

Disease Prediction Using Heart rate Variability Analysis - IoT

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Abstract: A smart watch which sends the Heart-rate Datasets of an Individual every minute/hour to the cloud for performing "Disease Predictive Analytics". The System which runs on the Backend/cloud, implements various Data Mining Techniques like Clustering and Classification, generates the Analysis report on heart-rate variations for every day, every month and every year. The System also serve the users with real-time notifications of their heart condition and guides them with proper healthcare. This kind of information can be of value to the medical community. Heart Rate Variability Analysis predicts near-future heart diseases in individuals, alerting them in advance.

Keywords: Heart Disease, Prediction, Internet of Things, Wearable.

1. Introduction

1.1 Background

Heart rate of a human varies every minute. This is the usual tendency shown by a healthy heart. Heart rate can reveal many aspects of an individual's health. Many diseases can be predicted by monitoring Heart Rate Variability, before Doctor's diagnosis.

1.2 Problem Statement

A person can be diseased if the heart rate increases or decreases linearly over a period of time. This cannot be regularly monitored by people because of their busy schedules.

1.3 Importance

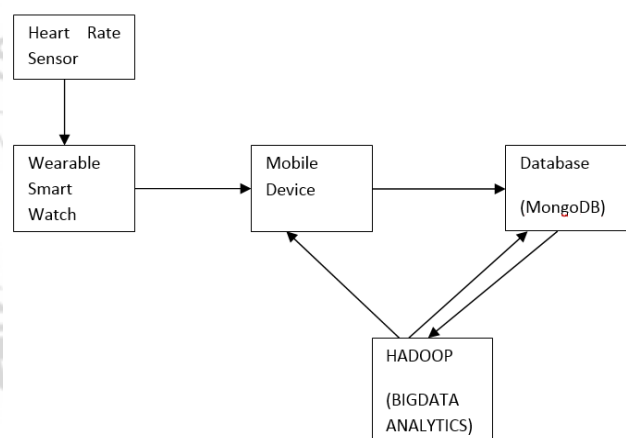
Use of analytics on heart rate can reveal a lot of information which can be critical in nature. This kind of information can be of value to the medical community. Heart Rate Variability Analysis predicts near-future diseases in individuals, alerting them in advance.

2. Overview

2.1 Proposed System

The system uses a wearable watch to do detect the heart beat pulses and Bluetooth 4.0 fitted to the wearable watch sends the data to the Mobile Application. Now, this sensor data is being pushed to the cloud for further analysis of Heart Rate Variability (HRV). The graph visualization of heart beat can be seen in your mobile. Based on increase/ decrease in HRV over a period of time, we predict the Chronic diseases of the heart using HRV analytical techniques and notifications are send to the user in the mobile application.

2.2 Architectural Specifications



2.2 Challenges

- 1) Excluding Heart Rate Data when human is mobile/running, from the observed Dataset using Accelerometer.
- 2) Data cannot be sent to the cloud directly. It should be done through mobile/public Wi-fi which has Internet connectivity.

2.3 Assumption

Mobile is always connected to the sensor through Bluetooth and also Internet.

2.4 Hardware Requirements

LilyPad Arduino, Heart Rate Sensors (using IR), Bluetooth 4.0 Module/ Wi-fi Module, Connecting Wires, LEDs

2.5 Software Requirements

Arduino Suite, Android Studio, MongoDB, Kubios Analysis, Hadoop

2.6 Data Mining Technique Used (Clustering and Classification)

Bayesian classification is based on Bayes' Theorem. Bayesian classifiers are the statistical classifiers. Bayesian

classifiers can predict class membership probabilities such as the probability that a given tuple belongs to a particular class. Bayes' Theorem is named after Thomas Bayes. There are two types of probabilities –

1. Posterior Probability $[P(H/X)]$
2. Prior Probability $[P(H)]$

where X is data tuple and H is some hypothesis.

According to Bayes' Theorem,

$$P(H/X) = [P(X/H) * P(H)] / P(X)$$

According to the Literature Review of Heart Rate Variability Analysis, it has been found that heart rate patterns have significance on few of heart diseases like,

Diabetics (A) - Heart rates of ~100 bpm with occasional increments up to 130 bpm , **Bradycardia (B)**- It is a sign of a problem with the heart's electrical system, heart beats less than 60 bpm, it is slower than normal , **Cerebrovascular disease (C)** - very fast rates of 200 bpm or more can precipitate heart failure , **Hypertension (D)** – heart rate constantly ranging from 100-200.

A, B, C, D diseases act as Different Classes in Baye's theorem and Trained Datasets (H) and Test Datasets(X) are used for the Classification of Data using Baye's Theorem and predict the Heart Condition and Disease.

3. System Design

3.1 High Level Design

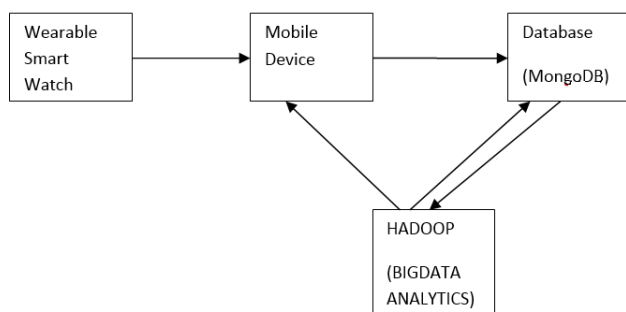


Figure 3.1.1: High Level Design

3.2 Low Level Design

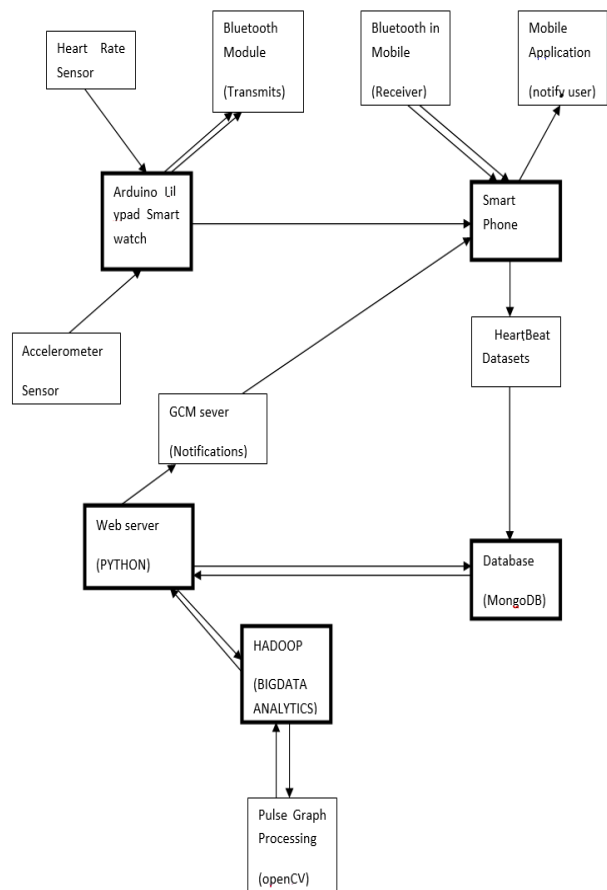


Figure 3.2.1: Low Level Design

4. Conclusion

Heart Rate Variability Analytics Using Internet of Things (IoT) was found out to be a very helpful measure in predicting a disease and also a good scope for applying predictive analytics. This Integration of Heart Rate Variability with Bayesian Prediction throws light upon the various unexplored fields in which the same principles can be applied. It suffices to say that Data Analytics is a very exciting field of Computer Science and its applications are far and wide.

References

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