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Article Title: Heart Attack Detection and Heart Rate Monitoring Using Arduino and IoT

Heart Attack Detection and Heart Rate Monitoring Using Arduino and IoT

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Abstract

This project focuses on the development of a heart attack detection and heart rate monitoring system utilizing Arduino and Internet of Things (IoT) technology. The system integrates sensors such as pulse sensors and electrocardiogram (ECG) modules to continuously monitor the heart rate and detect any anomalies. The data collected is processed using Arduino, which serves as the system's central microcontroller, and then transmitted to a cloud-based platform via IoT for real-time monitoring and analysis. Alerts can be sent to the user, caregivers, or medical professionals in the event of an irregular heart rate or potential heart attack. This approach enhances patient safety and provides a timely response in emergencies by leveraging IoT for remote monitoring and data storage, offering a comprehensive and accessible solution for cardiovascular health management.

Keywords: Pulse, ECG, Internet Technology and IoT.

1. Introduction

Heart attack detection and heart rate monitoring are critical aspects of healthcare that can significantly impact the outcomes of patients with cardiovascular issues. With the integration of modern technology such as Arduino and the Internet of Things (IoT), advancements in real-time monitoring and early detection of heart attacks have become more accessible and efficient. Arduino, an open-source electronics platform, provides the foundation for developing cost-effective and user-friendly monitoring systems. By utilizing various sensors and IoT connectivity, these systems can track a person's heart rate and detect irregularities indicative of potential heart attacks. This real-time data can be transmitted to healthcare providers or caregivers for timely intervention, ultimately leading to better patient outcomes and enhanced quality of life. The combination of Arduino and IoT in heart rate monitoring and heart attack detection marks a significant step forward in the field of healthcare technology. Heart rate Detection and Heart rate monitoring using Arduino and Internet of Things (IoT) is a health monitoring project that leverages technology to provide real-time monitoring of heart rate and detection of potential heart attacks. This kind of project aims to help patients, doctors, manage heart health more effectively.

2. Literature Survey

Heart attack detection and heart rate monitoring are critical aspects of cardiac care, and advances in technology, such as the Internet of Things (IoT) and Arduino, have enabled the development of efficient and accessible solutions for these purposes. Recent literature demonstrates a growing interest in utilizing these technologies to create systems that continuously monitor heart rate and detect abnormal patterns indicative of a potential heart attack. Arduino, an open-source electronics platform, provides a convenient and cost-effective foundation for building such monitoring devices. When combined with various sensors, such as photoplethysmography (PPG) or electrocardiography (ECG) sensors, Arduino can gather real-time data on heart rate and cardiac function.

IoT connectivity enhances these systems by enabling the transmission of data to remote servers or cloud-based platforms, allowing for continuous monitoring and analysis of heart health by medical professionals. This real-time data transfer can facilitate early detection and intervention in cases of cardiac distress. Additionally, machine learning algorithms can be employed to analyze the collected data and identify patterns associated with heart attacks, providing an extra layer of diagnostic support. Research has also focused on wearable devices incorporating these technologies, which offer patients the convenience of continuous monitoring without the need for intrusive medical equipment.

While there are promising results from current studies and projects, challenges remain, such as ensuring data accuracy, privacy, and security, as well as regulatory compliance. Ongoing research is aimed at refining these systems and addressing these challenges to improve their reliability and effectiveness in detecting heart attacks and monitoring heart rate.

Heart attack detection and heart rate monitoring using Arduino and IoT have seen significant progress in recent years, with researchers exploring new approaches to enhance the accuracy and efficiency of these systems. One key area of development is the integration of machine learning and artificial intelligence algorithms, which can process large volumes of data and identify patterns that may signal a potential heart attack. These algorithms can improve the specificity and sensitivity of heart attack detection, enabling early intervention and potentially saving lives.

Incorporating IoT capabilities into these systems allows the data to be transmitted wirelessly to a central server or a healthcare professionals, enabling real-time monitoring and immediate response in case of emergencies. The literature also highlights the importance of algorithmic accuracy in the detection process. These systems often involved continuous data collection, analysis and wireless transmission to healthcare professionals or mobile devices for prompt invention.

The literature suggests that these technological advancements can improve patient outcomes and potentially saves lives by enabling faster and more efficient responses to cardiac emergencies. Challenges such as ensuring data, privacy, system reliability, and user accessibility remain focal points for ongoing research and development in this field.

3. Existing System

Heart attack detection and heart rate monitoring using Arduino and IoT is an innovative method that leverages microcontroller technology and internet connectivity to monitor a person's heart health in real-time. The approach typically involves using an Arduino board connected to a heart rate sensor, such as a pulse oximeter or ECG sensor, to continuously monitor the user's heart rate and detect any irregularities. The data collected by the sensor is processed by the Arduino to identify potential signs of a heart attack, such as sudden changes in heart rate or abnormal ECG patterns. This information can then be transmitted over the internet using a wireless module (such as Wi-Fi or cellular) to a remote server or cloud-based platform for further analysis and storage. The IoT-enabled system allows healthcare providers or family members to receive real-time alerts if any anomalies are detected, enabling quick intervention and potentially saving lives. Additionally, the monitored data can be used to track the patient's heart health over time, helping to identify trends and inform medical decisions.

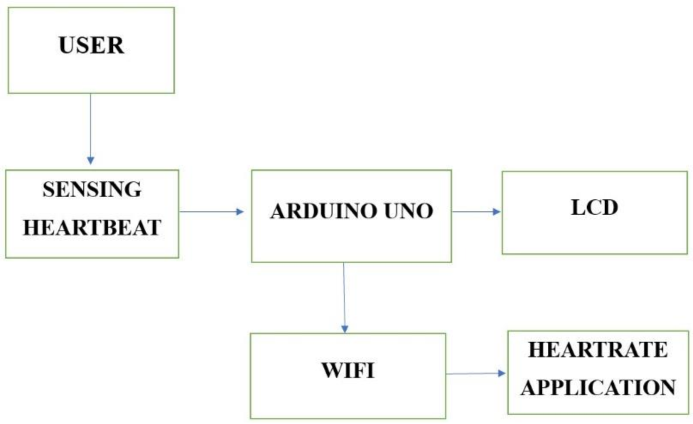

Figure 1: *Block Diagram of Existing System*

4. Proposed System

A proposed method for heart attack detection and heart rate monitoring using Arduino and IoT involves the integration of sensors, microcontrollers, and wireless communication technologies to continuously monitor an individual's heart rate and identify potential cardiac events. Utilizing Arduino microcontrollers as the central processing units, sensors such as pulse sensors are interfaced to measure heart rate. These Arduino boards are then linked to IoT modules like ESP8266 or ESP32 for wireless data transmission to IoT platforms such as ThingSpeak or AWS IoT. Upon receiving heart rate data in real-time, the IoT platform analyses it for irregular patterns indicative of a heart attack. When anomalies are detected, alerts are promptly generated and dispatched to designated caregivers or healthcare professionals through SMS, email, or mobile app notifications. This method facilitates timely intervention and medical assistance, enhancing the prospects of early detection and intervention in cases of

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cardiac emergencies, thus potentially saving lives. The Arduino reads the data from the sensor and processes to identify any irregularities in their heart rate.

4.1 Objective of the Proposed System

1. The main objective of the project is
2. To develop health monitoring system i.e. it measures body temperature and heart rate, Oxygen levels.
3. To design a system to store the patient data over a period of time using database management.
4. To do analysis of collected data of sensors.
5. Thus, the analog values that are sensed by the different sensors are then given to a microcontroller attached to it.

4.2 Block Diagram

The below Figure 2 shows the block diagram of the proposed system. It contains different sensors and functions. The health monitoring sensors are used to collect health related data i.e. for data acquisition. Communication can be done by controller for sending data on internet wirelessly. Data processing has been done at server. All data collected and aggregated at server point.

To get health related information in understandable format it can be shown on web page i.e. data management. Our proposed system uses Arduino with esp8266 to send data from sensors to cloud platform that is Ubi.com. The design a Health Monitoring System with two-way communication i.e. not only the patient's data will be sent to the doctor through SMS and email on emergencies, but also the doctor can send required suggestions to the patient or guardians through SMS or Call or Emails. This combination of Arduino's processing capabilities and IoT's connectivity allows for efficient, real time health monitoring.

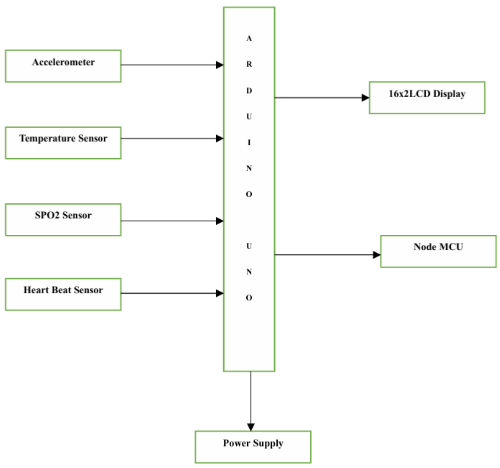

Figure 2: *Block Diagram of Proposed System*

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5. System Design

5.1 Hardware Components

These are the following components we used to design our Project "Epilepsy Seizure alert system using IoT"

- Node-MCU ESP8266
- Power Supply
- LCD Display
- Pulse-oximeter
- DHT 11 Sensor

NODE MCU

Node MCU is a low-cost open-source IOT platform. Which can be used as a Microcontroller.

Specifications

Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106,

Operating Voltage: 3.3V,

Input Voltage: 7-12V,

Digital I/O Pins (DIO): 16,

Analog Input Pins (ADC): 1,

UARTS: 1,

SPIs: 1,

I2Cs: 1.

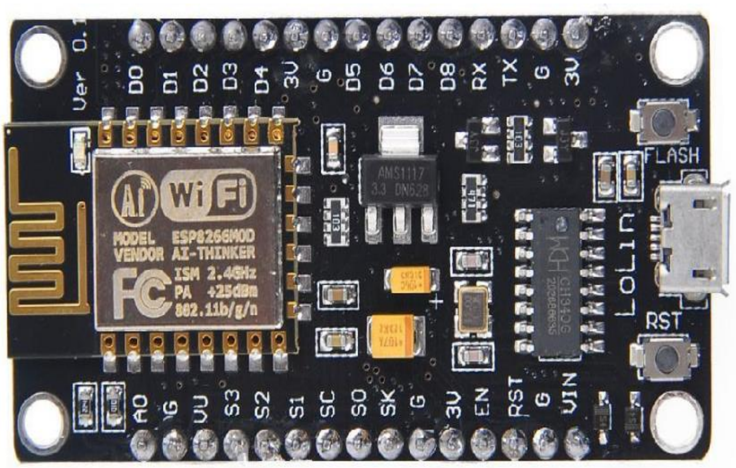

Figure 3: *Pin Configuration of Node MCU*

Power Supply

The power supply will supply the regulated power supply to the unit which is first converted into 12V AC. 12V AC is converted into DC using rectifier circuit. Finally the 7805 voltage regulator provides constant 5V DC supply which will be given to circuit.

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Specifications

Operating Voltage: 5V,

Input Voltage (Recommended): 7-12V,

Input Voltage (Limit): 6-20V,

Digital I/O Pins: 14(of which 6 provide PWM Output).

Figure 4: *Power Adapter*

LCD 16X2

LCD stands for liquid crystal display, which is used to show the status of an application, displaying values, debugging a program, etc. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data.

Specifications

This 16 x 2 LCD packs 32 characters into an outline smaller than that of most two-line displays. An LED backlight enables optimal viewing in all lighting conditions.

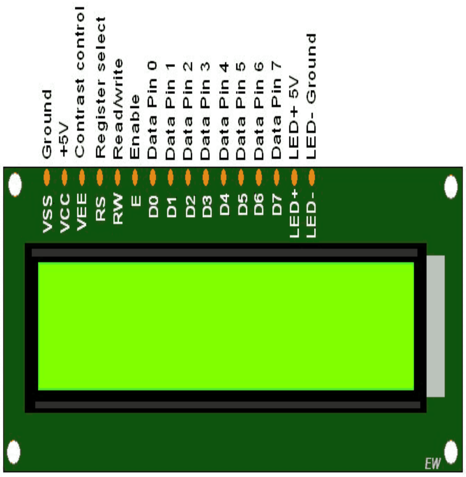

Figure 5: *Liquid Crystal Display*

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Pulse Oximeter Sensor (MAX30100)

The MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution. The heart rate and oxygen levels measure kit can be used to monitor heart rate of maternal. A Pulse oximeter is medical device that measure the oxygen saturation (SpO2) level in person blood, as well as their pulse rate. It is commonly used in health care settings to monitor a patient's oxygen level and heart rate.

Specification: The MAX30100 operates from 1.8V and 3.3V power supplies.

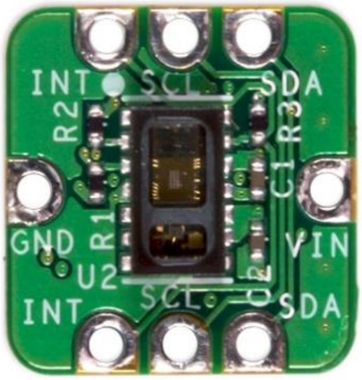

Figure 6: *Pulse Oximeter Sensor*

Temperature Sensor (DHT11)

It is used to measure the temperature of the person. Temperature sensor are mainly used to measure the body temperature of the maternal. It can measure temperature more accurately than a using a thermistor. It is common for a woman's body temperature to change during pregnancy

Specifications

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16
- Accuracy: ±1°C and ±1%

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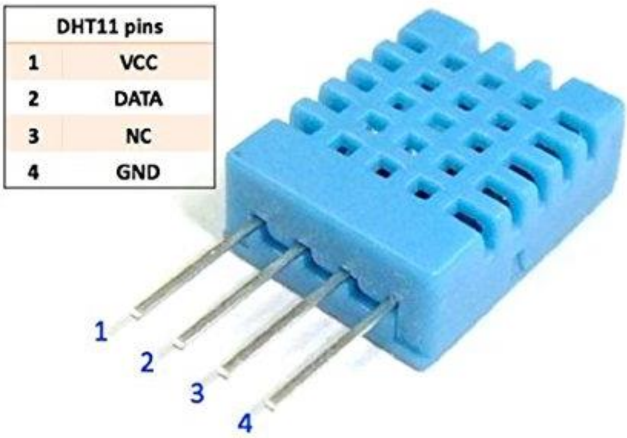

Figure 7: *Temperature Sensor*

5.2 Software Description

The "Heart attack detection and Heart rate monitoring using Arduino and IOT" is a software design to track and monitor heart health in real-time using an integrated system of hardware and software. By leveraging the capable of an micro-controller and heart rate sensors, The software continuously measures an identically heart rate and other related data.

Arduino 1.0.6 software tools used to program microcontroller. The working of software tool is explained below in detail.

- Ubidots
- Arduino IDE

UBI Dots (CLOUD)

Ubidots is an open-source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Ubidots enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

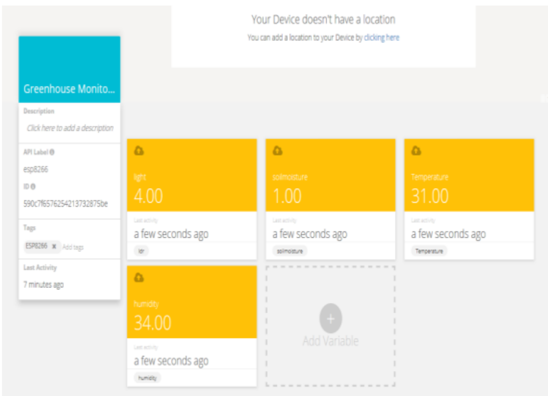

Figure 8: *Interface of UBIDOTS (Adding Variable)*

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Arduino IDE

The Arduino IDE (Integrated development Environment) is a software platform used for writing, Editing, Compiling, and Uploading code to Arduino microcontroller boards. In context of "Heart Attack Detection and Heart Rate Monitoring Using Arduino and IOT," The IDE place a crucial role in developing and deploying the software for Heart rate monitoring system.

An Arduino IDE provides a user-friendly interface for coding the heart rate monitoring system. Developers can write code to control the heart rate sensor, process the collected data, and manage communication with other devices or servers via IoT protocols. The IDE offers a variety of built-in functions and libraries to streamline the programming process, including support for common sensor interfacing, Wi-Fi or Bluetooth connectivity, and cloud-based communication. The Arduino IDE is a powerful and accessible platform for developing heart rate monitoring systems, enabling seamless integration of hardware and software to monitor heart health and detect potential heart attacks efficiently.

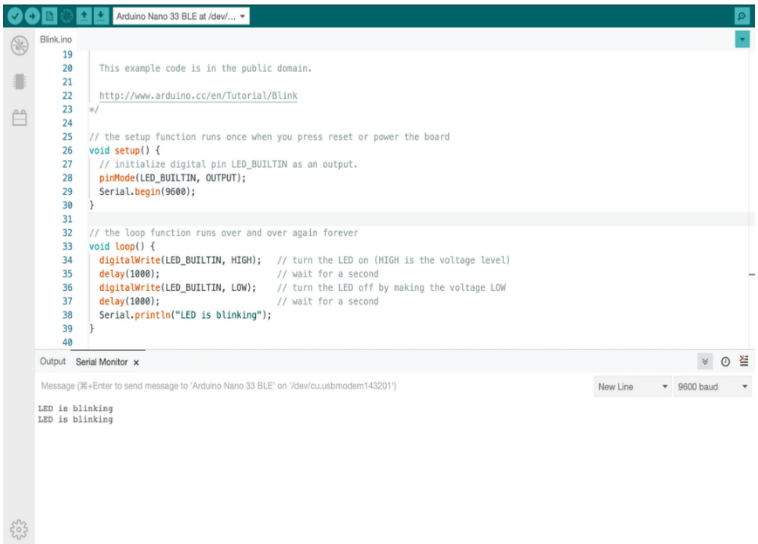

Figure 9: *Source code written in Arduino Compiler*

6. Implementation

Implementing an Epilepsy Seizure Alert System using IoT using NodeMCU, Pulse Oximeter, Accelerometer, DHT11 Sensor, and LCD involves a few steps. Here is a possible implementation:

1. Hardware Setup:

a. Connect the NodeMCU to the computer using a USB cable.

b. Connect the Pulse Oximeter to the NodeMCU using jumper wires.

c. Connect the Accelerometer to the NodeMCU using jumper wires.

d. Connect the DHT11 Sensor to the NodeMCU using jumper wires.

e. Connect the LCD to the NodeMCU using jumper wires.

2. Software Setup:

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a. Install the Arduino IDE on your computer.

b. Install the required libraries for the Pulse Oximeter, Accelerometer, DHT11 Sensor, and LCD.

c. Open the Arduino IDE and create a new sketch.

3. Here the system is working through the IOT-based. The sensors will senses the data of the victim's then the IOT will send the data to the database when the system is connected tothe Wi-Fi

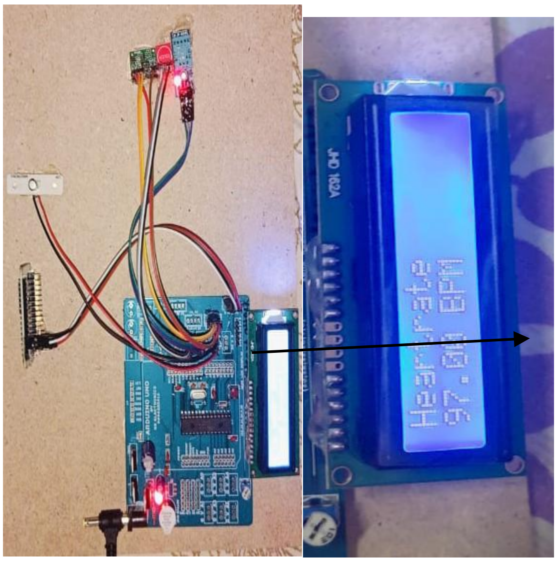

Figure 10: *System Implementation*

The power supply activates the circuit, enabling it to function**.** Thetouch sensor, heartbeat sensor, Spo2 and temperature sensor serve as inputs, detecting the victim's condition during critical situations. These sensors provide crucial information about the victim's state, facilitating appropriate responses or interventions. These sensors are connected to the Arduino with the help of cable wires as well as display. The display gets the data and that will be displayed to the user and sending to IOT.

7. Simulation Results

Case -1:

Input

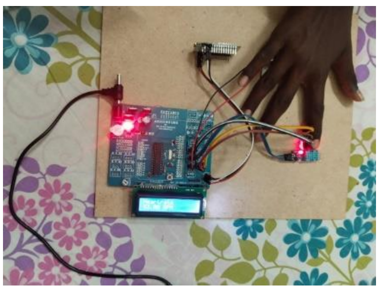

Figure 11: *Input of user1*

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Figure 12: *Output of user1*

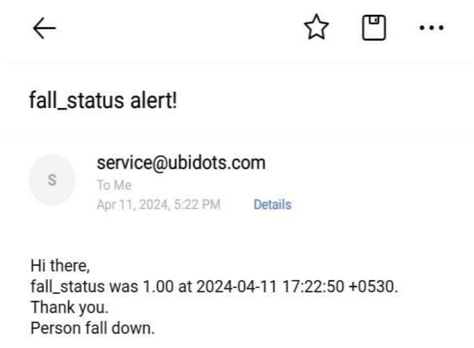

Figure 13: *Notification Alert*

The output of the system can be viewed on various devices such as computers, laptops or mobiles phones. Users can access the data on the UBI DOTS open-source platform by logging in with the User.

This allows them to monitor and analyze real-time readings from the sensors. The collected data of the user-1 will be displayed and user can be get notified though the E-mail.

User's can get all the readings from the sensors. In the Figure 11 we received all the data of the user1, the received data are Temperature, Spo2, Heart Rate and Fall Status.

In Figure 12, we got a Notification Alert from the UBIDOTS, Where the notification was sent to the registered Email Id.

Case – 2

Input

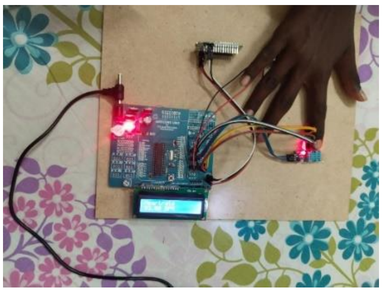

Figure 14: *Input of User2*

Output

Figure 15: *Web output Interface*

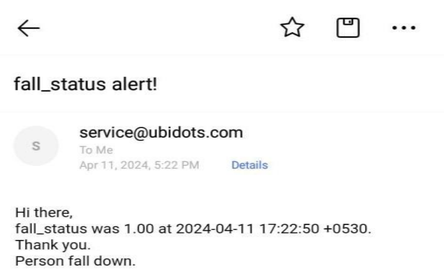

Figure 16: *Notification Alert*

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The output of the system can be viewed on various devices such as computers, laptops or mobiles phones. Users can access the data on the UBI DOTS open-source platform by logging in with the User.

This allows them to monitor and analyze real-time readings from the sensors. The collected data of the user-2 will be displayed and user can be get notified though the E-mail.

User's can get all the readings from the sensors. In the Figure 14 we received all the data of the user1, the received data are Temperature, Spo2, Heart Rate and Fall Status.

In Figure 15, we got a Notification Alert from the UBIDOTS, Where the notification was sent to the registered Email Id.

8. Conclusion

In conclusion, the implementation of heart attack detection and heart rate monitoring using Arduino and IoT technology demonstrates a promising approach to improving cardiovascular health monitoring. This innovative solution allows for real-time tracking and analysis of heart rate data, providing timely alerts and critical information for immediate medical intervention in the case of heart attacks. By leveraging IoT connectivity, the system can seamlessly transmit data to healthcare professionals and caregivers, facilitating proactive care and potentially saving lives. Additionally, the integration of Arduino offers a cost-effective and flexible platform that can be tailored to individual needs and expanded for broader health monitoring applications. As technology continues to evolve, such systems have the potential to revolutionize the way we monitor and respond to cardiac events, contributing to more effective and personalized healthcare outcomes.

9. Future Scope

The future scope of heart attack detection and heart rate monitoring using Arduino and IoT holds significant promise for the advancement of healthcare technology. As the field continues to evolve, there is potential for more accurate, real-time monitoring of cardiac health, allowing for timely intervention and improved patient outcomes. Integrating advanced sensors with Arduino and IoT technologies enables continuous tracking of vital signs, such as heart rate, blood pressure, and oxygen saturation, with higher precision and reliability.

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