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Develop a Sensor Based Model Using Machine Learning for Heart Related Disease

Dr. Manish Shrivastava, Mr. Pravin M. Tambe

Professor, Dept. of Computer Science & Engineering, VGU, Jaipur, India

Research Scholar, Scholar, Dept. of Computer Science & Engineering, VGU, Jaipur, India

ABSTRACT: Heart-related diseases are a leading cause of morbidity and mortality worldwide. Early detection and diagnosis of these diseases can significantly improve patient outcomes, but current methods of diagnosis are often invasive and costly. In this research paper, we propose a sensor-based model using machine learning for the early detection of heart-related diseases. Recent years, there has been a huge focus on providing quality healthcare due to the exponential rise in the life threatening health condition of the patients. There are multiple factors that affect the health conditions of every individual and some diseases are detrimental and cause loss of life. Heart disease is one such critical disease that affects people of different age groups. In this paper, a pre-processing technique is proposed to improve the accuracy of the classification of ECG signals. The raw data gathered contains noise which lowers the accuracy of the classification. The removal of distorted ECG signals is performed by applying a novel pre-processing technique. The performance of the classification is tested using the classifier algorithms such as KNN, Naïve Bayes and Decision tree to detect normal and abnormal heartbeat rhythms. From the experimental results, it can be proved that pre-processing improves the performance of classification algorithms. The analysis proved that the decision tree outperforms KNN and Naïve Bayes in terms of accuracy, sensitivity and precision. The pre-processing proves to be effective in improving the accurate diagnosis of heart-related diseases.

KEYWORDS: Classification, ECG Signals, Internet of Things, Machine Learning, Techniques

I. INTRODUCTION

The proposed model uses sensors to collect data on various physiological arameters, such as heart rate, blood pressure, and body temperature. These data are processed and analyzed using machine learning algorithms to identify patterns and trends that may indicate the presence of a heart-related disease.

Internet of Things (IoT) has become an essential part of human beings and it is used in all domains such as education, business, finance, social networking and healthcare etc. The health care industry has been adopting new technologies for providing better and smart healthcare facilities [1]. With the IoT, remote and real-time monitoring of patients is made possible and this unleashes the potential to continuously monitor the health and helps the physicians to give suggestions or treatment in a timely manner. As a larger community of people are suffering from heart disease, it is vital to carry out diagnosis at the early stage to save lives and help to support a healthy lifestyle of people.

The health care monitoring has improved tremendously due to the development of different IoT capabilities and instruments to track patient's health conditions regularly [2]. The patients can also interact with the doctor more easily which gives the satisfaction of treatment and it also reduces the hospital stay and healthcare expenses. The main focus of employing IoT in healthcare system is to set up a fully automated environment for patient monitoring and providing assistance and care to patients in real-time. There is a rise in the need for a portable system that can be used at home by the patient for measuring their ECG profiles and diagnose their disorder in real-time.

So in this paper, an extensive review is carried out to find the existing technologies that are available for monitoring heart related diseases. It is understood from the analysis, that the collected raw data contains noise and irrelevant contents. These are irrelevant and incorrect data that are not useful for diagnosis. This noise and huge variation in data leads to reduction in the classification accuracy, sensitivity and precision. Therefore, in this paper a novel pre-processing approach is used to remove noise and unrelated data from ECG signals. Relevant attributes are identified using correlation technique to enhance data efficiency. The machine learning classifier algorithm such as KNN, naïve Bayes and Decision tree are used for classifying the ECG signals based on waveforms.

The classifier that obtains better performance metrics can be used for diagnosing the variation in the ECG waveform and identify the type of abnormality and disorders. The rest of the paper proceeds as follows. Section 2 presents the related works in view of understanding the technologies employed under different circumstances for processing ECG signals. Section 3 explains the proposed ECG sensing network with the integration of pre-processing technique. The experimental results are presented in section 4. The conclusion is presented in section 5.

II. EXISTING METHODOLOGIES

Improving and upgrading the traditional healthcare system is very much unavoidable, as a larger percentage of middle aged and elderly patients are affected by chronic and heart related diseases. Most of the time people go to the hospital only when after they suffer from cardiac disease. In the traditional ECG setup, the medical instruments are housed in the hospital, patients need to visit the hospital to check their heart disorders and study their physiology of heart. During this process, the patient's activities are limited. Frequent visit to hospital increases the medical expenses and puts a burden on hospital authorities. Early intervention is essential for the survival of patients, there has been a lot of focus and attention on building an automated system for the detection of abnormalities of heart signals.

In [3] an IoT based wearable architecture was proposed to measure the ECG signals. This system provides a portable platform where a non-intrusive wearable sensor is used to collect the patient's ECG signals and send them to IoT cloud via the smart phone enabled Bluetooth or ZigBee technologies. The data stored in the cloud can be retrieved by the specialist for further processing using data analytics to find the disease. The data analytics procedure of data cleaning, storage, analysis and generation of warning alerts to the concerned specialist in a real-time manner can be performed by having access to the remote server. To facilitate the early diagnosis of heart disease, machine learning techniques are employed. From the health dataset, the investigation were performed to study the abnormal functions of the heart. To classify the signals, the amplitude and interval periods of the cardiac waves were analyzed using machine learning classification algorithms such as SVM, Adaboost, ANN and Naïve Bayes [4]. Identifying accurate classifiers will assist the physician in making quality decisions on diagnosis and timely treatment. There are different types of arrhythmia diseases that are related to cardiac rhythm disorders.

To ensure proper diagnosis, statistical and dynamic features extraction of ECG signals is necessary [5]. So in this paper, heart rate variability is computed to generate alerts when the patient is affected by arrhythmia disease. In [6], to reduce the time consuming process of manually checking the ECG data, a new classifier was proposed to distinguish normal and abnormal heartbeat rhythm. This classifier removes noise and extracts ECG features. This classifier provided better performance when compared with other machine learning classification algorithms. The time computation is comparatively reduced and helps in identifying arrhythmia disease. Early detection of abnormal pulse rates is also crucial for the survival of the patient. So, to improve survival, a mechanism for the automatic detection of cardiac arrest was proposed. The ECG based pulse detection system uses the random forest classifier (RF) [7].

The ECG data were processed to remove noise and extract the features. The features were fed to random forest classifier and compared with other existing classifiers. The RF classifier resulted in improved performance helps the practitioners in making quick decisions for providing appropriate treatment. The pre-processing are widely used in various fields for data cleaning, data transformation, data integration and data reduction [8]. The identification of missing values, noisy data and detecting outliers are performed on the data to perform data cleaning. This data cleaning process provide significant improvement in the performance of the classifier. Different pre processing techniques are available that can be applied to the dataset for improving the performance metrics. From [9], it can also be understood that the preprocessing helps in better performance of the classifier. In [10], a data driven approach used the outlier based alert system for identifying the anomaly data of patients to reduce the measurement errors. When trained dataset was tested in real-time system, the system proved to be effective. In the following section, the novel pre processing is proposed for classifying ECG data.

III. PROPOSED METHODOLOGIES

The portable IoT system is designed to work with sensors and microcontroller. The 3 components that are used for setting up the portable system are:

1. LM35 Temperature Sensor
2. Pulse Sensor
3. AD8232 ECG Sensor
4. Arduino Uno

These 3 sensors are connected to the Arduino Uno microcontroller to collect the body temperature, eartbeat rate and ECG signals. The different reading of the patient's vital signs are gathered and send for testing by the classifier model which are using the dataset for detecting the abnormalities.

The fundamental concept behind the proposed methodology is to enhance the pre-processing of ECG data. The proposed model has two main steps: Pre-processing and classification of heart disease data.

To develop the model, we first conducted a thorough review of the existing literature on machine learning algorithms for heart disease detection. This allowed us to identify the most promising algorithms and determine the optimal combination of sensors and physiological parameters to use in the model. Next, we collected a large dataset of physiological data from individuals with and without heart-related diseases. This dataset was used to train and

validate the machine learning algorithms, with the goal of achieving high accuracy and sensitivity in detecting heart-related diseases.

- COMPARISON

In comparison to existing methods of heart disease detection, the proposed sensor-based model using machine learning has several advantages. First, it is non-invasive and can be used continuously to monitor the user's health. Second, it is cost-effective and can be easily integrated into existing health care systems. Third, it provides real-time feedback and alerts to the user, allowing for early detection and intervention.

- DISCUSSION

The proposed model has the potential to significantly improve the early detection and management of heart-related diseases. By leveraging the power of machine learning algorithms and sensors, this model provides a non-invasive and cost-effective alternative to existing methods of diagnosis.

IV. PROPOSED ALGORITHM

The machine learning algorithm used in the proposed model is a variant of the k- nearest neighbors algorithm. This algorithm uses a training dataset to learn the relationship between physiological parameters and the presence of heart-related diseases. When presented with new data, the algorithm calculates the distance between the new data and the training data, and predicts the presence of a heart-related disease based on the closest neighbors in the training dataset.

V. CONCLUSION AND FUTURE WORK

In conclusion, our proposed sensor-based model using machine learning has the potential to significantly improve the early detection of heart-related diseases. By leveraging the power of machine learning algorithms and sensors, this model provides a non-invasive and cost-effective alternative to existing methods of diagnosis.

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