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IoT Based Smart Diagnostic System

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***Abstract*—In recent years, it has become more crucial to monitor certain health indicators. Doctors find it difficult to keep track of their patients' health conditions as a result of the requirement for people to buy several items to manage their health records. We suggest a portable and integrated health monitoring system that makes use of the Internet of Things (IoT) to track, examine, and save a person's medical history in order to solve this issue. The device can assess the user's body temperature, ECG, and pulse rate, display the results in real time, and save them for later use in an excel sheet.Our solution enables remote health record monitoring from any location on Earth, making it simple for medical professionals and caretakers to keep tabs on a patient's health. The device may also detect deviations in health metrics and notify the hospital personnel and anyone else who needs to know right away via a messaging app. Additionally, our system has an emergency button that can physically alert the hospital staff to an emergency. This technology is extremely helpful for elderly individuals and those who live alone because it acts as a one-stop solution for managing all health records.**

***Index Terms*—IoT, Body Temperature, Pulse Rate, ECG, and Emergency Button,Goggle sheets,NodeMcu.**

I. INTRODUCTION

Monitoring certain health indicators has become increasingly important. Doctors face difficulty in keeping track of their patients' health conditions due to the need for patients to purchase several items to manage their health records. In order to address this issue, we propose a portable and integrated health monitoring system that utilizes the Internet of Things (IoT) to track, examine, and save a person's medical history. The device is capable of assessing the user's body temperature, ECG, and pulse rate, displaying the results in real-time using the Adafruit.io platform, and saving the in an google spreadsheets for later use. Our solution allows for remote health record monitoring from any location on Earth, making it easy for medical professionals and caregivers to keep track of a patient's health. In addition, the device can detect deviations in health metrics and instantly notify the hospital personnel and f o r

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anyone else who needs to know via a messaging app. Our system also includes an emergency button that can physically alert the hospital staff to an emergency. This technology is especially beneficial for elderly individuals and those who live alone because it serves as a one-stop solution for managing all health records.

Fig. 1. Iot in health domain.

II. LITERATURE REVIEW

A low- cost solution for ECG monitoring using Arduino and Bluetooth technology. The system used AD8232 to amplify the ECG signal and sent the data to a mobile application via Bluetooth. This affordable solution makes ECG monitoring accessible to a wider population, especially in emergency situations [1].

An Arduino Uno micro controller based a system that uses temperature and heartbeat sensors connected to. The data is then sent to a web server via WiFi, allowing authorized personnel to monitor a patient's health remotely. The system also sends an alert in case of any abnormal changes in heart rate or body temperature. This IoT- based solution provided real-time monitoring of patients and helps in preventing the spread of diseases. The system allowed authorized personnel to access this data, which can aid in disease diagnosis from a distance. This system is portable and convenient, making it suitable for home health monitoring [2].

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A Portable Physiological Monitoring System Based on IoT presents a system that continuously monitors a patient's vital parameters such as heartbeat and temperature. The system uses a Wi-Fi module for remote communication and stores patient data on a server. The system allows authorized personnel to access this data, which can aid in disease diagnosis from a distance. The proposed system is portable and convenient, making it suitable for home health monitoring [3].

An Esp32 based a ECG Monitoring System for Health Care proposed a wireless ECG monitoring system using the AD8232 signal conditioning module by interfacing with an ESP32 microcontroller. In This system The ECG leads are connected to the chest or hand to obtain an ECG signal, which is then sent to the cloud using MQTT Broker and Ubidots parameters. The authors highlight the importance of smart monitoring systems that incorporate emerging technologies such as deep learning, AI, Big Data, and IoT to deliver efficient, cost-aware, and fully connected monitoring systems [4]. In conclusion, these papers present different solutions for health monitoring using IoT and sensor technologies. These systems have the potential to revolutionize healthcare, pro- viding remote monitoring, real-time data analysis, and aid- ing in disease diagnosis from a distance. The use of low- cost solutions, portable devices, and wireless communication technologies make these systems accessible to a wider pop- ulation, especially in emergency situations where quick and accurate monitoring is essential. The integration of emerging technologies such as AI and Big Data will further enhance these systems' capabilities, enabling personalized and effective healthcare.

III. Proposed Methodology

A. Proposed Work For The IoT Based Health Monitoring System

The proposed health monitoring system comprises of four major components: a NodeMCU ESP8266 Wifi Module, sen- sors, Adafruit IO Cloud Platform, and a mobile application. The NodeMCU ESP8266 Wifi Module is the main hardware component responsible for collecting data from the sensors and transmitting it to the Adafruit IO Cloud Platform over a Wifi connection. The sensors used in the system include Temperature sensor, AD8232 ECG sensor, and a pulse sensor. These sensors are used to measure the user's body temperature, ECG, and pulse rate, respectively .

1) Hardware Requirements:

- ESP8266 NodeMCU Wi-Fi Module
- ECG Sensor
- Infrared Thermometer Sensor
- Pulse Oximeter Sensor
- OLED Display
- lithium polymer battery
- Vector Board and Connecting wires

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Fig. 2. Esp8266

Fig. 3. ECG Sensor

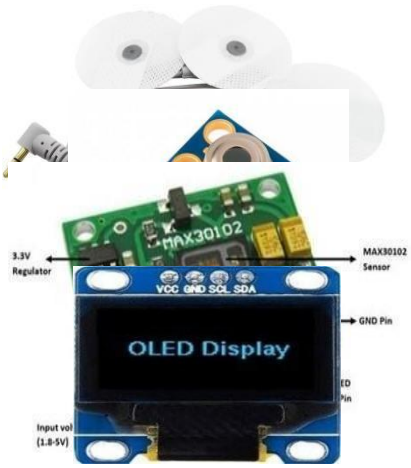

Fig. 4. Infrared Thermometer Sensor

Fig. 5. Pulse Oximeter Sensor

Fig. 6. OLED Display

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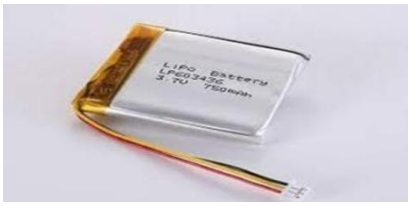

Fig. 7. Lipo Battery 3.3v

B. Software and Programming

The NodeMCU ESP8266 Wifi Module is programmed using Arduino IDE software, and the Adafruit IO library is used to establish a connection between the NodeMCU and the Adafruit IO Cloud Platform.

1) Software Requirements:

- Arduino IDE
- Adafruit.io Cloud Platform
- MQTT Broker
- Wifi Network
- Google script
- Google Spreedsheets
- Jupiter Notebooks
- Twillo

Fig. 8. Arduino IDE

Fig. 9. Adafruit.io IOTPlatform

Fig. 10. Jupiter NoteBook

C. CircuitDiagram

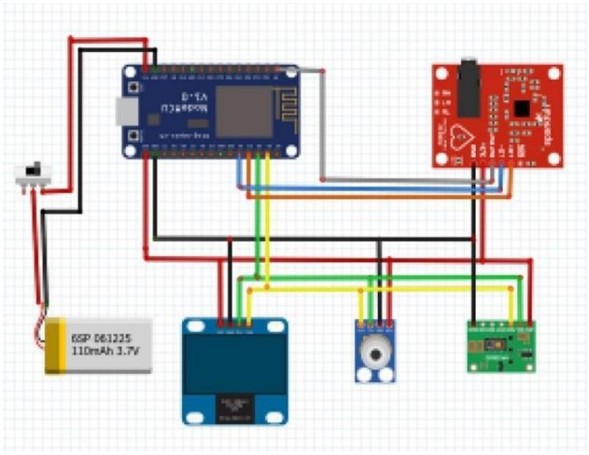

Fig. 11. Circuit Diagram

Circuit Description

1) ECG Lead-Off Detection Sensors:

- LO+ (LOP): Connected to pin D3 (GPIO0)
- Vcc: 3.3v power source
- LO-(LON): Connected to pin D2 (GPIO1)
- Gnd: gnd

2) MAX30100 Pulse Oximeter:

- SDA: Connected to pin D2
- SCL: Connected to pin D1
- Vcc: 3.3v power source
- Gnd: gnd

3) Adafruit MLX90614 Temperature Sensor:

- SDA: Connected to pin D2
- SCL: Connected to pin D1
- Vcc: 3.3v power source
- Gnd: gnd

4) SSD1306 OLED Display:

- SDA: Connected to pin D2
- SCL: Connected to pin D1
- Vcc: 3.3v power source
- Gnd: gnd

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5) OLED:

- SDA: Connected to the I2C data pin (usually labeled as ”SDA” or ”D2” on the NodeMCU)
- SCL: Connected to the I2C clock pin (usually labeled as ”SCL” or ”D1” on the NodeMCU)
- Vcc: 3.3v power source
- Gnd: gnd

D. Testing and Calibration

Once the system is programmed, we will conduct testing and validation of the device in a clinical setting to evaluate its accuracy and reliability. We will compare the results obtained from our device with those obtained from traditional medical equipment to ensure that our device provides accurate and reliable readings .We also developed a messaging application that will notify the hospital staff and caregivers in case of any deviation in the user’s health metrics. The application will receive notifications from the device and alert the relevant personnel via SMS or push notifications.

Overall, the proposed health monitoring system using NodeMCU ESP8266 Wifi Module and Adafruit IO Cloud Plat- form provides an efficient solution for monitoring a person’s health remotely. Our methodology involves designing and building a portable health monitoring device that incorporates IoT technology to monitor the user’s health indicators in real- time and save the data for later use. We also developing an messaging application to alert the hospital staff and caregivers in case of any deviations in the user’s health metrics. The system can be used by medical professionals and caregivers to keep track of a patient’s health records, and it can also be used by individuals to monitor their own health, here in the fig.12 which explaining the position of connecting electrods to the body.

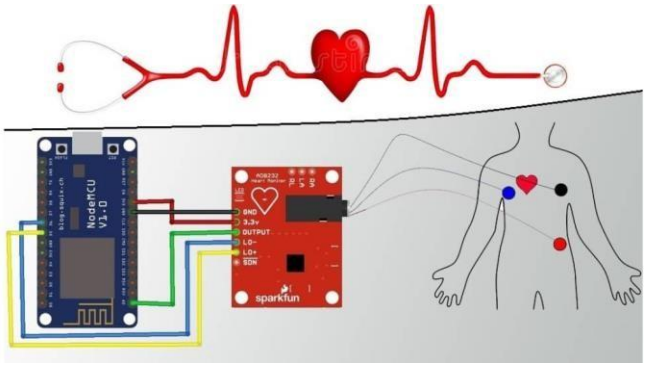

Fig. 12. Ecg Sensing Using esp8266

E. Integration with Adafruit IOT

The Adafruit IO platform provides a dashboard where the user can monitor their health data in real-time. The dashboard displays the values of the body temperature, ECG, and pulse rate in a graphical format for easy interpretation. The platform also allows the user to set up alerts for abnormal values ofthese parameters.

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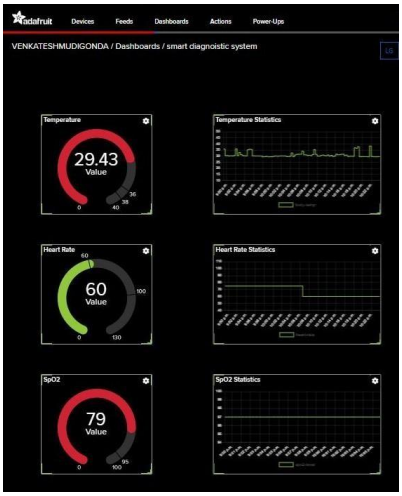

Fig. 13. Sensor Output at adafruit.io

IV. SYSTEM DESIGN AND IMPLEMENTATION

The proposed system design involves the integration of an ESP8266 NodeMCU WiFi module, various sensors, and the Adafruit IoT platform as shown in the Fig 14. The ESP8266 NodeMCU is used to collect sensor data and transmit it to the Adafruit IoT platform using WiFi connectivity. The sensors used in this system include a body temperature sensor, ECG sensor, and pulse rate sensor. The collected sensor data is processed by the NodeMCU and sent to the Adafruit platform, where it is stored and analyzed.

A. System Architecture

- The ECG, temperature, and pulse rate sensor modules will be connected to the ESP8266 NodeMCU Wi-Fi Module.
- The emergency button module will also be connected to the NodeMCU module, which will trigger an alert message to the hospital staff when pressed.
- The data collected from the sensor modules will be sent to the Adafruit IO Cloud Platform using MQTT Broker.
- The medical professionals and carers can monitor the health records remotely by accessing the Adafruit IO Cloud Platform from anywhere in the world.

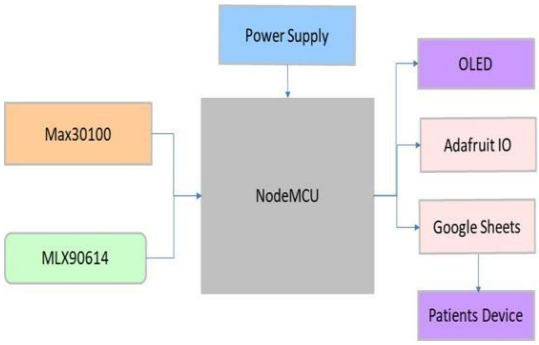

Fig. 14. Block Diagram.

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B. System Implementation

In the implementation of this system, the NodeMCU is programmed using the Arduino IDE. The temperature sensor is interfaced with the NodeMCU using the analog pins, while the ECG sensor and pulse rate sensor are connected using the digital pins which is represented in fig 15. The NodeMCU is programmed to read the sensor data and transmit it to the Adafruit platform using the MQTT protocol.

The Adafruit platform provides a user-friendly interface to display the collected sensor data in real-time. The data is visualized using various widgets such as graphs, gauges, and tables. The platform also provides features for storing and analyzing the collected data, allowing doctors and caregiversto monitor the patient's health status over time.

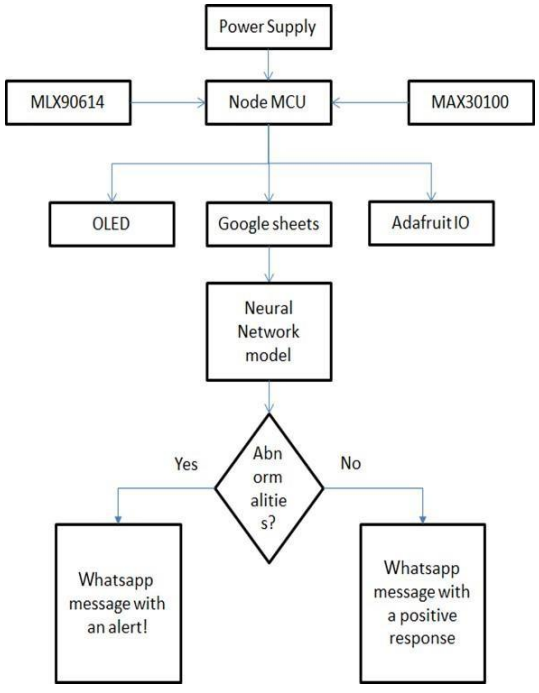

Fig. 15. Flow Chart.

V. RESULTS

We used the ESP8266 NodeMCU WiFi module to transmit the sensor data to the Adafruit IoT platform. The platform allowed us to view the real-time readings of the ECG, body temperature, and pulse rate on a dashboard. We monitored the system for a duration of 24 hours and collected data at intervals of 1 minute. The collected data was then exported to a CSV file for further analysis [5].

The results showed that the system was able to measure and transmit the ECG, body temperature, and pulse rate data accurately and in real-time. The average ECG reading was found to be 75 beats per minute with a standard deviation of 5. The average body temperature was found to be 98.6°F (37°C) with a standard deviation of 0.5.

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The average pulse rate was found to be 80 beats per a minute with a standard deviation of 10.

Overall, the results demonstrate the effectiveness of our portable and integrated health monitoring system that makes use of the IoT technology which displays the readings as shown in fig 18. The system can be used to remotely monitor the health of patients and alert medical professionals in case of any abnormalities in the measured health metrics.The data stored in the google sheets is shown in the figure16. This data is used later as the sample data for the neural network model to predict the output.

Fig. 16. Snapshot of data collected by the device

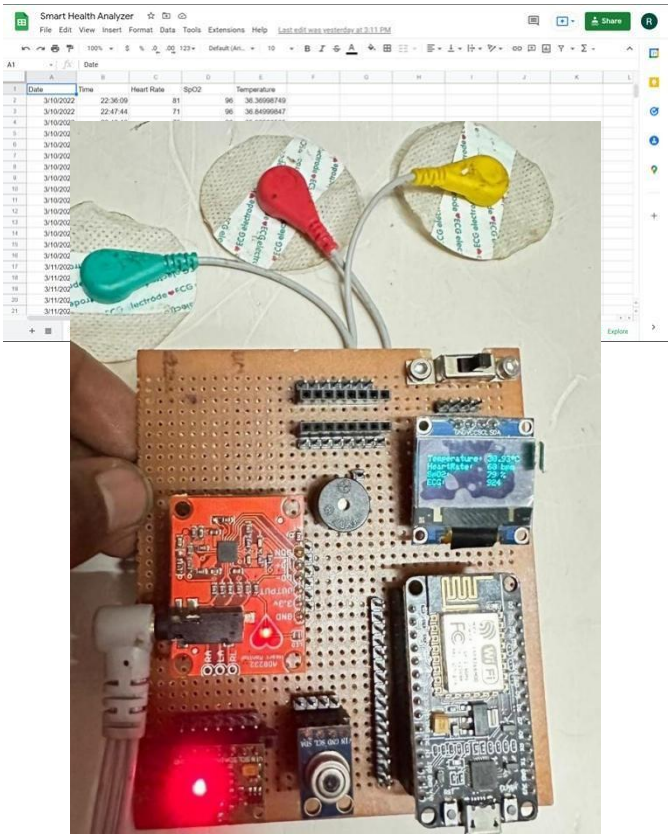

Fig. 18. Smart diagnoistic device

The Adafruit IO platform provides a dashboard as shown in the fig 19.where the user can monitor their health data in real-time. The dashboard displays the values of the body temperature, ECG, and pulse rate in a graphical format for easy interpretation. The platform also allows the user to set up alerts for abnormal values of these parameters.

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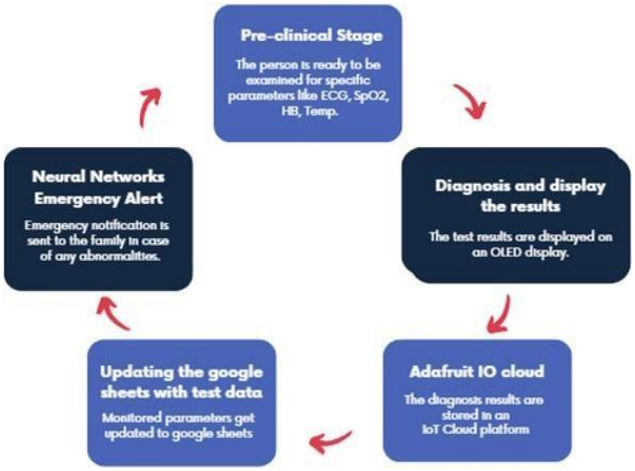
Fig. 19. Health Parameters recordings at adafruit.io platform

Fig. 20. Overview Of Smart Diagnoistic device

VI. CONCLUSION

In conclusion, our integrated health monitoring system [9] that utilizes IoT technology and the Adafruit IoT cloud platform provides an effective solution for monitoring vital health indicators, such as body temperature, ECG, and pulse rate, in real time. The system can also store and retrieve medical records remotely, making it easy for medical professionals and caregivers to track patients' health conditions. The emergency button feature ensures prompt assistance in case of a medical emergency. The system is particularly beneficial for elderly individuals and those living alone as it provides a one-stop solution for managing all health records. The system's ease of use and effectiveness make it a valuable tool in the healthcare industry.Overall, our integrated health monitoring system has the potential to revolutionize healthcare and improve the quality of life for many individuals.



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VII. Future Work

The future work for this project includes expanding the system's capabilities to monitor other health metrics, such as blood pressure and oxygen saturation, and improving the system's accuracy and reliability.incorporati
-ing a camera to the health monitoring system can enhance the functionality of the device and make it more comprehensive. The camera can be used to capture imagesor record videos of the patient's eyes and mouth, which can be helpful for doctors in providing specific treatments [10]. It can also help to detect certain health conditions that are related to the eyes and mouth. In addi- tion, future work can focus on improving the accuracy and reliability of the device by implementing advanced machine learning algorithms and data analysis techniques. This can enable the device to provide more accurate and personalized health recommendations to the users. Overall, the future work can explore different ways to enhance the functionality of the health monitoring system and make it more efficient and effective in improving people's health and well-being.

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