WEARABLE HEART MONITOR FOR DETECTION OF BRADYCARDIA AND ATRIAL FIBRILLATION

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Keywords

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Introduction

A heart rate of less than sixty beats per minute is known as bradycardia, and because of its effect on efficient blood flow, it is a serious concern in the field of cardiovascular medicine. Fatigue, lightheadedness, and syncope are among the symptoms of this disorder, which is caused by abnormalities in the electrical conduction system of the heart. The most common cardiac arrhythmia in the world, on the other hand, is atrial fibrillation, or AFIb. Heart failure, stroke, and other cardiovascular complications are increased when there is rapid and irregular electrical activity in the heart's upper chambers, which results in ineffective blood pumping.

A study suggests utilizing an Arduino platform, an LCD, a pulse sensor, and software such as the Arduino IDE and Google Spreadsheet to create a real-time cardiac health monitoring system. Based on user health data, this intelligent system seeks to identify cardiac conditions and provide tailored recommendations. By offering individualized advice based on each user's unique health condition, it overcomes the shortcomings of current fitness applications.

Objectives

Personal healthcare has been transformed by wearable technology, especially in the area of cardiovascular health management. The goal of this project is to create a sophisticated wearable cardiac monitoring watch that can distinguish between bradycardia and atrial fibrillation with accuracy. The watch delivers accurate real-time monitoring through the integration of advanced Body Temperature, SpO_2 detection, and machine learning algorithms such as fuzzy logic. Its features for adaptive learning adapt to the individual cardiac physiology of each user, guaranteeing reliable and customized monitoring. By providing users with practical insights, the watch encourages early intervention and improved health outcomes.

Methodology

Through the use of photoplethysmography (PPG), the MAX30102 module facilitates continuous non-invasive monitoring by measuring changes in blood volume related to SpO2 and heart rate. With waterproof options, the DS18B20 temperature sensor provides accurate readings in a variety of environments. The ESP8266 - NodeMCU and Arduino Uno R3 both support IoT and sensor integration. Functionality, user interface, and data visualization are improved by additional tools such as Flask, Firebase, React.js, Plotly.js, Node.js, React Router DOM, SSD1306 OLED display, and Axios.

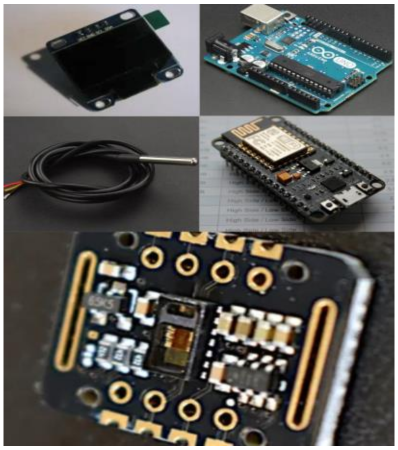

Fig 1. Components used

The Arduino, ESP8266, MAX30102, and DS18B20 are integrated into the real-time health monitoring system. After processing, sensor data is wirelessly transferred to Firebase and shown on OLEDs and web interfaces. For user comprehension, fuzzy logic associate’s health conditions with vital signs.

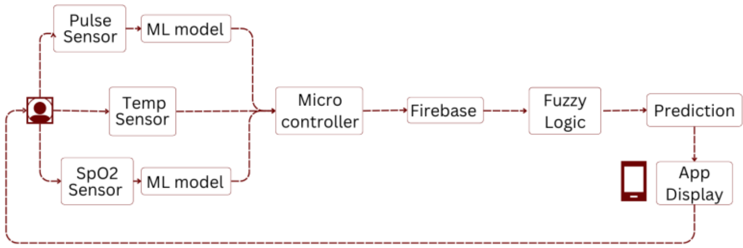

Fig 2. Block Diagram

Results

Atrial Fibrillation and Bradycardia are conditions based on the heart rate of an individual. However, in the above proposed research oxygen saturation (SpO_2) and temperature were taken into consideration to eliminate conditions like fever, which automatically raises the heart rate of an individual, inorder to give out better results on the heart conditions of the patient. The circuit is rigged up as shown in figure 3 and displays the real time values of the heart rate and SpO_2 are always being displayed on the OLED along with a rough plot of the heart rates as in Figure 4.

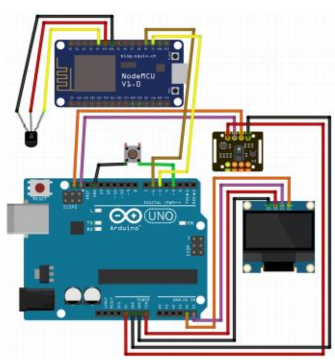

Fig 3. Schematic of the circuit-built

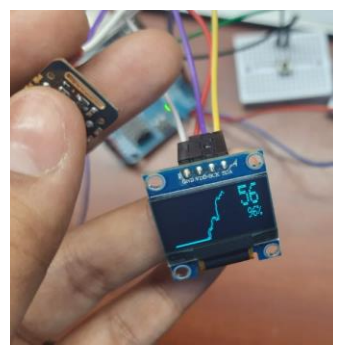

Fig 4. Display of the OLED

All the values of the heart rates, SpO_2 and the temperature are going to the firebase database through the ESP8266 WiFi module wirelessly. The updation on the database is as shown in Figure 6.

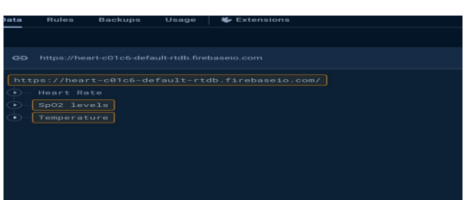

Fig 6. Updation shown in the database

The threshold of each parameter - heart rate, temperature, and SpO_2, were all considered after extensive research and clinical evidence. This was also validated by the medical professionals as well. Using these we can classify the readings as seen in figure 7 as Bradycardia, figure 8 as normal and figure 9 as Atrial Fibrillation.

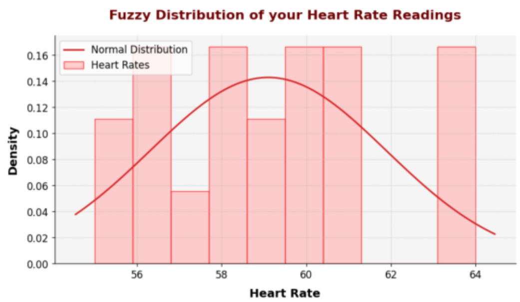

Fig 7. Readings classified as Bradycardia

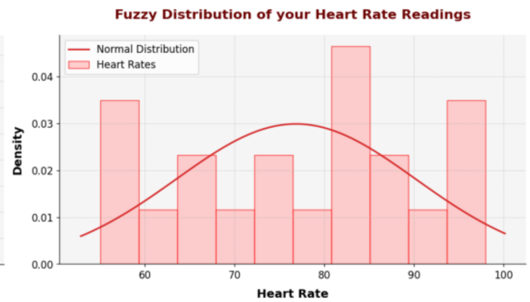

Fig 8. Readings classified as normal

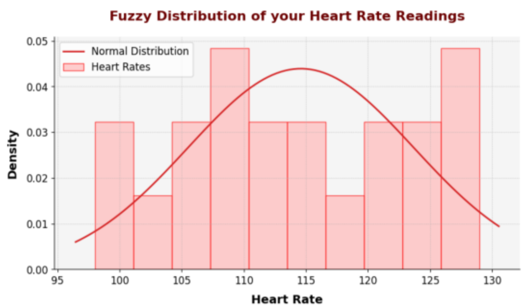

Fig 9. Readings classified as Atrial Fibrillation

Conclusion

In order to improve health outcomes, the proposed project highlights how crucial early cardiac diagnosis is for enabling targeted therapies and preventative measures. It provides enhanced detection capabilities by fusing state-of-the-art sensor technologies with fuzzy logic-based algorithms. It transcends traditional healthcare boundaries by offering real-time alerts, personalized insights, and continuous monitoring beyond detection. This multidisciplinary project unites engineering and medicine, demonstrating how teamwork can redefine expectations for healthcare. In the end, it sees a healthier society in which early intervention enhances general wellbeing and empowers people.

Innovation in the project

The incorporation of Machine Learning models, such as fuzzy logic, into wearables represents a revolutionary development in medical technology, with the primary goal being the identification of cardiac irregularities rather than a wide range of features. This customized method guarantees very high accuracy in detecting cardiac abnormalities by adding SpO2 and temperature information in addition to heart rates, which increases the efficacy of fuzzy logic models. The accuracy and dependability attained with this specialized technique mark a substantial advancement in the field of wearable health monitoring technology. The extensive research conducted to determine the thresholds for temperature, heart rate, and SpO2 within the fuzzy logic model further highlights the innovative approach of the project.

The wearable system maximizes its potential for accurate heart anomaly detection and enhances user experience by concentrating on a single, crucial task. With its ground-breaking use of fuzzy logic models in wearables, this technology raises the bar for individualized health monitoring and gives consumers unmatched clarity and assurance about their cardiovascular health.

Scope for future work

The project's goals go beyond simple technological improvements to include bettering healthcare outcomes, encouraging preventive care, and promoting individual wellbeing. In order to identify heart disease early and promote improvements in detection techniques, proactive prevention strategies are prioritized. Long-term objectives include enhancing the efficacy of the system by adjusting to developments in technology and medicine. In order to improve accuracy and efficiency in the diagnosis of cardiac problems, flexibility makes it possible to incorporate cutting-edge methods, sophisticated algorithms, and inventive techniques.