An IOT Gait analysis framework for the pattern recognition of heart disease using RFO algorithm

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ABSTRACT Heart disease is characterized by constricted or clogged blood arteries, which may lead to a heart attack, angina pain from decreased blood flow to the heart, or stroke. There is a need to create awareness among people due to the increased rate of heart stroke among children/adolescents and it is necessary to install a system that will allow the patient to monitor the signs of a heart attack at any instant of time. In forecasting the possibility of cardiovascular illnesses, there is a need of monitoring the necessary symptoms such as age, gender, pulse, etc., Artificial intelligence (AI) is the most accurate and efficient algorithm well suited for the prediction system. There are three stages for predicting heart disease. The first stage is the feature selection method to choose the characteristics that contribute the most to predict variables or outcomes. The second step will be processed using the XGBoost Machine learning (ML) technique towards gait analysis. The third stage is interface design where the user will interact with the system. The information entered by a patient will be processed by an ML algorithm that will predetermine the health status of the patient with heart disease.

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Keywords: IoT, Gait analysis, Artificial Intelligence, Machine Learning, Blood pressure, Wireless body area networks, heart rate, Advanced feature reduction, confusion matrix.

I. INTRODUCTION

The terms "heart disease" and "cardiovascular disease" are often used interchangeably. The term "heart disease" is used to describe a variety of diseases that affect the heart blood veins that are constricted or obstructed may cause a heart attack or chest discomfort owing to decreased blood flow. There might be other kinds of cardiac conditions, such as coronary artery disease, Angina (abnormal blood flow to the heart) or even a stroke. The impact of heart muscles, valves, or rhythm in which the heart beats are sometimes believed to be a kind of cardiac illness. Symptoms of heart disease are determined by the kind of heart condition the patient. Men and women may have various types of heart disease. Men are affected more by cardiac disease than women due to chest discomfort, shortness of breath, nausea, and severe tiredness are more likely symptoms of chest pain. If the blood is clotted, the patient may experience discomfort, numbness, weakness, or coldness in their legs or arms. Those regions of the body have constricted vasculature [1]. Other signs and symptoms include neck discomfort, headaches, and dizziness. The mouth, neck, upper belly, back, and many other areas are also affected. Heart disorders are the result of irregular heartbeats, arrhythmias in the heart, heart abnormalities, and weak heart muscles (dilated cardiomyopathy), infections of the heart, and valvular heart disease. Many types of cardiac disease may be avoided

or treated by adopting a healthy lifestyle [2]. The heart disease diagnosis should be performed early to prevent deaths [3-5].

In healthcare, a variety of machine learning techniques may be applied to enhance prediction accuracy. To correctly forecast a patient's incidence of heart disease, this study examines various ensemble techniques (Bagged Tree, Random Forest, and AdaBoost) in combination with the Feature subset selection method- Particle Swarm Optimization (PSO). Experimental findings indicate that Bagged Tree and PSO [7] achieve the greatest accuracy.

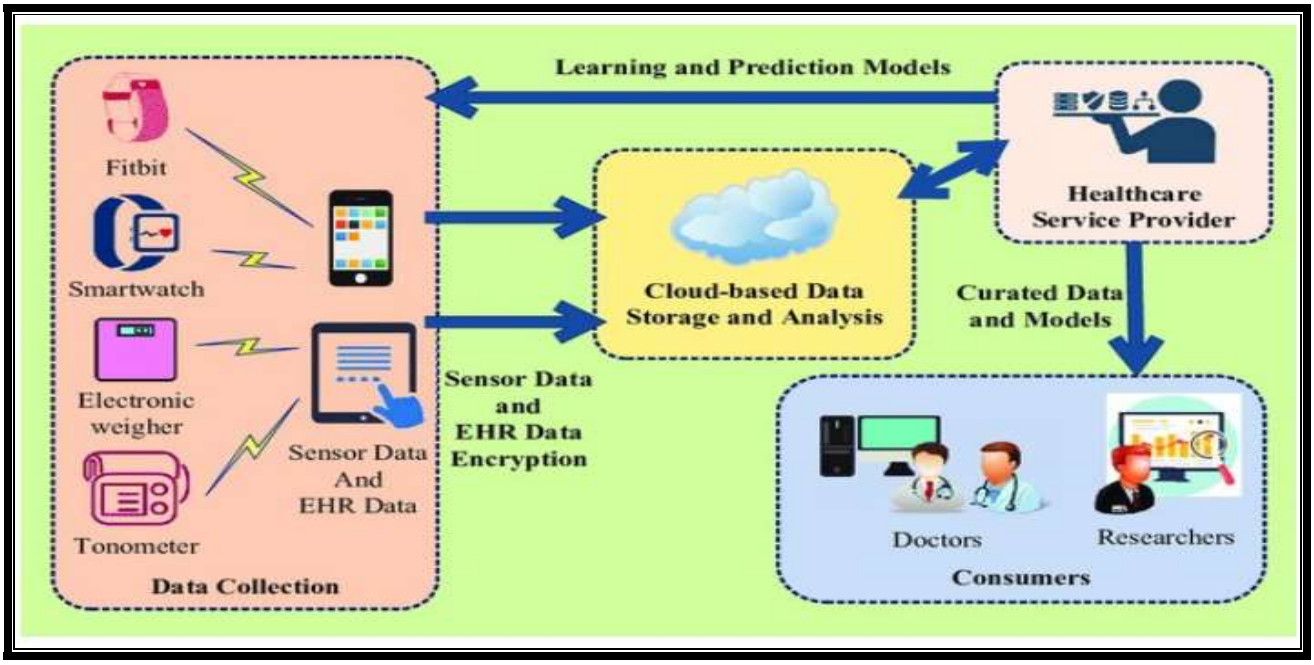

Fig.1. IoT framework for heart disease prediction.

Figure1 gives a description of various sensors required for the collection of features for a patient. Sensors such as SmartWatch, Fitbit, Electronic weigher, and Tonometer record parameters like blood pressure, heart rate, etc., and are recorded in an android app and the values are sent to the cloud through the internet and forwarded to the healthcare service provider. The prediction can be done by Doctors and researchers with the help of the machine learning process.

C.S. Dangare et al., predicted heart disease based on medical terminology including age, blood pressure, cholesterol, obesity, smoking, and 13 other factors. The classification methods of Decision Trees, Naive Bayes, and Neural Networks were implemented. Among them, Neural Networks predict heart disease with the greatest accuracy[10]. Hybrid techniques were created using CFS with Bayes Theorem and CFS with Filter Subset Eval, which offers greater accuracy[11]. A GUI-based interface was used to access medical data and to determine patients' heart disease using a Weighted Association Classifier. Traditional methods such as decision treaties and rule induction have failed when compared to Association Classifiers. The WAC shows more accuracy when compared to other similar classifiers currently in use. As a data mining method, the software then use WAC to build a rule basis. The benchmark data from UCI's training repository was used to install the framework on the Java platform. The model may be extended for the new dataset [12].

The datasets conceal a lot of information. Even useless data may be transformed into valuable data by data mining methods. This article describes a method for identifying cardiovascular illness and demonstrates how Naive Bayes may be used to do it. Within our system, we divide health data into five categories: no, low, medium, high, and extremely high[13].

An Intelligent System utilizing the data mining technique Naive Bayes, a web-based application, gathers data from an existing server, and the clients' trustworthiness is compared to qualifying data. Traditional decision-making systems can't answer complex issues about heart disease diagnosis and treatment. An intelligent system enables health practitioners to make informed patient decisions, reduce healthcare costs by providing effective therapies [14].

Today's healthcare industry includes sensitive data that may influence decision-making. Several machine learning classifiers such as Decision Tree, J48, ID3, Nave Bayes, CART, and Bayesian Networks were employed to predict heart disease. The findings indicate that the outcomes are 99 percent predictable. Data mining aids in the prediction of software collecting patterns in the health sector [15][16].

In this proposed work, the XGboost algorithm has been implemented to predict heart diseases by collecting patients' databases efficiently. Android app has been implemented for collecting the data such as blood pressure, diabetics, hypertension, history of heart failure, and cholesterol level by remote monitoring of health status of patients.

III.METHODOLOGY

XGBoost is indeed a gradient boosting-based selection ensemble Machine Learning method. Artificial neural networks surpass all other algorithms or frameworks in prediction issues involving complex data (pictures, text, etc.). These algorithms are now regarded best-in-class for the limited data structure. The development of tree-based algorithms throughout time may be seen in the graph below [17][18].

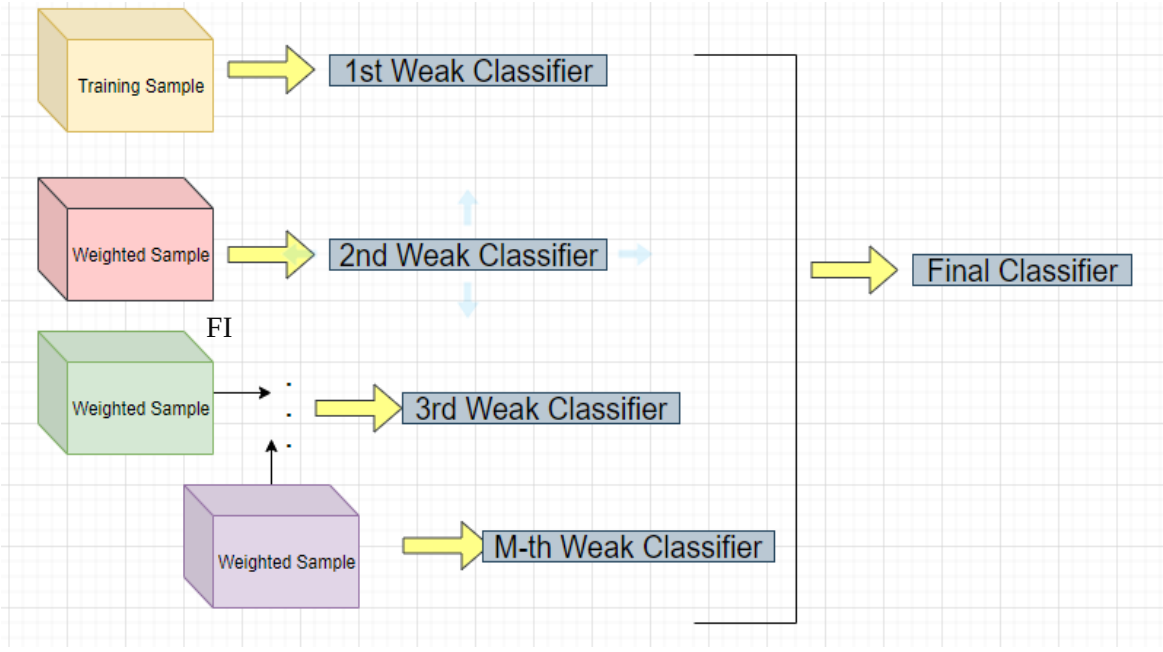

Fig.2.Flow Chart for XGBoost Classifier Algorithm

An objective function in XGBoost regulates the model complexity. This formula contains up of leaf nodes and th e modulus of the square computed for each leaf node's fraction output[16].

1. Operates in the following manner: XGBoost selects a training subset at random at first.
2. It trains the Algorithm of XG Boost by selecting the training set based on the prediction based on previous training.
3. It gives observations of a weak classifier greater weight so that they have a better chance of being classified in the following iteration.
4. It also gives weight to the trained classifier in each iteration based on the classifier's accuracy. The more accurate the classifier, the higher the weight.
5. This procedure iterates until the whole training data fits without errors or until the given maximum the number of estimators is reached.
6. The outputs are combined and the final prediction is obtained.

IoT is used for collecting and analyzing the data set with maximum patients' health information.[17]. The main concept involved in classifying heart disease is a hybrid technique and optimization can be done by using machine learning algorithms [18].

IV RESULTS

The confusion matrix and the report of classification are explained in detail. A confusion matrix is divided into four parts: this one is a true positive (TP), in which the values are recognized as true while also being true in actuality. The second kind is false positive (FP), which occurs when the values detected are erroneous but are reported as true. The third kind is a false negative (FN), which occurs when a correct result is recognized as negative. The final is true negative (TN), in which the value was genuinely recognized as negative.

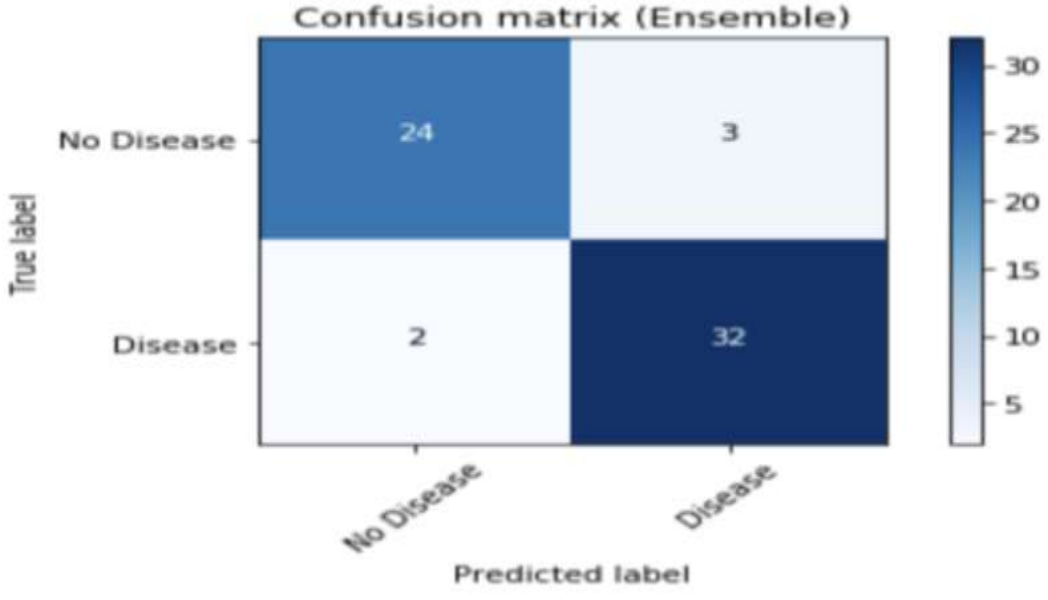

Fig.3. XGBoost Algorithm confusion matrix

As can be seen in the figure above, In total 32 individuals have the 32 showed proper cardiac illness, but 24 people have not having disease ,3 people have mild symptoms and 2 people does not have disease. On the other hand, for a person who has the condition, it has been predicted incorrectly.

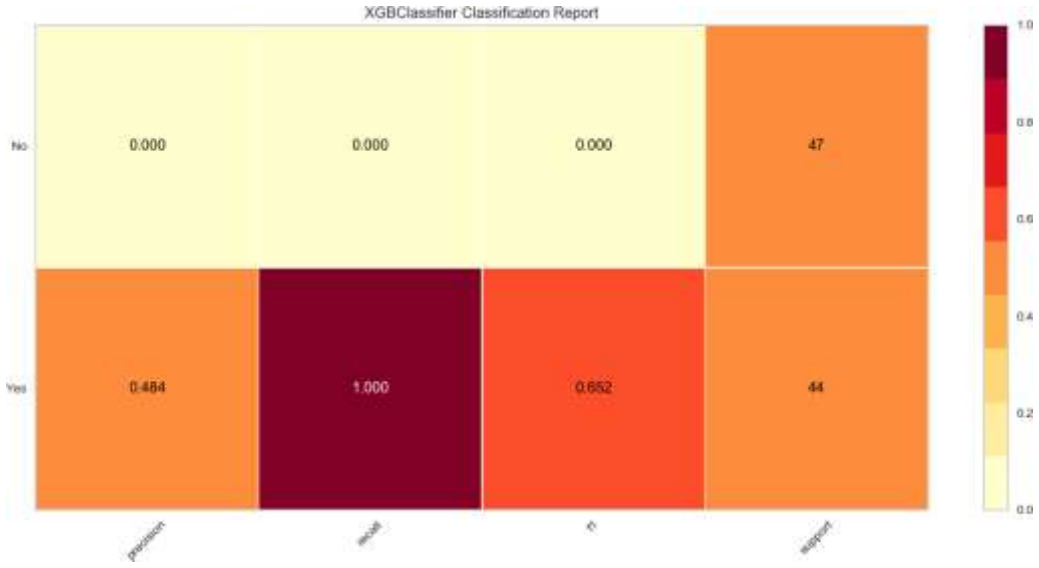

Fig.4 Classification report of the XGBoost algorithm

As seen in the figure above, Hit has projected that 24 individuals do not have cardiovascular disease, which is accurate, but it has been forecast incorrectly for 3 subjects. On the other side, it has predicted correctly for 32 subjects but incorrectly for 2 subjects for the person who has illnesses.

RESULTS

Myocardial infarction, often known as a heart attack, maybe detected using a smartphone application. The software does not need any additional hardware since it makes use of the phone's built-in motion sensors, particularly the gyroscope. As a result, the technology employed is quite similar to the atrial fibrillation detection software. This app used for detecting myocardial infarction should be ready for testing. Cardiovascular illnesses were the leading cause of mortality in 2012, killing over 17.5 million individuals across the globe. Acute myocardial infarction, often known as a heart attack, is one of the most well-known illnesses in this group. It’s critical to recognize a heart attack as soon as the first symptoms emerge so that the patient may get medical help as soon as possible. However, some individuals erroneously believe that chest discomfort is just temporary or that it is caused by a heart attack, which may be deadly. A blockage in the coronary artery, which delivers oxygen-rich blood to the heart, causes myocardial infarction. Because the portion of the heart muscle that is deprived of oxygen may be irreversibly damaged, prompt therapeutic intervention is critical. The proposed diagnostic systems are evaluated based on the accuracy which needs to be improved. [19-20]. The optimum therapy is a fast coronary angioplasty. The research looked at how effectively data from a smartphone's built-in motion sensors might be used to identify a heart attack. The rotational micromovements of the chest were measured by putting the smartphone on the patient's chest for

a few minutes while they were lying down. Each patient had two recordings, one during the heart attack and the other after coronary angioplasty surgery. The researchers then compared the two sets of data. When the phone is put on the patient's chest, the smartphone's sensors, such as the gyroscope, are sensitive enough to detect the rotational micromovements of the chest produced by the heart's movement. These micromovements in the chest are altered when blood supply to the heart muscle is disrupted, and the phone can detect it. A gyroscope is built into every iPhone and many Android phones.

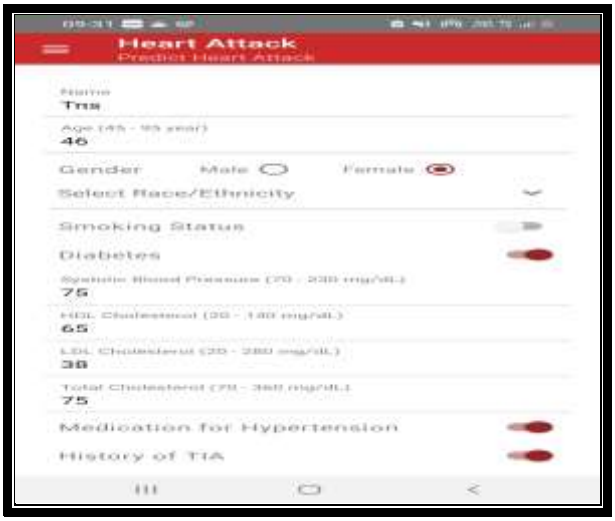

Fig.3. Entering patient details Page

Fig.4.Entering the Features for Heart Disease

Data processing is done automatically and does not need interpretation by a medical professional. “Before the real machine learning analysis, the data is preprocessed, for example, by removing data that has been damaged by excessive motions. The machine learning system we created can then identify whether the

patient is suffering a heart attack right away. The system identified myocardial infarction with a minimum accuracy of more than 70% in the trial. The researchers think that if the app has captured the patient's baseline before the heart attack, and accuracy of above 90% should be achievable. To begin the recording, the phone should be put on the person's chest while they are experiencing severe chest discomfort. It takes approximately two minutes to gather data. The app instantly analyses the data and displays the results. The software is designed to urge people to seek medical attention more quickly.

Fig.5.Displays Risk prediction

Fig.6. Displays complete report

The above figure is showing the risk prediction of the disease and the complete report of the health status is given in detail. "Our aim is not to rule out heart attacks but to alert the patient when a true emergency exists by using the app's intended function. This is worth a solution like this that might reduce the bar for seeking medical help in the event of acute myocardial infarction. Assessing the signs of a heart attack may be challenging at times, and the extra confirmation provided by the app could be very helpful.

CONCLUSION

Machine learning techniques, such as healthcare recognition, were the focus of our research. There are a variety of ensembles, including bagging, to enhance accuracy in the prediction of cardiac disease, mathematical data sets are boosted or stacked. The accuracy results were extremely useful for testing data sets and putting up strategies. Stacking ensemble testing yields more efficient results. We predicted if the patient is prone to heart disease in this research. The suggested system was implemented in two stages: dataset pre-processing and data

analysis. Machine learning algorithms are being used to forecast illnesses. The system's first phase was the data is being pre-processed. The data was put through a feature selection procedure to ensure that the characteristics of the data were taken into account. The information was then passed on to the algorithms. The AdaBoost classification was the first algorithm, and it provided excellent accuracy. The testing set had been in the 85-90 percent range. The XGBoost algorithm was the second algorithm to be implemented. This resulted in a 50-60% accuracy. The cause for this was because the dataset provided to XG-Boost training data was limited, this algorithm needs more data to make accurate predictions. The stacking classifier has been the third and last algorithm used in these two models. XGB Classifier and Random Forest Classifier, for example, have an accuracy of 85-90 percent. After the algorithms have been refined the user then inputs 13 medical information, followed by the application determining whether or not a person has heart disease. As a result, the more precise the data, the better algorithms there are, the better it will be to forecast heart disease. In addition, there are additional future algorithms that can be more accurate than the three algorithms mentioned above. The results of the various system configurations indicate that the suggested model is correct. The suggested model is an artificial intelligence approach for cardiovascular prediction that is especially successful in terms of Clinically relevant assessment activities include sensitivity and specificity. To sum up, By integrating initial test characteristics, this study shows the advantage for clinic decision-makers via various grading algorithms, with anticipated grade labels of specimens

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