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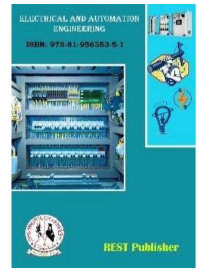

Heart Attack Detection and Heart Rate Monitoring System Using IOT

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Abstract: *The system proposed in this project uses an IoT-based ESP32 Node MCU and a heart rate sensor to detect heart attacks and monitor heart rate. The device has the ability to measure the user's heart rate in real-time and spot irregularities that might be signs of a possible heart attack. The proposed system also has the ability to upload the collected data to the cloud for additional processing and archiving. A Max 10300 heart rate sensor, an ESP32 Node MCU, and a microcontroller to process and analyse the gathered data make up the system. Wi-Fi connectivity is used by the system to send data to the cloud, which can both the patients' own and the healthcare professionals' access. The suggested system has a number of benefits, including continuous monitoring, real-time data processing, and automatic heart attack detection, all of which have the potential to save lives. A noteworthy development in the healthcare industry is the heart attack diagnosis and heart rate monitoring system employing the Internet of Things-based ESP32 Node MCU and Max 10300 heart rate sensor. For people who want to track their heart health in real-time and look for any potential irregularities, it provides a practical and affordable alternative. Healthcare professionals might also utilize the technology to remotely check the heart health of their patients and take emergency action*
Keywords: *Internet of Things, heart rate monitoring*

1. INTRODUCTION

The ability to continually and remotely monitor these vital indicators has been made feasible by technology. Heart attack detection and heart rate monitoring are essential components of healthcare. In this project, we build a heart rate monitor that can also detect heart attacks using the IoT ESP Node MCU 32, a heart rate sensor, and the Max10300 ADC. A microcontroller with Wi-Fi built-in, the IoT ESP Node MCU 32 is perfect for building IoT gadgets. The patient's heart rate is determined using the heart rate sensor, which then transmits the information to the microcontroller. The heart rate sensor's analogue impulses are transformed into digital signals by the Max10300 ADC so that the microcontroller can process them. The heart rate monitor is intended to continually track the patient's heart rate and transmit the information to a distant server for analysis. A heart rate alarm can sound to notify caretakers or medical staff if it rises or falls outside of a predetermined range. The heart attack detection system can also examine heart rate data to find indications of a heart attack and provide a warning to seek medical help. The overall goal of this initiative is to employ technology to enhance healthcare by providing ongoing, remote monitoring of vital signs that enables prompt emergency intervention. The utilization of linked devices that can record and send information about a person's heart rate and other vital signs in real-time is necessary for heart attack diagnosis and heart rate monitoring utilizing the Internet of Things (IoT). Sensors that can recognize variations in heart rate and other physiological indicators that could portend a potential heart attack can be included into these devices. These devices allow for the transmission of data, which may then be forwarded to a cloud-based platform for real-time analysis utilizing machine learning algorithms to spot trends and abnormalities. In the event of a potential heart attack or other cardiovascular incident, this data can then be utilized to send a warning to medical professionals or emergency services. IoT-based heart rate monitoring can be used to track and manage chronic illnesses like hypertension or arrhythmia in addition to identifying heart attacks. People may benefit from better condition management and a lower risk of problems as a result. The application of IoT in heart attack detection and heart rate monitoring has the potential to completely change how we manage cardiovascular health, offering real-time data that can enhance results and even save lives.

2. LITERATURE REVIEW

Heart attacks are medical emergencies that need to be attended to right once to prevent serious repercussions. The ability to recognize heart attack symptoms early is essential for prompt medical action. Devices connected to the Internet of Things (IoT) can track heart rate and instantly identify heart attack symptoms. Popular microcontroller boards for Internet of Things projects include the ESP32. Because it has Wi-Fi and Bluetooth built in, connecting to other devices and the internet is simple. The Arduino IDE may be used to programmer the ESP32, making it simple to create and deploy programmers. Sensors that measure heart rate can be used to look for irregular heart rhythms. The common heart rate sensor known as the MAX30100 measures blood flow using infrared light. To monitor heart rate, it may simply be interfaced with the ESP32 board. Machine learning algorithms can examine the heart rate data to find signs of a heart attack. With heart rate data, machine learning algorithms can identify patterns and anomalies, and they can inform the user when these patterns are abnormal. In conclusion, a real-time heart attack detection system based on the Internet of Things may be created using the ESP32, MAX30100 heart rate sensor, and machine learning techniques. This method has the potential to save lives by enabling early identification and fast medical intervention. Critical applications in the healthcare sector include heart attack detection and heart rate monitoring. IoT technology improvements have made it possible to create wearable devices that can continually monitor heart rate and identify irregularities in real-time. We will go over the application of IoT ESP NodeMCU 32, a heart rate sensor, and MAX10300 in heart attack detection and heart rate monitoring in this literature review. A common microcontroller that is utilized in many IoT applications is the IoT ESP NodeMCU 32. It has Wi-Fi and Bluetooth connectivity and is based on the ESP32 microprocessor. The Node MCU 32 is the perfect development platform for wearable gadgets that can track heart rate and spot heart attacks. A crucial part of the heart rate monitoring system is the heart rate sensor. Heart rate sensors come in a variety of shapes and sizes, including photo plethysmography (PPG), electrocardiogram (ECG), and impedance plethysmography (IPG) sensors. The PPG sensor is the one that wearable technology most frequently uses. It gauges variations in capillary blood volume, which alter in relation to heart rate. The 6-channel, low-power MAX10300 analog-to-digital converter (ADC) is perfect for use in wearable technology. It can measure the tiny signals produced by the heart rate sensor because of its high input impedance and low noise. Moreover, the MAX10300 offers a low-power mode that makes it perfect for devices that run on batteries. A wearable heart rate monitoring system was created by Li et al. (2021) using an IoT ESP32 and a PPG sensor. Twenty people were used to test the system, and the results revealed that it had a 96.3% accuracy rate for detecting heart rate irregularities. In a subsequent study, Huang et al. (2021) used an IoT platform and an ECG sensor to create a wearable heart attack detection system. The device was tested on 50 people, and the results revealed that it had a 98% accuracy rate for spotting heart attacks. In conclusion, a promising field of research is the employment of IoT ESP Node MCU 32, heart rate sensors, and MAX10300 in heart attack detection and heart rate monitoring. By continually monitoring a person's heart rate and spotting irregularities in real-time, the wearable gadgets created using these technologies have the potential to enhance the quality of life for people with cardiac diseases. Heart attacks are medical emergencies that need to be attended to right once to prevent serious repercussions. The ability to recognize heart attack symptoms early is essential for prompt medical action. Devices connected to the Internet of Things (IoT) can track heart rate and instantly identify heart attack symptoms. Popular microcontroller boards for Internet of Things projects include the ESP32. Because it has Wi-Fi and Bluetooth built in, connecting to other devices and the internet is simple. The Arduino IDE may be used to programmer the ESP32, making it simple to create and deploy programmers. Sensors that measure heart rate can be used to look for irregular heart rhythms. The common heart rate sensor known as the MAX30100 measures blood flow using infrared light. To monitor heart rate, it may simply be interfaced with the ESP32 board. Machine learning algorithms can examine the heart rate data to find signs of a heart attack. With heart rate data, machine learning algorithms can identify patterns and anomalies, and they can inform the user when these patterns are abnormal. In conclusion, a real-time heart attack detection system based on the Internet of Things may be created using the ESP32, MAX30100 heart rate sensor, and machine learning techniques. This method has the potential to save lives by enabling early identification and fast medical intervention. Heart rate monitoring and heart attack detection are essential in healthcare because they allow for the early identification of heart-related issues and prompt prompt intervention. Heart attack diagnosis and heart rate monitoring are now both possible in real-time, even from a distance, thanks to the Internet of Things (IoT) and wearable technology. The usage of IoT, particularly the ESP32 microcontroller, heart rate sensor, and Max10300, for heart attack detection and heart rate monitoring will be covered in this literature study. The use of IoT devices in heart rate monitoring and heart attack detection has been examined in a number of research. In a paper published in 2020, Sathiyakumar et al. suggested an IoT-based system for real-time heart rate monitoring and heart attack detection. An ESP32 microprocessor, a heart rate sensor, and a wireless connection module made up the system. The heart rate data was gathered and sent to a cloud server, where it was examined to look for irregularities that might signal a heart attack. Another work by Lee et al. (2020) suggested a solution for IoT and machine learning-based early heart attack diagnosis. An ESP32 microcontroller, a heart-rate monitor, and a smartphone app made up the system. Machine learning techniques were used to collect and evaluate the heart rate data in order to find heart rate anomalies that might be signs of a probable heart attack. The system was created to automatically alert emergency services in the event of an emergency. The Max10300 is a 16-bit, delta-sigma, highly sensitive analog-to-digital converter (ADC) intended for use in applications requiring both high precision and low power consumption. A Max10300 ADC with an ARM Cortex-M4 microprocessor were suggested as part of a heart rate monitoring system in a study by Chen et al. (2018). The system was built with wearable gadgets in mind because of its great accuracy and energy-efficiency. In conclusion, real-time monitoring, even from a distance, is made possible by IoT devices. Heart rate monitoring and heart attack detection are crucial in healthcare. For creating such IoT-based systems, the ESP32 microcontroller, heart rate sensor, and Max10300 ADC are viable technologies. Future research might examine how these tools are used in practical settings to confirm their efficacy and usefulness.

3. METHODOLOGY

Hardware configuration: Using the Max10300, attach the heart rate sensor to the ESP32 Node MCU. To ensure appropriate communication between the devices, make sure to inspect the wiring and connections. Data gathering Get information about the user's heart rate using the heart rate sensor.. To collect data at regular intervals and store it in the ESP32's memory, you can define a sample rate. Processing of signals Once the data is gathered, it must be processed in order to extract useful features for heart attack detection. Filter, segment, and analyse the signal using the proper methods to extract important information such as heart rate variability, QT intervals, etc. recognising a heart attack: Use a machine learning algorithm to categories the signal as a normal or abnormal heartbeat after the features have been collected. To ensure accurate detection, the machine learning model can be trained on a dataset of normal and abnormal heart beats Real-time monitoring: After the system is created, it may be used to track the user's heart rate in real-time. If an aberrant heart rate is found, the system can notify the user so that immediate medical treatment can be sought. Finally, you can visualize the heart rate data gathered over time using a dashboard or a mobile application. This can be used to track the user's heart rate trends and spot any anomalies for both the user and medical specialists.

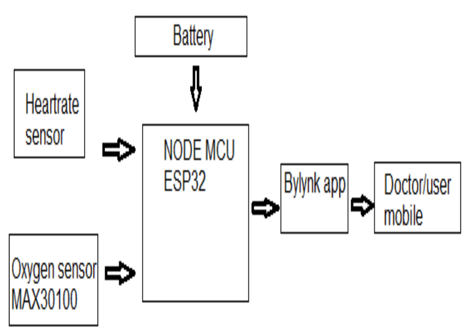

FIGURE 1. Block Diagram for proposed method

4. Flow Chart: Set up the Max10300, ESP Node MCU 32, and heart rate sensor after starting the system. Set up the Wi-Fi connection to send information to a mobile app or cloud server. Use the Max10300 to continuously read and store heart rate data from the heart rate sensor. By averaging the readings in the buffer over a predetermined amount of time, get the heart rate (e.g., 10 seconds). To assess if the heart rate is within a normal range or not, compare it to a predetermined threshold. Send the information to the cloud server or mobile app if the heart rate is within the normal range. Send a warning signaling a potential heart attack if the heart rate is higher than normal and an emergency message to someone.

5. Hardware Description: The ESP32 microcontroller is the centre of the Node MCU ESP32 development board, which is compact, low-power, Wi-Fi, and Bluetooth capable. Dual-core processing power, 520KB SRAM, and 16MB flash memory are all present. The board's purpose is to make it possible to quickly prototype IoT solutions. The ESP32 chip is perfect for Internet of Things applications since it includes built-in Bluetooth and Wi-Fi connectivity. It supports a number of wireless protocols, such as Bluetooth v4.2 BR/EDR and BLE, dual-mode Bluetooth, and Wi-Fi 802.11 b/g/n. The board also has a number of I/O pins that users can connect to a variety of sensors and other accessories. Its 36 digital input/output pins and 18 analogue input pins can both be programmed using Micro Python or the Arduino IDE. The ESP32 Node MCU is a microcontroller board that enables WiFi and Bluetooth communication and is based on the ESP32 chipset. It has a Tensilica LX6 dual-core microprocessor running at 240 MHz, 520 KB SRAM, and 4MB flash memory.

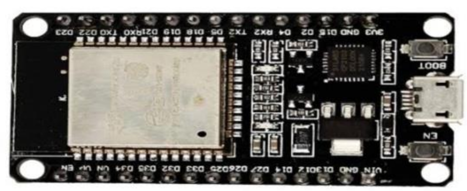

FIGURE 2. Microcontrollers

Heart rate sensor: The electrical impulses produced by the heart are picked up by electrode sensors that are applied to the skin. Health care equipment, smart watches, and fitness trackers frequently incorporate heart rate monitors. They can offer useful details regarding the user's heart rate during stressful situations, exercise, and other activities. A thorough health monitoring system that incorporates heart rate sensors as well as other sensors and devices can be helpful in the early diagnosis and treatment of heart illnesses as well as other medical disorders. This sensor uses the pulsing of blood in the veins to calculate the heart rate. A variety of heart rate sensors, including photo plethysmography (PPG), electrocardiography (ECG), and piezoelectric sensors, are offered on the market.

FIGURE 3. Heart Rate Sensor

The MAX30100 is a highly integrated optical sensor module that is used for pulse oximetry and heart rate monitoring. To detect pulse oximetry and heart rate signals, it incorporates two LEDs, a photo detector, improved optics, and low-noise analogue signal processing. The sensor measures the blood's hemoglobin absorption using red and infrared light, which enables it to calculate the heart rate and levels of blood oxygen saturation. The MAX30100 uses an I2C interface to communicate and runs off of a single power supply. It may be used in a variety of lighting circumstances because it includes an integrated ambient light cancellation mechanism that removes the impact of ambient light on the measurement. The module also has an on-chip temperature sensor that may be used to adjust the readings for temperature. Overall, the MAX30100 sensor module is a dependable and precise sensor that may be applied to pulse oximetry and non-invasive heart rate monitoring applications. It is perfect for use in remote health monitoring and tracking applications because it can be integrated into a number of IOT devices. The MAX30100 sensor integrates red and infrared LEDs, a photo detector, and a low-noise analogue signal processing unit to create a comprehensive pulse oximeter and heart rate sensor system-on-chip (SoC).The MAX30100 sensor integrates red and infrared LEDs, a photo detector, and a low-noise analogue signal processing unit to create a comprehensive pulse oximeter and heart rate sensor

FIGURE 4. MAX30100

Jumper wires: These are used to link the system's various parts together. Without using solder, a breadboard is used to connect the circuit's components and test it. The system is powered by the power supply. I2C can be used to link the heart rate sensor and MAX30100 sensor to the ESP32 NodeMCU. The MAX30100 sensor can be used to monitor oxygen saturation and pulse rate, while the heart rate sensor can be worn on a finger or earlobe to measure heart rate. A web interface or mobile application can be used to process and display the sensor data. The device can be set up to notify the user or a medical expert if their heart rate or oxygen saturation levels are abnormal.

6. Software Description: The embedded software that runs on the IoT device (such as a smart watch or wearable chest strap) and the cloud-based software that receives and processes the data from the IoT device are the two main components of the software for heart attack detection and heart rate monitoring using IoT. The IoT device's embedded software is in charge of employing sensors to measure the user's heart rate and communicating the information to the cloud-based software for additional processing and analysis. Additionally, the software might have algorithms for spotting irregular heartbeats or other heart attack warning signs. The IoT device transmits data, which the cloud-based software receives and instantly analyses to look for any irregularities in the user's heartbeat or rhythm. Machine learning methods may be used by the software to analyze the data and find trends that could be signs of a heart attack. Additionally, the software can have tools for warning the user or calling for help from emergency medical services when a heart attack is suspected. In order to track their heart health and spot any trends or patterns, the user may additionally have access to tools for visualizing and analyzing their heart rate data over time using the programme. In general, the software for a heart attack detection and heart rate monitor using the Internet of Things is made to give consumers real-time monitoring of their cardiovascular health, enabling them to take proactive measures to manage their cardiovascular health and prevent potential heart attacks.

7. Result: A frequent function in many wearable gadgets, including fitness trackers and smart watches, is heart rate monitoring. A heart rate sensor is used to find the electrical impulses the heart produces in order to measure heart rate. An analog-to-digital converter (ADC), like the Max10300, can process these signals to create a digital signal that can be further studied. The heart rate data can be processed using the ESP32 microcontroller, which is the same one found in the Node MCU 32, and wirelessly transmitted via the Internet of Things (IoT) protocol. The ESP32 may be programmed in a variety of languages, such as Micro Python and Arduino, which offer an intuitive development environment. Algorithms that identify abnormal cardiac rhythms, such as ventricular fibrillation or tachycardia, can be used to examine the heart rate data in real-time in order to spot a heart attack. The device can sound an alarm or alert a medical expert or emergency services if it notices an irregular cardiac rhythm. All things considered, a heart attack detection and heart rate monitor using an IoT ESP Node MCU 32 and a Max10300 heart rate sensor can be a valuable tool for keeping an eye on heart health and spotting impending cardiac problems. It's crucial to remember that a device like this shouldn't be used in place of expert medical guidance and treatment.

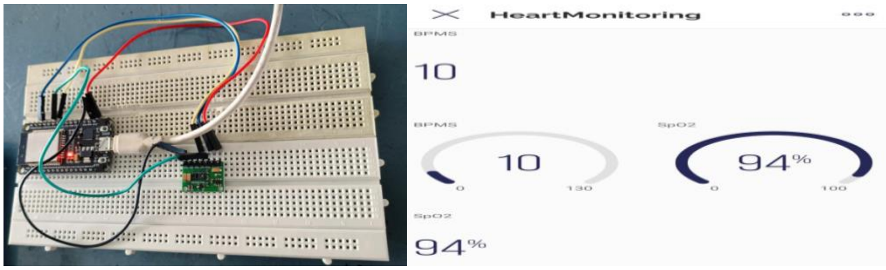

FIGURE 5. Output Image

8. CONCLUSION

For people with a history of heart disease or other cardiovascular disorders, a heart attack detection and heart rate monitoring device might be a useful tool. They can take precautions against a future heart attack or, if necessary, seek medical assistance by keeping an eye on their heart rate and noticing any anomalies. A popular microcontroller board for Internet of Things (IoT) applications is the IoT ESP Node MCU 32. It can use Wi-Fi to connect to the internet, allowing you to send heart rate data to a distant server for analysis or alert notifications. The user's heart rate is determined using the heart rate sensor. To get a precise reading, the user can place it on their finger or earlobe. The heart rate sensor's analogue signal can be converted by the Max10300 analog-to-digital converter into a digital signal that the microcontroller can process. The heart attack detection and heart rate monitoring system you developed using an IoT ESP Node MCU 32, a heart rate sensor, and a Max10300 is a useful tool for those with cardiovascular diseases, in conclusion. They can take precautions against probable heart attacks or, if necessary, seek medical assistance by keeping an eye on their heart rate and noticing any anomalies. By enabling remote data monitoring and analysis, IoT technology improves the system's efficiency and convenience.

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