International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

IOT BASED SOLAR POWERED HEART RATE MONITOR AND ANALYSIS OF HEART RATE VARIATION USING MACHINE LEARNING

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Abstract - *This Heart Rate Monitor is aimed for rural areas of Asia where many places power, and due to the financial limitations they face, medical facilities may not be adequate. This project basically aims at monitoring the heart rate of the patient using Pulse Detector Sensor interfaced with an ATmega328 micro controller. The sensor data can be uploaded in the free source cloud platform THING SPEAK. The data collected can be analyzed using Machine Learning Algorithm, where the algorithm will be trained from the data set and the aim is to investigate different potential Machine Learning (ML) algorithms for creating diagnostic heart disease models.*

Key Words: **ATmega328 micro controller, Pulse Detector Sensor, ESP83266 WI-FI Module, Solar Panel for Power Supply, Think Speak, Python3.**

1. INTRODUCTION

Heart disease is the number one cause of death for men, women, and people of most racial and ethnic groups. More than one person dies every minute and nearly half a million die each year. Heart rate (HR), is defined as the number of heart beats per unit of time, is a measure for assessing cardiac well-being. Typically, it is measured as the number of heart contractions per minute (bpm). Its regular measurement is crucial in assessing and monitoring a myriad of health conditions. With advancements in Technology and people being more conscious about their health than ever, technical advancements in the field of medicine are inevitable. People are switching towards wearable devices to keep track of their health and fitness related data. But the rural areas where people are deprived of the basic needs like food and water, expensive Healthcare is a questionable term. This project looks into the development of a Heart rate monitor with a very minimal cost which can be a replacement of ECG'S which costs around 1000-1500$ and also the analysis of the Heart rate of the patients to investigate potential ML algorithms for creating diagnostic heart disease models and do the required treatment for the patients.

1.1 BLOCK DIAGRAM

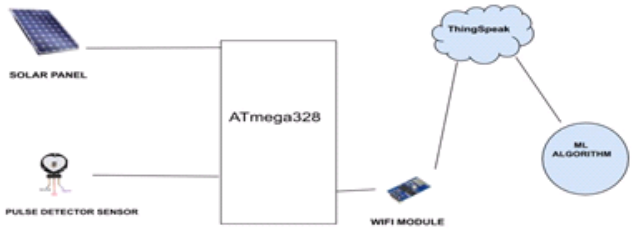

Fig -1: BLOCK DIAGRAM

1.2 WORK DESCRIPTION

The Heart Rate Sensor has two LED's one IR (infra red) transmitter and one IR receiver. The IR transmitter emits infrared light, that gets reflected by the blood in your finger. This reflected IR light is detected by the IR receiver.

Now when your heart beats, there is a slight increase in volume if blood in your finger. This means more IR light is reflected to the IR receiver. The receiver's signal gets amplified by an op-amp and the signal is fed to the micro controller, which then counts each beat and calculates the beats per minute (BPM).

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any micro controller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. With ESP8266 sensor data will be uploaded in an open source cloud platform Thing Speak.

Meanwhile, Thing Speak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to Thing Speak from your devices, create instant visualization of live data, and send alerts.

For analysis part, Machine Learning is used. Applciation of ML is across many spheres around the world. The healthcare industry is no exception. Machine Learning can play an essential role in predicting presence/absence of Locomotor disorders, Heart diseases and more. Such information, if predicted well in advance, can provide important insights to doctors who can then adapt their diagnosis and treatment per patient basis.

Since, this project is based on the principle of photoplethysmography (PPG) ,which is a non-invasive method of measuring the variation in blood volume in tissues using a light source and a detector. Features commonly extracted from PPG time series are morphological descriptors, time domain statistics, frequency domain statistics, nonlinear measures, wavelet based measures, and cross-correlation measures. There were generally three main ML approaches used : k-nearest neighbors (KNN), support vector machine (SVM), and decision trees (DT). KNN classification is a relatively simple clustering technique where a sample is classified by a plurality vote of its neighbors and assigned to the class based on the most common class among its K closest neighbors.

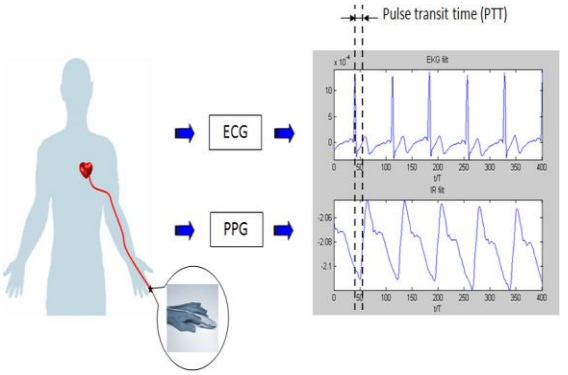

Fig -2: Comparison Between ECG and PPG Heart Rate Signal.

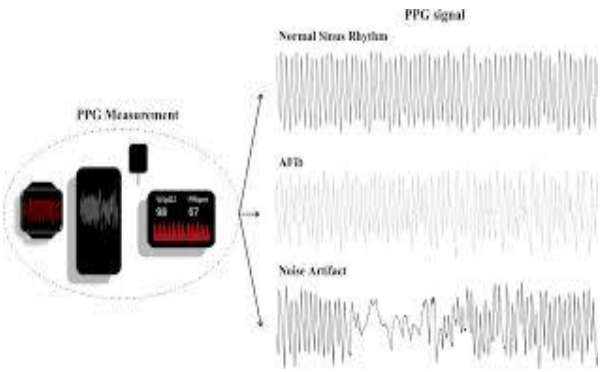

Fig -3: PPG signal acquired using a wearable device and typical waveforms representing NSR, AF, and noise artifact.

2. COMPONENTS

1. Atmega328 Micro controller

ATmega328 is basically an Advanced Virtual RISC (AVR) micro-controller. It supports the data up to eight (8) bits. ATmega-328 has 32KB internal built in memory. ATmega 328 has 1KB Electrically Erasable Programmable Read Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). Other features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable, programming lock for software security, throughput up to 20 MIPS.

Fig -4: Atmega328 Micro controller

2. Pulse Detector Sensor

The heartbeat sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (avascular region). In the case of applications where the heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by the blood, the signal pulses are equivalent to the heartbeat pulses.

Fig -5: Pulse Detector Sensor

3. ESP8266 WIFI Module

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any micro controller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

Fig -6: ESP8266

4. Solar Panel

Solar panels work by absorbing sunlight with photo voltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology.

Fig -7: Solar Panel

3. CONCLUSIONS

In this project, we have used solar panel as the power source so it can be used in rural areas where power supply is not adequate. Pulse rate measuring sensor, which will give the BPM reading. WIFI module is used to upload the data on the cloud using internet. Think Quick is an open source cloud platform, from here data can be easily gathered and be seen from anywhere on the internet. Many machine learning algorithms used in the clinical field are essentially black boxes, which make predictions without giving any clinical explanation. The clinical community points out that the accuracy achieved by the ML algorithm is not enough for accepting ML-enabled technology. Explainable ML algorithms are emerging with interpretable models, which can give information about which aspect of input data contributes more to the final prediction. Similarly, from PPG many diseases like Atrial fibrillation (AF), a cardiac rhythm disorder associated with increased morbidity and mortality. It is the leading risk factor for cardioembolic stroke and its early detection is crucial in both primary and secondary stroke prevention.

4. FUTURE SCOPE

A general limitation in the medical field and also in the studies of AF detection is the fact that models take into consideration a small group of patients from one medical center. The models should be developed using data from multiple medical centers in order to ensure that all the population heterogeneities were represented in the sample used for the study. Also, developing countries can have this project as an alternative for ECG machines. Monitoring of patients can be done remotely. Other sensors like Pressure Monitoring, Temperature Monitoring sensors can be used for a complete health analysis of the patient.

ACKNOWLEDGEMENT

We would like to thank our Prof. Mrs. Snehal Gaikwad for guiding us throughout the project.

REFERENCES

[1] Kirchhof P, et al. 2016 ESC guidelines for the management of atrial fibrillation developed in collaboration with EACTS. Eur.Heart J.2016;37:2893–2962.doi: 10.1093/eurheartj/ehw210.

[2] American Heart Association. Heart Disease and Stroke Statistics 2018 At-a-Glance. 2018. Available online:**https://healthmetrics.heart.org/wp-content/uploads/2018/02/At-A-Glance-Heart-Disease-and-Stroke-Statistics-2018.pdf**(accessed on 31 January 2018).

[3] Hoffmann K., Wiemeyer J. (2017b). Statistical models for predicting short-term hr responses to submaximal interval exercise, in International Symposium on Computer Science in Sport(Constance: Springer;), 57–68.[Google Scholar]

[4] Heaps C. L., Gonzalez-Alonso J., Coyle F. F. (1994). Hypohydration causes cardiovascular drift without reducing blood volume. Int. J. Sports Med.15, 74–79. 10.1055/s-2007-1021023 [PubMed] [CrossRef][Google Scholar]

[5] Selvaraj N., Jaryal A., Santhosh J., Deepak K. K., Anand S. (2008). Assessment of heart rate variability derived from finger-tip photoplethysmography as compared to electrocardiography.J. Med. Eng. Technol.32, 479–484. 10.1080/03091900701781317.

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