ISSN : 2347 - 2243

Indo - American Journal of Life Sciences and Biotechnology

www.iajlb.com
Email : editor@iajlb.com or iajlb.editor@gamil.com

ISSN 2347-2243 www.iajlb.com
Indo-Am. J. of LifeSc & Bt.,2023- Vol.20, Issue.2, june 2023

Indo-American Journal of Life Sciences and Biotechnology

A Novel Method for Detecting Kidney Diseases using RF Classifier

C. Madhu[#1], E. Anant Shankar[*2]

Article Info

Received: 29-01-2023 Revised: 20 -02-2023 Accepted: 12-03-2023

Abstract
The kidney illness may be diagnosed by analysing ECG data using machine learning techniques. A random forest classifier was used to determine the outcome. Data from the aforementioned online database was used to validate the model, and it was found that the model was able to accurately categorise the majority of cases. Patients with Chronic Kidney Disease (CKD), or chronic renal failure, have a condition where the kidneys begin to fail. As the name suggests, Unexpected Cardiac Death (SCD) is defined as the sudden death of a healthy individual owing to a cardiac impact. The ECG of each CKD patient displays substantial alterations that may be linked back to CKD, according to several key studies. This section summarises the dynamic alterations that may be noticed in the ECG of CKD patients.

Keywords: Nephrotic syndrome, chronic kidney disease (CKD), nephrotic syndrome, end stage renal disease (ESRD), acute kidney damage

INTRODUCTION

In the early stages of a kidney disease, there are usually no symptoms at all. You can discover how frequently your kidneys work via practise. When the kidneys are unable to function properly, they are diagnosed as having renal disease. The term "kidney disease" does not refer to any particular sort of condition. Some other factors may lead to renal failure and/or illness, and depending on how they alter the symptoms connected with kidneys [1, 3, 4]. GFR (glomerular filtration rate) is a blood test that measures how effectively your kidneys filter your blood. a person's normal GFR varies with age (could decrease as you get older). The GFR score is at least 90 or above. Insufficient renal function is indicated by a GFR below 60. GFR levels below 15 indicate an increased likelihood of renal failure and, thus, thenecessity for dialysis or a transplant. Creatinine is a byproduct of the breakdown of human tissue and is excreted in the urine. A creatinine level over 1.2 for women and above 1.4 for males may indicate that the kidneys aren't working as well as they should.

BUNs often fall in the 7–20 range. There is an increase in BUN (Blood Urea Nitrogen) when kidney growth slows. Your blood contains albumin, a kind of protein. Albumin cannot be excreted in the urine by a healthy kidney. An ultrasound picture of a kidney is created using electromagnetic radiation. Kidney abnormalities or blockages like stones or tumours may be detected with this test. The kidneys are identified using X-rays in a CT scan imaging procedure. Structural and ineffective phenomena may also be sought for using this method. Patients with renal problems may need to utilise a comparative injectable dye during this treatment. Every year, regardless of whether or not you have the disease, you should be checked for glucose levels.

When a person's kidneys suddenly cease functioning, this is referred to as acute kidney failure (AKI) for a short period of time. Acute renal insufficiency (AKI) is another name for AKI (ARF). Because of the danger, it must be treated as soon as possible. Like kidney failure, which occurs as a result of the body's natural ageing process, AKI is almost always treatable if caught and treated soon. If your kidneys failed abruptly and you were assessed for AKI immediately away, when your AKI is treated your kidneys that operate properly or nearly normally. AKI may permanently damage the kidneys in many patients. Patients with chronic renal disease are at risk of kidney failure if they do not take preventative measures. As a result of a sudden loss of kidney function, chronic kidney disease (CKD) or renal failure (ARF) is a chronic condition. Your kidneys' primary characteristic is the elimination of this material. Fluids in the body will increase dangerously if kidneys lose their ability to filter them. When electrolytes and waste products build up, they might pose a hazard to life.

Assistant Professor[1,2],
Sri Venkateswara College of Engineering, Tirupati
[1]cherukulamadhu@gmail.com
[2]Anant.shankar16@gmail.com

Assistant Professor[1,2],
Sri Venkateswara College of Engineering, Tirupati
[1]cherukulamadhu@gmail.com
[2]Anant.shankar16@gmail.com

Increased cardiovascular risk factors have been linked to chronic kidney disease (CKD) in many studies. Chronic kidney disease (CKD) patients often have ECG abnormalities. ECG anomalies in individuals with chronic kidney disease (CKD) vary widely in the literature, and there is a lack of data in the local community. The Cardio Renal Syndrome (CRS) is a condition that may lead to a heart attack or stroke in the last stages of renal disease, according to the latest studies. Heart rate variability (HRV) in dialysis patients, as well as the frequency of the digital ECG, were examined.

lower values may be found Chronic renal illness and cardiovascular problems are linked, thus this model may be used to determine whether a patient's kidney function is reduced in those suffering from cardiovascular issues. An early diagnosis of Chronic Kidney Disease (CKD) may

provide patients a better chance of reversing the disease's progress, or at least delaying it.

Kidney failure, commonly known as end-stage renal disease, is the last stage of chronic kidney disease (ESRD). Most patients with end-stage renal disease (ESRD) are diabetic. The second most common cause of end-stage renal disease (ESRD) is hypertension. It is not uncommon for kidneys to cease working within a few of days or hours (within two days). It is known as acute kidney injury or damage. Focal segmental glomerulosclerosis (FSGS) is the most common cause of adult kidney disease. If you have high blood pressure, a heart infection, or are experiencing kidney failure, talk to your primary care physician about how frequently you should be checked. The more you learn about your kidney condition, the better your treatment options will be.

RELATED WORK

The block diagram for existing method is given below.

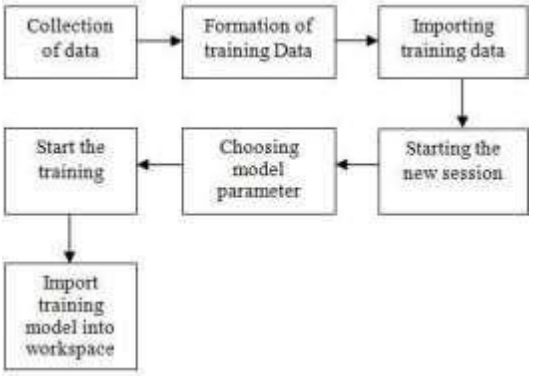

Fig 1: Block diagram of existing method.

To begin building the model, we had to extract the ECG data in its entirety from the database and convert it to digital form. Because the CKD patients in the PTB database were all senior individuals, we used digitised ECGs from two databases - the PTB database of ECGs from kidney patients and the Fantasia database of ECGs from healthy elderly people - to reduce the rising influence on CVD. The QT and RR intervals were determined by analysing the ECG data using Berger's technique. A training set with patients previously identified as clean or renal was built using the extracted function from the digitised ECG. Two characteristics serve as predictors in this case, while the label represents what the model is supposed to do with fresh data. Classification Learner, a MATLAB-based tool, was used to train and validate the model. MATLAB 2018a was chosen since earlier versions [5, 6, 7] may not include the aforementioned application.

In the Classification Learner application, the parameters for the model were selected, including a linear Support Vector Machine (SVM), QT interval and RR interval [2], the kernel function, linear, automated, and the cross-Recognition structure. Because the training data set includes pre-labeled data and the ECGs for both groups of patients were previously known, supervised machine learning was employed in this study. SVM was used for classification applications in supervised machine learning because it has performed well in numerous experiments. In order to create a non-biased model, about 700 observations from each group were employed, and the cross validation method was applied with a degree of 50%. As a user-defined function, the model's learned state may be imported into a workspace and utilised in the learning of other datasets. As soon as the trained model was imported into the workspace as a function, it was utilised to classify the fresh data that was provided through it. An additional Excel file was created to test the model's assumptions using unused data from PTB and Fantasia. This file had the features, but no decisions. The model was able to make the right categorical data type selection after passing through the function.

METHODOLOGY

The random forest classification is used to diagnose renal illness, according to the presented approach. Physionet (www.physionet.org) provided the model training data from two open access online datasets, PTB (used for renal patients' digitised ECG) and Fantasia (used for healthy people's digitised ECG). Each minute was recorded in the database.

lengthy patient digitalized ECG signals from which Berger's technique was used to extract the QT and RR intervals. The average age of the patients who had ECGs taken was

between 50 and 70 years old. The suggested strategy for detecting renal disease is shown in the accompanying figure.

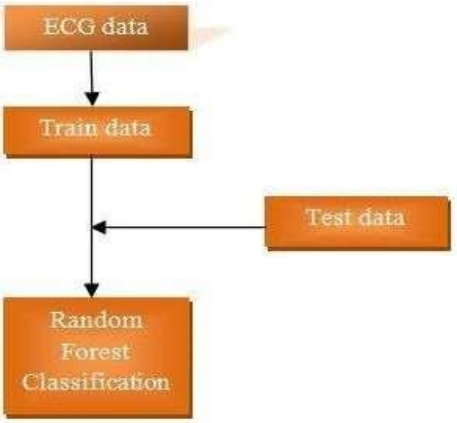

Fig 2: Block diagram of proposed method.

With numerous call trees abusive treatment and a computational modelling approach known as cloth, Random Forest is an integrative machine learning technique that can execute each regression and classification operation. One of the most prominent ensemble strategies for dealing with large variation and significant bias is boosting. Instead of just averaging the tree computation, random subgroups of attributes for splitting nodes are used, which employs two key principles that automatically supply the designation while doing different tree design phases. In other words, instead of concentrating on a single decision tree, spontaneous timberland builds numerous prediction models and uses their projections at the same time to provide a more accurate and thorough estimate. In a random forest, the tree is an example of a representative pick in the preparation stage.

Each measurement is utilised several times in a single tree as a result of a process known as bootstrapping. If you learn each tree separately and then combine them, you will be able to lessen the complexity of the whole forest, but not at the expense that there will be a wider bias in the data. If bootstrap = True, the bootstrap samples are constructed by substitution. The datasets used by each tree are the same if bootstrap = False.

As a result of using random forest classification, the renal illness may be detected more accurately.

1) Method: First, we get the ECG readings from the provided database.

For example, the QT interval and the RR interval are extracted from this ECG data.

To train, we utilise the data from these two periods, known as "train data."

Random forest is a machine learning method.

As a classifier, Random Forest is used. It categorises the data from the trains and the tests.

Finally, it provides accurate information about renal illness.

I. RESULTS AND DISCUSSION

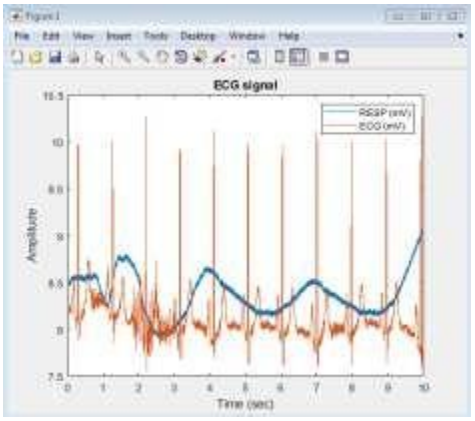

Fig 3: Input signal

Figure 3 depicts the input ECG signal graphically. From the dataset, these ECG signals are gathered and saved as ".mat" files. In this graph, the amplitude and time are displayed in seconds, and the different kinds of millivolts per Volt like RESP and ECG are

highlighted in the form of colourful legends on the graph.

Fig 4: Confusion matrix

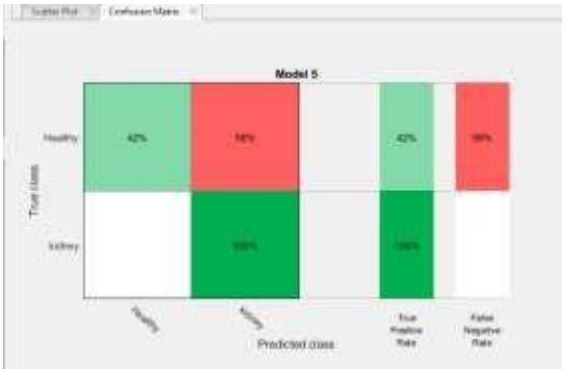

Fig 5: Confusion matrix indicating true positives

In the context of classification, a confusion matrix describes the results of a prediction. Count values are used to represent the number of correct and incorrect predictions, which are then split down by class. This is the primary source of perplexity in the matrix. The model of classification's confusion matrix reveals how confused it is as it observes. This offers us a better understanding of the sorts of errors produced by a classifier, as well as the number of errors made.

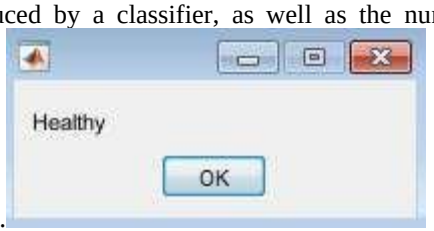

Fig 6: Dialog box indicating the output

Using ECG data, the Random forest classification algorithm is given characteristics such as QT and RR intervals as input. As a test, these inputs are compared to the training data and the classifier returns a categorised result as "Healthy/Kidney" from the comparison.

TABLE 1 COMPARISON RESULTS

Parameters	Existing method	Proposed method
Accuracy	67%	84%
F- measure	72%	82.3%
Specificity	77%	83.67%

When constructing a classification problem model, it is nearly always preferable to consider the model's accuracy in terms of the total number of accurate predictions. Our model performs better when it is more accurate. Nearly 67 percent of the pre-existing works are accurate, whereas our suggested model is 84 percent accurate.

It is defined as the weighted harmonic mean of the precision and recall of a test and is known as the F1 score or F score.

The higher the F-measure, the better the model. Using the pre-existing model, the F-measure is 72 percent, whereas using the new model, it is 82 percent (F).

To illustrate or assess the accuracy of a test for accurately ruling out the existence of some ailment or disease state, specificity is often utilised It's critical to know how accurate a test is in classifying samples when a false positive might cost a lot of money. The more specialised a model is, the better it performs in terms of accuracy and F-measure. The pre-existing model provides 77% of the F-measure, whereas the new model provides 84%.

CONCLUSION

The suggested system was shown to be able to diagnose renal disease utilising ECG signal data and machine learning. Random forests are a useful tool for this. There is no misunderstanding here. This is a simple way to detect renal illness, and the findings are better.

REFERENCES

[1] National Institute of Health. "National Institute of Diabetes and Digestive & Kidney Disease." [1] Report on the Year's Data.

[2] [2] "An Algorithm for QT Dispersion Analysis: Validation and Application in Chronic Kidney Disease," M. Corzo-Cuesta and C. Alvarado-Serrano, 2016.

[3] The National Kidney Foundation, 2018.

[4] Patients with chronic kidney disease are at increased risk of sudden cardiac death, which can be prevented by a number of different methods [4]. In a recent study, B. Franczyk-Skóra and colleagues found this to be the case in patients with chronic kidney disease who also had other risk factors for sudden cardiac death.

[5] According to World Life Expectancy 2018, "Kidney Disease in Bangladesh" [Online]. At http://www.WorldlifeexpectancyCom/bangladeshkidney-sickness. [Accessed: 8-Apr-2018].].

[6] "Unexpected Cardiac Death (Sudden Cardiac Arrest) health/illnesses/17522

[7] sudden-cardiac-arrest.

[8] D. Zachariah, P. Kalra, and P. Roberts, "Sudden cardiac death in give up stage renal ailment: unlocking the mystery," Journal of Nephrology, vol. 28, no. 2, pp. 133-141, 2014.