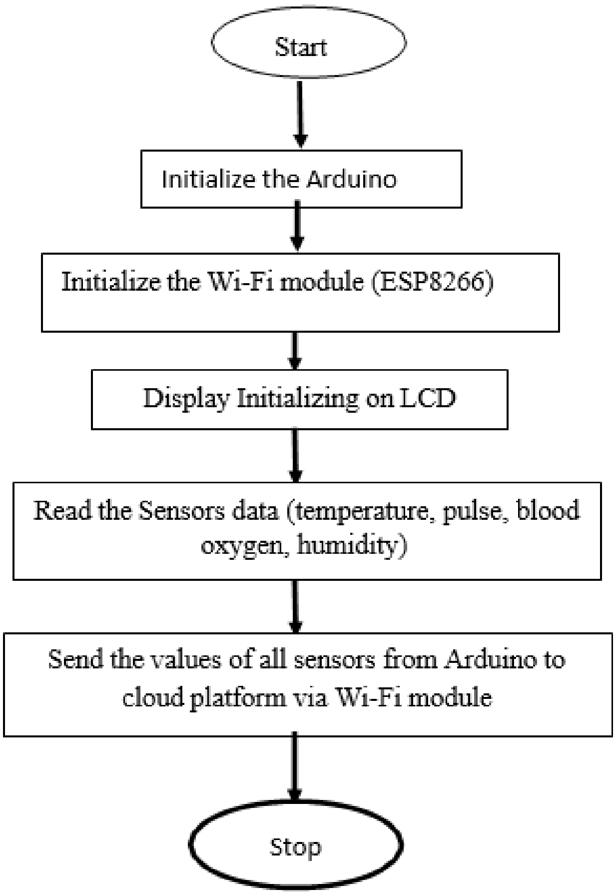

Figure 11. Flow chart of the proposed system

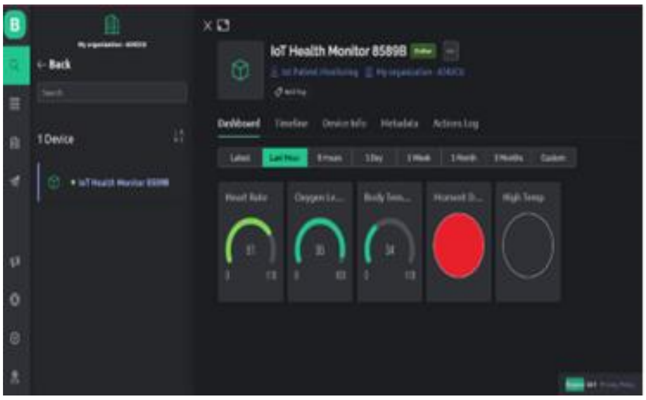

Figure 12. Output Of the Blynk Server

VI. RESULTS

All of the patient's vital parameters, such as heart rate, body temperature, pulse levels, and critical levels, were presented on the Blynk server. Doctors were provided regular information so that they might be contacted if an emergency occurred. We'll use the Blynk app to keep track of the situation and notify them by buzzer if anything goes wrong.

Figure 13. LCD Displaying the condition of patient

The message will be sent to the registered number after the temperature and heart rate have been measured, and a notification stating "Message was sent" will appear on the LCD. Whenever a message is received, the doctor or a patient's relative is notified, and they can assure the patient's safety. As a result, ECG continuous monitoring is carried out using the Ubidots platform, which allows us to observe reliable ECG monitoring with a delay. The permanent monitoring provided by the wireless ECG monitoring system considerably enhances the quality of life of cardiac patients. An immediate alarm is sent to the physician in the event of an accident. Long-term monitoring allows for the capture of occasional events, which is an essential contribution to the improvement of therapy and, as a result, to the patients' health. Bluetooth technology, an ECG detector, and a personal computer as a monitor were used to complete the assignment.

Figure 11. ECG Graph Monitoring through UbiDots

This method has proven to be particularly beneficial in diagnosing patients who have frequent cardiac symptoms. The wireless ECG monitoring system delivers precise readings of the heart's electrical activity, which are displayed on an intuitive graphic user interface (GUI). The ECG system is a critical tool for monitoring the heart's electrical activity. Because the wires are continuously getting in the way of medical workers or the patient himself, it is currently prone to human mistake. Bluetooth is the wireless system of choice. The Bluetooth ECG allows the patient to move around freely without having to carry extra weight or cords. Furthermore, the wireless ECG monitoring device is small and portable, allowing patients to wear it comfortably and discreetly.

VII. CONCLUSION

The system is designed for people who are not in a life-threatening scenario but need to be monitored by their doctor or family on a regular basis. So that we may easily protect a large number of lives by delivering prompt assistance. According to the research, the design of a health monitoring system is based on a researcher's notion that satisfies the needs of patients**.** The ECG, Blood Oxygen, pulse and Temperature Monitoring results are computed in less than a minute by the health- monitoring system.

Because of the combination of the number of pharmaceutical data sensors on a single component, the scope also lowers when compared to the conservative method. As a result, time-cost complexity is decreased.

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