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ECG Monitoring and Analysis using Machine Learning

[1] Shardul Aryamane, [2] Atharva Kurlekar, [3] Jitendra Bakliwal

[1][2][3] Marathwada Mitra Mandal's College of Engineering, Pune, India

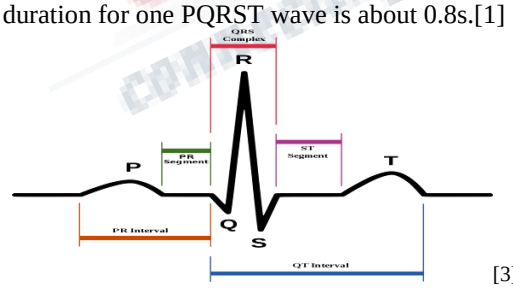
***Abstract*--- Nowadays, people prefer staying home due to the pandemic situation. This system will help reduce contact between patient and doctor and reduce efforts by saving time as it will send the patient's recorded data to the doctor's database. Doctors can access this real-time database through cloud. This system will analyze whether the patient has Sinus Tachycardia or Sinus Bradycardia using Machine Learning. Sinus Tachycardia (also colloquially known as Sinus Tach or Sinus Tachy) is an amplified sinus rhythm depicted by an increase in the rate of electrical impulses arising from the sinoatrial node. In adults, sinus tachycardia is defined as a heart rate greater than 100 Beats/min (Bpm). Sinus Bradycardia is a slow, regular heartbeat. It happens when the heart's pacemaker, the Sinus node, produces heart beats less than 60 times in a minute. In few cases, such as healthy young adults and athletes, Sinus Bradycardia can be normal and a sign of Cardio-vascular health.**

Henceforth, this system will be beneficial for adults and aged patients who are suffering from Cardio-vascular diseases as the patients will not have to visit the doctor's clinic or hospital very often.

***Index Terms*— AD8232 sensor, MCP3008 ADC, Raspberry, sinus tachycardia sinus bradycardia**

I. INTRODUCTION

ECG, i.e., Electrocardiogram, is a medical test that detects abnormalities in the heart by calculating the electrical activity generated by the heart in its contraction process. ECG test is a safe and painless test that takes some time. Nevertheless, such machines are not available in rural areas due to the high costs. Handling these machines needs special care. The work aims to develop low cost, less complex, and real-time ECG monitoring system. The ECG waveforms have a phase and amplitude relationship. However, a change in amplitude and phase in the ECG waveform determines abnormalities in the heart's functioning. Standard heart rate of human beings about 72 BPM. Figure.1 shows ECG signals having different waves. The P wave of the ECG waveform is caused due to the contraction (depolarization). QRS complexes are caused due to contraction (depolarization). However, a T wave is formed because of ventricular relaxation. Detection of the QRS complex is vital to find out the R-R interval. Further, it will calculate heart rate in Beas Per Minute (BPM). The time duration for one PQRST wave is about 0.8s.[1]



[3]

Fig.no.1

II. PROCEDURE FOR PAPER SUBMISSION

A. Review Stage

Current ECG systems in hospitals work such that when ECG is taken, it takes some time, and then we get the report after some time. Even in most modern hospitals, the readings are sent over to the server, and the cardiologists then make a report and send it back through the mail.

Our systemes machine learning gives the patient a rough idea of whether their heart readings are normal or fall in two basic categories, na: sinustachycardia and sinus bradycardia.

Not just that, but the doctor can immediately check the report online.

B. Figures

Final Connections

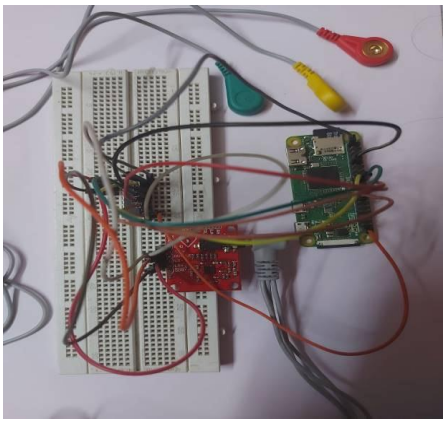


Fig.no.2

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Output

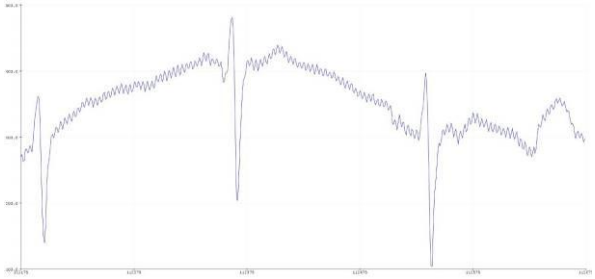

Fig.no.3

III. MATH

When the heart rate is normal, the heart rate can be determined by the interval between two consecutive QRS structures. In the standard paper with the most common detection settings, the calculation of heart rate is is done by carrying out a division of the number of large boxes (5 mm or 0.2 seconds) between two consecutive QRS structures into 300. For instance, if the interval between two QRS structures is larger than the boxes, the average is calculated as 150 beats per minute (bpm), (300 ÷ 2 = 150 bpm).

Helpful Hints

A. Figures and Tables

Block Diagram

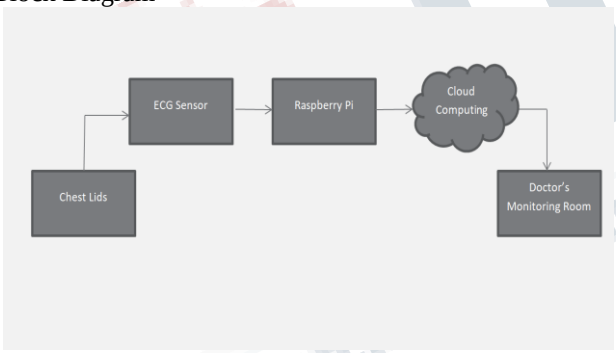

Fig.no.4

Flow Chart

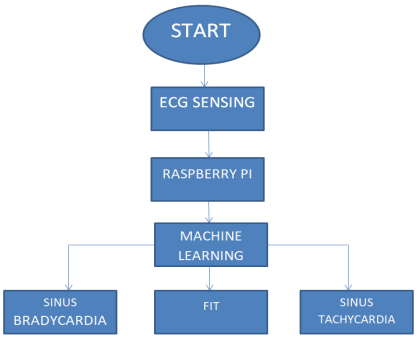

Fig.no.5

ECG Surface Electrodes: The electrode is an active pad in contact with the body forming the electrical circuit and electrocardiograph. These electrodes get minor electrical changes occurring in the skin from the myocardium and changes in electrical energy over time disintegration and regeneration of the auricle and ventricles.
Sensor materials Ag-AgCl take up these minor issues

AD8232 ECG Module & surface Electrodes

AD8232 ECG Module: AD8232 integrated a signal of the shape of a signal with unique elements instrumentation amplifier, active amplifier, right leg power boost drive, and reference bar for centralized ECG moreover, other measuring programs may be bio. It has integrated ECG block conditioning block designed extracting, enlarging, and filtering small bio-potential signals in the presence of noise, such as motion artifact or placement of a remote electrode.AD8232 contains special an amplifier that amplifies the ECG signal over time rejecting the power of a part of an electrode cell at the same stage. This pole high pass filter is firmly attached to construction of amplifier steel to allow both great profit and high filter in one category, therefore saving space and costs. This design allows for ultralow an analog-to-digital power converter (ADC) or embedded microcontroller to detect the output signal easily. The result The ECG module is connected to the ADC.[2]

Raspberry Pi

Raspberry Pi is the preferred processor for low cost and various GPIO (Standard Installation Result) pins. Once the release of MCP3008 is connected to the raspberry pi pins GPIO, it acts as an integrated ECG monitoring device.
The processor speed varies depending on 700 Mhz goes to 1.2 GHz, and the memory on the board varies from 256MB to 1 GB. An operating system, Raspbian, based on Linux is loaded onto a microSD card. There are different types of GPIO pins found in user support standard terms such as I2C and SPI.
If an internet connection is provided on the Raspberry Pi will act as a server. After that, the server can automatically load data on a web page. Wi-Fi modules are also built into the board.[2]

MCP3008 ADC

MCP3008 ADC:
The system detects real-time ECG with a frequency of up to 20 Hz and a sample rate of up to 1khz. Therefore, the ADC details need to be matched to compare the ratio of ADC and ECG signal samples. Thus, eight-channel, 10-bit solution MCP3008 ADC with SPI serial interface is preferred. This ADC is made by Microchip Technology Inc. successive simulation type Analog to Digital (A / D)

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converter with board sample and holds circuits. The maximum sample rate is 20ksps. Communication with devices is achieved through a simple serial interface compatible with SPI protocol.
The MCP3008 is connected to the Raspberry Pi using the SPI serial connection. There are two ways to communicate using software SPI and hardware SPI. Hardware SPI is preferred for our project because of its incredible speed.[2]

IV. SOME COMMON MISTAKES

Various fundamental errors have commonly been practiced that lead to wrong readings that, in turn, can lead to a misguided diagnosis.
The measurement of ECG after performing any rigorous activity increases the heart rate of the body.
Not lying down calmly, being in a state of tension, stress, excitement, or even fear also affect our heart rate.
Having any metallic objects nearby affects the sensor and its ability to read the heart's electric activity. All these mistakes lead to fluctuations in the readings and inaccuracy in the report.
Prevention of such errors is highly recommended

V. CONCLUSION

According to the design and algorithm, our system can make ECG testing easy and helpful for doctors and patients.
Remote access to data will reduce the direct contact between doctors and patients.
In addition to all this the use of machine learning will help the doctor and patient to detect two conditions, namely sinus tachycardia and sinus bradycardia.
This system will highly reduce the frequency of going to the hospitals for the checkups.
This project is sponsored by Whiz Key Pvt. Ltd.

Notations
ECG:- Electrocardiogram
ADC:-Analog To Digital Converter
GPIO:-General Purpose Input Output

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