DETECT HEART DISEASE THROUGH MACHINE LEARNING ALGORITHMS AND REAL-TIME MONITORING OF HEART HEALTH

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ABSTRACT

In recent years, heart diseases have become the leading cause of death affecting both developed and developing countries worldwide. Early diagnosis and prompt treatment can help reduce mortality. However, it is not possible for physicians to make accurate diagnoses and care for the patient environment as it requires skill, time, and expertise. This study presents a preliminary design of a cloud-based cardiovascular disease assessment using machine learning. To achieve this goal, a 10-fold cross-validation was used to test the performance of the predictive model using widely available open-source data. The accuracy of the SVM algorithm reaches 97.53%, while its sensitivity and specificity are 97.50% and 94.94%, respectively.of the SVM algorithm reaches 97.53%, while its sensitivity and specificity are 97.50% and 94.94%, respectively. In addition, we developed a real-time patient monitoring system using Arduino to track parameters such as body temperature, blood pressure, humidity, and heart rate. The system allows regular monitoring of heart patients by their relatives and doctors. The system records data and sends it to a central server, where it is updated every 10 seconds. Doctors can access this information through the application, allowing them to instantly view patient information and initiate a call if urgent treatment is needed. The accuracy of the SVM algorithm in predicting heart disease is 97.53%, while its sensitivity and specificity are 97.50% 94.94%,respectively. In addition, we developed a real-time patient monitoring system using Arduino to track parameters such as body temperature, blood pressure, humidity, and heart rate. The system allows regular monitoring of heart patients by their relatives and doctors. The system records data and sends it to a central server, where it is updated every 10 seconds. Doctors can access this information through the application, allowing them to instantly view patient information and initiate a call if urgent treatment is needed. The accuracy of the SVM algorithm in predicting heart disease is 97.53%, while its sensitivity and specificity are 97.50% and 94.94%,respectively. The combination transfers the input data to a central server where it is updated every 10 seconds. Doctors can instantly access patients' medical records via the app and initiate a video call when urgent medication is needed. In addition, if a measurement exceeds the threshold, the system immediately alerts the provider via GSM technology.

Keywords

Data Mining, Machine Learning, IoT (Internet of Things),Patient Monitoring System, Heart Disease Detection and Prediction.

INTRODUCTION

The heart is responsible for pumping blood throughout the body and plays an important role in the cardiovascular system, which also includes the lungs and many blood vessels such as arteries, veins, and nerves. These blood vessels carry blood to different parts of the body. Poor circulation can lead to many cardiovascular diseases, including cardiovascular disease (CVD), and is the leading cause of death worldwide. According to the World Health Organization (WHO), 17.5 million people die from heart disease and stroke each year, and more than 75% of these deaths occur in developing countries. Additionally, 80% of deaths from CVD are due to stroke and heart attack. Early detection and prediction of heart disease can save many lives, help doctors improve the quality of care, and ultimately reduce the risk of heart disease. As medical technology advances, large amounts of patient data, including large electronic medical records, can now be used to develop predictive models for cardiovascular disease.The heart is responsible for pumping blood throughout the body and plays an important role in the cardiovascular system, which also includes the lungs and many blood vessels such as arteries, veins, and nerves. These blood vessels carry blood to different parts of the body. Poor circulation can lead to many cardiovascular diseases, including cardiovascular disease (CVD), and is the leading cause of death worldwide. According to the World Health Organization (WHO), 17.5 million people die from heart disease and stroke each year, and more than 75% of these deaths occur in developing countries. Additionally, 80% of deaths from CVD are due to stroke and heart attack. Early detection and prediction of heart disease can save many lives, help doctors improve the quality of care, and ultimately reduce the risk of heart disease. As medical technology advances, large amounts of patient data, including large electronic medical records, can now be used to develop predictive models for cardiovascular disease. Data mining and machine learning are studies that analyze big data from different perspectives to reveal useful insights. This information is important because it reveals important information that was not previously known. Today, the healthcare industry produces a lot of information about diagnoses, patient information, and more.

LITERATURE SURVEY

Heart disease continues to be a leading cause of death worldwide. Early detection is critical for effective management and treatment. Traditional diagnostic methods, while effective, often lack the urgency and accuracy needed for early intervention.Machine learning (ML) algorithms, combined with the content of monitoring technology, offer promise for developing accurate and timely diagnosis.

Supervised learning: Techniques such as logistic regression, decision trees, random forests, and support vector machines

(SVM) are used to predict heart disease based on patient history. This model is good at stratifying patients into risk groups based on collected data.Serial data to increase prediction accuracy.

Deep Learning: Neural Networks, including Convolutional Neural Networks (cnns) and Recurrent Neural Networks (rnns), are employed to capture intricate patterns from ECG signals and other time-series data, enhancing prediction accuracy.

Background and Objectives

Research has shown significant benefits of machine learning in heart disease diagnosis and prediction. In particular, in cardiovascular care, AI-enhanced diagnostic tools have been shown to improve standards, such as the American College of Cardiology/American Heart Association (ACC/AHA) CVD detection and prediction model. In 2011, Zhao, Wang, and Nakahira explored the potential of Internet of Things (IoT) medical technology to provide better healthcare services and analyze important clean health indicators and technologies that need further development [5]. In 2014, Chiuchisan and Geman developed a system to support home care, diagnosis, medication, treatment, and recovery of patients with Parkinson's disease [6]. Over the years, wireless health monitoring systems (WHMS) have gained popularity in both the scientific and business communities. Advances in machine learning algorithms and classifiers (such as correlation weights) have improved heart failure diagnosis [7], and signal sensors and smartphones are key components of these systems.

Methodology and Data Analysis

In this study, Java-based Open Access Materials Research Platform (WEKA) is selected due to its ability to detect cardiovascular diseases and identify high-risk patients. The study also presents a continuous heart monitoring system developed using an Arduino-based microcontroller. The following description is a step-by-step procedure to set up and use the system.

- All real-time sensor data is automatically stored in the cloud server database and updated after a certain period of time (every 10 seconds), and in case an undesirable sensor value is detected, prescriptions are given to doctors from all over the world. Mobile SMS notification using GSM module. For patients in intensive care, there are alarms that use audible alerts to immediately alert caregivers or caregivers.
- After receiving the report containing the current data of the mobile phone sensor, the doctor will enter the application, examine the patient's previous physical data received during the video stream and advise on the necessary medication.
- A rudimentary wireless patient monitoring device was developed using Arduino with temperature, humidity, and heart rate sensors to collect real-time data about the patient's body and check vital signs in patients.

Proposed System Architecture

This section describes the proposed process and details all the materials, methods, and tools used to develop the process. To develop good heart disease models, advanced software tools are required to train large datasets and compare various machine learning algorithms. Once a robust algorithm with accuracy and efficiency is identified, this algorithm will be incorporated into a smartphone application to diagnose and predict heart disease. Create a continuous patient monitoring system using hardware such as Arduino/Raspberry Pi, various sensors, monitoring devices, and audio alerts.

Hardware Components of the Patient Monitoring System

1) The Arduino/Genuino Uno: The Arduino/Genuino Uno is a microcontroller board powered by the ATmega328P microcontroller. It has 14 input/output pins, 6 of which can be used as PWM outputs and 6 as analog inputs. In addition to these function pins, the board also has power pins, a 16 MHz quartz crystal oscillator, an ICSP header, a reset button, and a USB connection. It can be powered by external power or by using a USB cable. The board provides all the components needed to power the microcontroller; simply connect it to your computer using a USB cable, or use an AC-to-DC adapter or battery power.

2) Heart rate sensor: Heart rate sensors work by detecting changes in light as blood flows through your finger with each heartbeat. The change in light across the vascular space is used to estimate heart rate because the light absorbed by the blood corresponds to the heart rate signal [12]. This sensor is designed to provide digital results of the heart rate when the finger is placed over the sensor. This digital output can be connected directly to an Arduino to measure the heart rate.

3) Electric buzzer: A buzzer is an electronic device that makes a sound to alert authorities in the event of a serious emergency. This sound signals an immediate risk to the patient's health, allowing family and caregivers to receive timely warning and respond appropriately in an emergency.

4) Temperature and Humidity Sensor (DHT11): DHT11 is a device with a humidity and temperature sensor that measures the air temperature in any space, whether indoors or outdoors. Since rapid temperature changes can cause discomfort and lead to heart failure, it is important to monitor humidity and temperature to maintain patient comfort and control their condition.

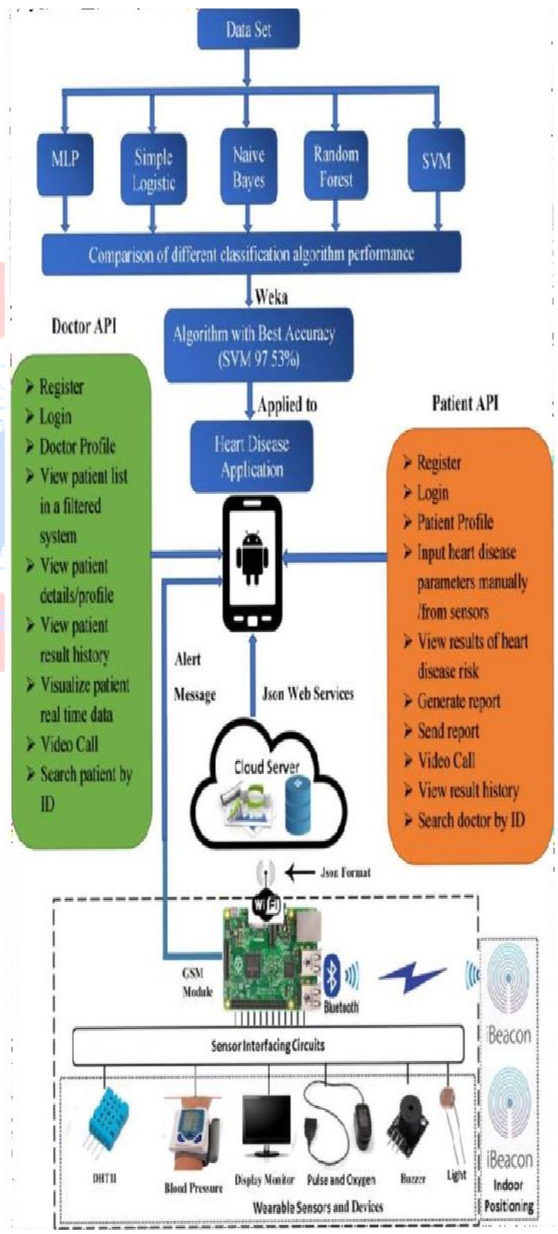

Figure 1.Overview of the proposed heart disease prediction and patient monitoring system.

Machine Learning Algorithms

Many data mining applications use machine learning algorithms, including some free and open source options such as WEKA, TANAGRA, RapidMiner, MATLAB, and Apache Mahout [14]. WEKA version 3.8.2 is used in this study. WEKA, the full name of which is "Waikato Information Analysis Environment", is a software developed by the University of Waikato in New Zealand for data analysis purposes. It is open source and released under the General Public License. WEKA provides a variety of data analysis functions, including classification, integration, custom selection, data preprocessing, and visualization. WEKA was originally written in C and later rewritten in Java to make it compatible with most computers. Its user-friendly graphical interface makes it easy to install and operate. Verify the performance of the model. Among these five indicators with high accuracy (e.g. above 80%), performance indicators are taken into account and are briefly described below:

Experimental Setup of the Proposed Cardiac Monitoring System

Use the cable to connect the Heart Rate Sensor Module MOD-00158 to Arduino Uno to monitor heart rate (BPM) and attach the sensor to your finger or ear for measurement. Also connect the DHT11 humidity and temperature sensor module to the Arduino Uno board using jumper wires. These sensors are very important for monitoring the patient's body temperature and humidity, especially when the patient cannot express their condition. The system will read and measure the weather conditions such as humidity and temperature to provide feedback on the patient's condition. A buzzer is installed in the system and if the heart rate, temperature, humidity or other parameters are not better than previously measured, an alarm will sound and the nearest doctor will be notified. The system also sends notifications to doctors via wireless and GSM modules, allowing patients to monitor their condition in real time via apps and video. Finally, the monitor is connected to the system to measure current. Figure 9 shows the complete hardware setup.

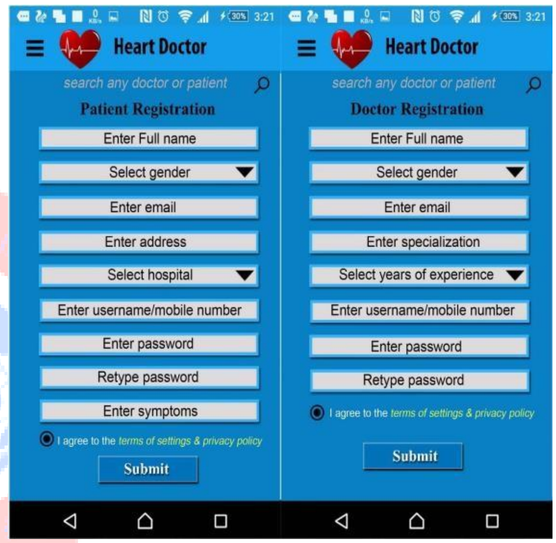

Figure 5.Patient and doctor registration process on the application.

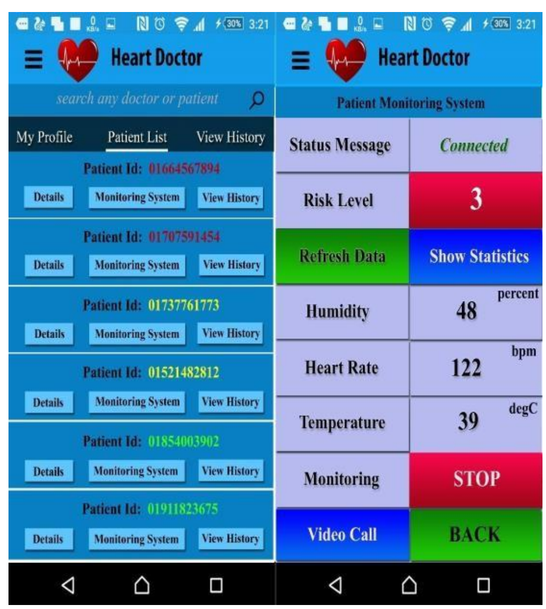

Figure 6.Patient data I/O and operation on result.

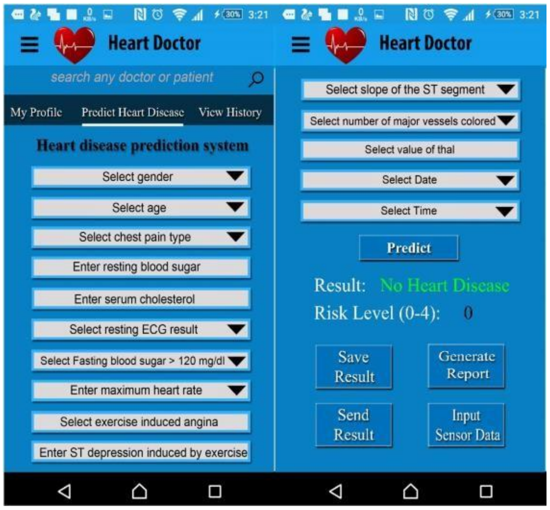

Figure 7.Patient list according to priority and live monitoring API.

Conclusion

The model has an accuracy of over 95% and is very important for biomedical applications in disease diagnosis and prognosis. In addition, various measures were taken into account to determine the best performance of the models considered in this study. In particular, the SVM model outperforms random forest and logistic regression models in terms of sensitivity, specificity, precision, and F value. SVM also has the lowest error rate. The number of features also affects the classification and prediction ability of the model; unpublished results show that the performance decreases as the number of features decreases, but SVM consistently maintains the best performance. The analysis was also performed on the Python platform, where SVM using the radial basis kernel function performed best.therefore, when we consider the 13 features in our st udy, it is clear that the support vector machine 2 is the most effective method used to predict h eart disease, as we found. Previous studies [2]-[14][17][18][19] on the comparison of various machine learning algorithms have found that no algorithm uses the same number and type o 2 f features as used in this study. Additionally, i n this study, two documents with the same nu mber and type of characters were combined. T herefore, the selected model will be more pow erful than those proposed in other studies.

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