RESEARCH ARTICLE OPEN ACCESS

IOT Based Heart Monitoring System using ECG

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Abstract:

Internet of Things (IoT) has proven to be a lot more helpful and smart in various applications in this era and continues to be useful. The most promising IoT application is in the field of health care. People in some countries continue to lack access to quality health care due to a variety of barriers. One of the primary reasons is the physical distance between the patient and the clinic. This paper investigates the use of IoT in the health care domain, and a system is proposed to monitor the ECG of a distant patient. The Raspberry Pi, Arduino Uno, ECG Sensor, and IoT Cloud are used in this system to store and plot ECG data in real time.

Keywords* — *Internet of things (IoT); electrocardiogram (ECG) monitoring system; ECG sign signal parameters; cardiovascular disease; logistic regression model.

INTRODUCTION

Healthcare technologies are gradually making their way into our daily lives, gradually replacing older devices and techniques with more intelligent ones. Although they are intended to assist people, people's reactions and willingness to use such new devices can be unexpected, particularly among the elderly. A fall is one of the most significant factors influencing an elderly person's physical and psychological health. Physical injuries caused by falls include heart attacks, bone fractures, and general connective tissue lesions.

A fall has significant psychological consequences because it significantly reduces affected people's self-confidence and independence. Healthcare technology based on wireless sensors has matured and proven to be reliable, and these devices are now being used to manage people's health in homes and nursing homes. In this project, an improved fall detection system for elderly person monitoring is proposed, which is based on smart sensors worn on the body and operates via consumer home networks. The smart sensors include a temperature sensor, an ECG sensor, and a heartbeat sensor. The sensor values are measured by an MCU and transmitted to the PC via Wi-Fi.

It will receive sensor data and store it in a database. Any sensor value that exceeds the limit will alert the corresponding person. This research also demonstrates that transmitting acceptable quality ECG signals can significantly improve the battery lifetime of IoT-enabled devices. [1]

PROPOSED WORK METHODOLOGY:

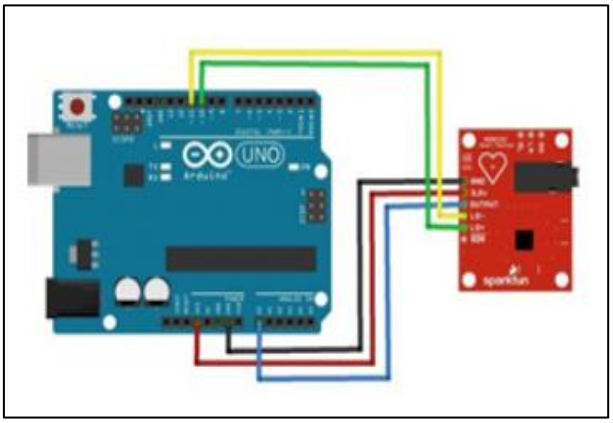

Figure 1: Arduino with Heart Rate Monitor

A Health Monitoring System is made up of three major parts: a data sensing module, a data processing module, and a data communication module. The data sensing module is made up of a temperature sensor and a heartbeat sensor, which detect changes in the physiological parameters. The data is transferred to the data processing module's microcontroller. The input signals are analysed by the data processing module. The noise signals are filtered, and if the processed value exceeds the normal value, the medicine to be administered as first aid to the patient is displayed on the personal computer via a graphical user interface. The communication module is used to exchange data between people and machines. The message, the sender, the receiver, the medium, and the protocol by which the message is sent to the doctor via mobile phones by an information gateway for treatment are the basic components of this.

BLOCK DIAGRAM:

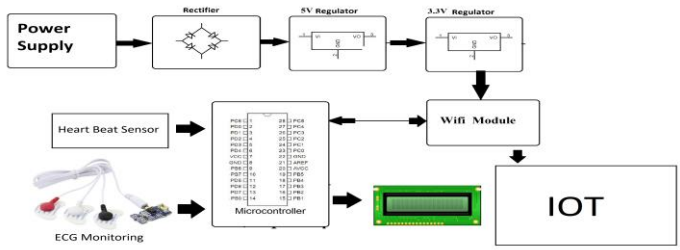

Figure 2: Block Diagram of ECG System

An ECG signal can be used to track various physiological and pathological heart states in the block diagram. This cardiac monitoring equipment also helps to determine whether a person has any heart problems. This is done by measuring the heart rate. An Atmega controller is used in this system to scan ECG signals and look for patterns in a common range; if the pattern is found to be in the normal range, the individual is healthy; if it is not in the normal range, the individual has a cardiac condition. The following result is provided as an alert message on the Internet of Things.

Figure 3: Design of the IOT Device-based ECG System

In software implementation, the software and hardware components are combined. To control the hardware, necessary code was written. The Arduino pin 2 (SDA and SDL) is used to initialise the cardiac bit sensor pin in the coding section. Two additional buttons are set to GND and 3.3v. Arduino pins 10 and 11 are used to initialise the ECG sensors LO+ and LO-. Pin OUTPUT to A0, GND to GND, and 3.3v to 3.3v are used to initialise additional controls. At first, the ECG and Heartbeat values are both zero. The Wi-Fi cloud module includes an auto-configuration feature. RX and TX Wi-Fi modules are initialised on Arduino pins 9 and 8, while CH EN and VCC are connected to Arduino pin 3.3v. Another GPIO 0 pin is used to upload the programme to the Wi-Fi module.

Initially, two different sensors are combined, and programmes are launched simultaneously to obtain the output result in the Arduino's COM3 port. The hardware is used to read the heartbeat in the heartbeat approach. The heartbeat is first counted for 20 seconds. The value is calculated when the heart bit pin rises to a high position. The heartbeat is estimated for 60 seconds or one minute while collecting data. Finally, the heartbeat data is stored in the cloud. The ECG method uses the same command line as the heartbeat method. If the ECG count is less than 50, count the ECGs and send analogue or digital data to the cloud, which is then sent to the MQTT web server, where the ECG

result is displayed. Using the loop approach, analogue ECG data is uploaded and converted to digital data. When the ECG score is greater than 80, the data is uploaded; otherwise, an ERROR message is displayed. [2]

The ESP8266 Wi-Fi module is connected to Arduino for uploading the MQTT programme. GND is connected to the ESP8266 GPI 03 pin. The pin is unplugged after uploading the programme, the RX, TX, and GPIO 0. The ESP8266's RX and Tx pins are connected to Arduino's TX pin 8 and RX pin 9. After completing all of these steps, the project runs and sends sensor data to the cloud. The result is visualised on the MQTT box by the cloud. [3]

SYSTEM DESIGN AND IMPLEMENTATION:

This study presents the integration of a human heartbeat rate monitoring system using a heart vibration sensor and IoT-based technologies. The human heartbeat is detected and recorded by this sensor. The read data is processed by the ESP32 controller before being sent to the Wi-Fi module for upload to the Biodots internet server platform for further analysis and visualisation. When data is collected, it is processed and saved in real time, along with a date and time stamp. The proposed work's input units are the ECG sensor unit, the power supply unit, and the user interface unit. The Wi-Fi Module is the output unit. The ESP32 controller unit monitors and controls the signals. The system is programmed using the integrated C programming language. The ECG sensor will detect the heartbeat. The data sensed by the sensor is sent to an analogue to digital converter (ADC), which converts it to a digital signal. The generated digital signal is then sent to the ESP32 controller. The ESP32 controller responds to the signal using commands written in the embedded C programming language. The data is also sent in real time to the Wi-Fi module and then to the webserver (Ubidots) for additional analytics and visualisation. The analysed data is continuously updated in real-time to show the condition of the human heartbeat rate. It also has a buzzer and an LED that will light up if the cardiac condition worsens.

Arduino serves as the system's central control unit. There's also a pulse sensor, an ECG sensor, and a slew of manual buttons on the input side. The result is shown on the Arduino com port. The Wi-Fi Module allows data to be uploaded to the cloud, where it can then be accessed by logging into the server with a computer or smartphone.

OBJECTIVES:

- Create a health monitoring system, which measures body temperature and heart rate.
- Using database management, design a system to store patient data over time.
- Conduct data analysis on sensor data collected.

REVIEW OF LITERATURE:

The term "IoT" was coined in "Kevin Ashton 1999" and was deemed significant as a method of simulating multiple services. The "Internet of Things" (IoT) is a powerful network system that can be structured according to the framework of standard collaborative communication agreements based on the IoT European Research Cluster (IECR) project concept. IoT is a flexible infrastructure that connects everyone, wherever, whenever, and wherever to all facilities via connectivity and networking. It is regarded as a groundbreaking development that has undergone several improvements over the years. The Internet of Things (IoT) was a revolutionary idea that was implemented in a smart world with a type of rational energy efficient technology. "The Internet of Things has become a major focus of health, energy, the environment, public protection, food and water access, connectivity, manufacturing, and much more in various areas of social use." Currently, there are 20.35 billion connected devices worldwide, with 75.44 billion by 2025, according to statistics.

Some of the related literature is concerned with data acquisition and system hardware design. While most people use wireless transmission for remote monitoring, such as General Packet Radio Service (GPRS), Global System for Mobile

Communications (GSM), and the Internet. The proposed design by Abo-Zahhad et al. is capable of measuring vital signs such as the patient's heart rate, blood pressure, blood oxygen level, and ECG and sending the results via the internet. To reduce data transmission costs, abnormal readings, alerts, or data are sent via GPRS to the doctor and GSM to the patient's relatives. The authors did not provide any tests or results to demonstrate that their proposed design works properly. [4]

The consumer was the subject of the study when Saini et al developed its healthcare system: the programmed specifications used a basic design methodology similar to typical software development courses. The WSN is an important component of IoT, and it also plays a role in its healthcare applications. They are well-known for their high-end and diverse wireless control systems for various regular devices. Rotariu and Manta emphasised the importance of working on the WSN for pulse rates and oxygen saturation in 2012. [5]

RESEARCH METHODOLOGY:

Books, educational and development journals, government papers, and print and online reference resources were just a few of the secondary sources we used to learn about the composition, use, and consequences of an IOT-based heart monitoring system using ECG. As described in this paper, ECG monitoring systems are made up of a variety of components, frameworks, and technologies. The breadth and diversity of ECG sensor-based architectures.

RESULT AND DISCUSSION:

HEARTBEAT RESULT ANALYSIS:

An automatic blood pressure system analysed the heartbeat result to determine whether or not the heartbeat sensor is functional (Fig. 4). Data were collected from five different people in the specified age range for further processing. The information was listed along with the date and time. [6]

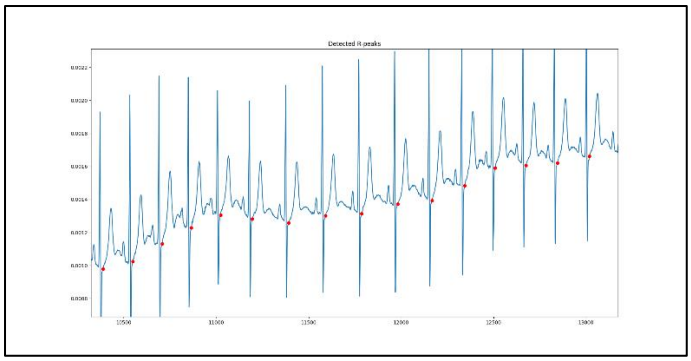

Figure 4: Heartbeat Result Analysis

The value is converted into a curve, uploaded to the webserver, and virtualized via mobile app and website. Figure 4 shows the Arduino com port result.

The graph below depicts deviations from the ECG sensor in the proposed model. This is done on a Raspberry Pi.

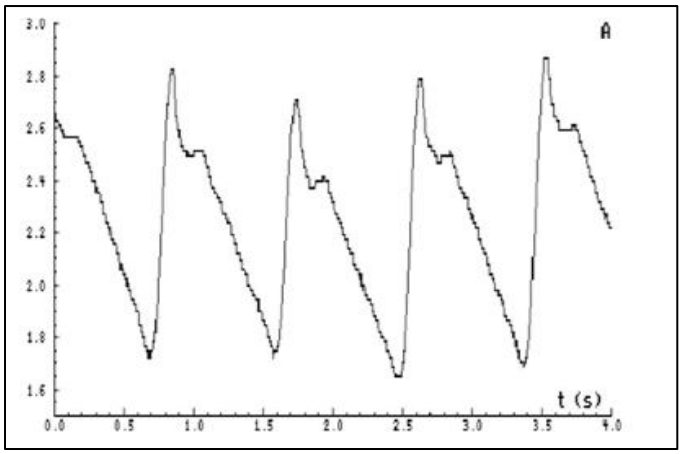

Figure 5: ECG sensor in the proposed model

ECG REPORT ANALYSIS:

Initially, three electrodes are placed on the patient's chest. The red electrode is placed on the right side of the patient's chest. The green electrode is on the left side of the chest, and the yellow electrode is beneath the green electrode. The ECG push button is then pressed. [7]

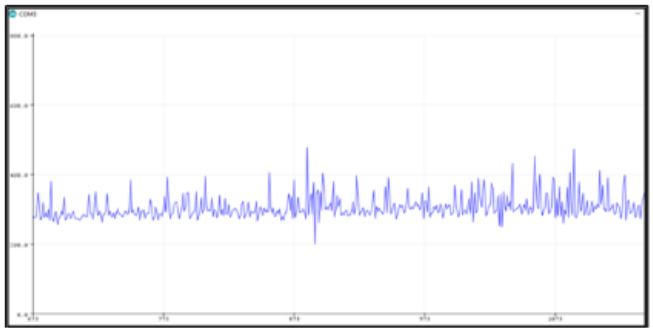

Fig. 6. Arduino com Port Result

The key feature of the measured ECG is depicted in Fig. 6

The graph below depicts a portion of the ECG data collected from the healthy volunteer. It is clear that the intervals between adjacent R waves (RR interval) are nearly identical, indicating that there is no risk of developing arrhythmia.

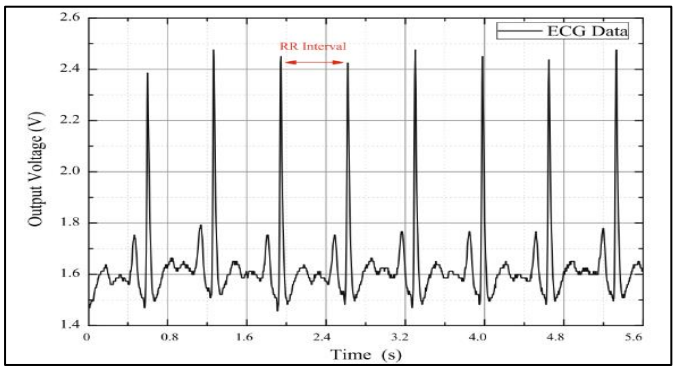

Figure 7: Real time ECG Signal

A typical ECG includes the following components:

RR interval: The R wave, as one of the most noticeable characteristics, is frequently used to determine the period of an ECG signal. The RR interval denotes the time interval between two adjacent R waves, which can become irregular in the event of certain heart diseases, such as arrhythmia.

PR interval: The PR interval is the time between the start of the P wave and the start of the QRS complex. It denotes the time it takes for an impulse to travel from the sinus node to the ventricles.

QT interval: The time between the start of the Q wave and the end of the T wave, which is related to ventricular depolarization and repolarization, is represented by the QT interval. If the QT interval exceeds the normal value, there is an increased risk of ventricular fibrillation or even sudden cardiac death. [8]

CONCLUSION:

We designed and implemented an ECG monitoring system entirely based on current IoT technologies. The proposed design is used to build the IoT-based ECG monitoring system. For health monitoring, an IoT-based healthcare platform connects with smart sensors attached to the human body. In this article, we discussed IoT-based patient monitoring systems. Smartphones and gadgets employ intelligent technologies, and we have discussed the benefits, drawbacks, and opportunities. For the medical patient to be observed, continuous remote monitoring is required. Our research work enables continuous patient monitoring via web app services and mobile massage services. This study also compared the ancient medical system to modern health monitoring. The work will change medical science and be a boon to rural areas. The research has already proven to be beneficial. We intend to expand the project by promising that one day, every person in our country will be able to receive immediate medical treatment thanks to our efforts.

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