Arrhythmia Bot: Arrhythmia Disease Prediction using Internet of Things with Machine Learning Approaches and Telegram Bot

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Abstract--**Cardiac demise as of arrhythmia remains a prime cause of mortality in the world. Arrhythmia patient monitoring is a vital technique that gives customers all vital statistics regarding every day maneuver of a cardiovascular affected person. Arrhythmia is an irregular heartbeat; the troubles arises at the same time as the electric waves that harmonize the coronary heart's beats. The faulty signaling reasons for coronary heart to normal or abnormal beating. In this paper ECG assesses heartbeat rate, 5-50 Hz bandpass filter used for filtering, Stationary wavelet transform used for artifact removing. Age, Cp, Trestbps, Chol, Fbs, Rest ECG, Thlach, Exang, Old Peak, Slope, Thal, Sex, Target are the features extraction by Independent component analysis technique. Finally, support vector machines have been categorized the dataset as healthy or arrhythmia patient with 85% and above accuracy. The proposed system is design for arrhythmia disease prediction and send the result by Telegram Bot. The classification result sends to the user's emergency numbers using Bot. The main objective of our proposed system is to monitoring lonely or paralyzed peoples in their home. The proposed work can have a notable impact on paralyzed persons, old age home, health care and as well as society.**

Index Terms--Machine Learning; Internet of Things; Arrhythmia; Bot; Electrocardiography; Support Vector Machine

I. INTRODUCTION

Oneof the severe illnesses in today's world include arrhythmia, symptoms of which include non-uniform heart beating which can cause sudden fatality if not treated on time. Due to these reasons patients with arrhythmia essentially need continual [1]. Worldwide 12% of the total fatality is reported to be caused by cardiac arrhythmia [2]. Stress can increase risk for heart disease [3-5]. Early diagnosis of arrhythmia can lessen the life risk. Proper treatment of cardiac arrhythmia requires smart medical management that will provide suitable health facilities in this field. In ICU up to 86% of the false alerts tend to decline the standard of health care provided for which both the patients and medics are affected through retarding the time of response in time of emergencies [6].Using IoT we can now solve the issues faced by arrhythmic patients since it has the potential to untangle the medical field by non-invasive and automatic surveillance. For predicting cardiovascular disease, IoT network recovers and processes the signals from ECG, and alerts the medics in situations of exigency via IoT connected ECG measuring structure which enables timely detection of any abnormalities. On uniform heart beats arise when electrical signals responsible for synchronizing heart's rhythm fail, this results in either fast heart rate(tachycardia) or slow heart rate(bradycardia) leading to irregular heart rhythm.

In this paper we will propose an algorithm to assist patients during home and additionally assist healthcare for arrhythmia patients. The proposed system is easy to handle, overall project cost is economical so the system will be helpful for any age of people who are suffering from arrhythmia disease.

The rest of the paper are as follows: section II for literature survey, section III for proposed work, IV for result and V for conclusion and future work.

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II. Literature Survey

The previous published paper [7], has depicted the classification of rate of heartbeat during watching movies or sharing movie ratings in telegram bot. While watching a movie, at any point a person can experience a sudden increase in heartbeat which can adversely harm that person's health andcan even result in cardiac arrest. The ECG apprehends heartsignals caused due to electrical fields and are caught by sensors. The mentioned paper upholds the condition of heartbeat while watching the movie which was classified under Backpropagation Neural Network. Ac- cording to theobservations and analysis of the data collected and ratings of individuals who already have seen the movie, a discretionmessage will be sent via telegram about the type of the movie. Based on that a person can decide whether to watch that particular movie as per their health status. This system will be beneficial for individuals with weak heart, teens and parental guidance.

In the current paper, the ECG monitoring is done on elderly people and the alert is sent to their family members, nearest hospital and emergency services available using Telegram Bot.

In our previous published paper [8], will be discussed IoT and ML based smart system for cardiovascular disease. IoT is a popular intelligent system that manifests the non-hazardous technique of machine learning and speculates results. In the previous paper, we focused on speculating cardiovascular disease output with the help of IoT along with machine learning strategies for safety in block-chain platforms. The electrical signals were collected from the human heart by placing the electrodes on the chest – a process called ECG. The dataset collected were pre-processed by using 5-15 Hz band pass filtering and SWT and PCA used for undesired artefact elimination. SVM is used for classifying any individual as healthy or as a patient with compromised cardiovascular condition.

In the current paper, we are focusing on the health care of elderly people and we are using Telegram Bot for sending alert messages which is cost effective as well.

Izci et. al. [9], were discussed on, that Heart diseases are among the primary reasons for sudden fatality. Cardiac arrhythmia if diagnosed early and treated could help pre- vent life risk. To develop an algorithm for predicting arrhythmia based on the principle of EMD. Pre-processing, Empirical Mode Decomposition, feature extraction and classification are the four steps of this algorithm. To differentiate between signals obtained from normal and arrhythmic heart six types of arrhythmia features was used.

In this current paper, the steps of our algorithm are as follows: filtering, artifact removal, feature extraction, classification and sending messages to the user to classify the dataset as arrythmia or healthy person.

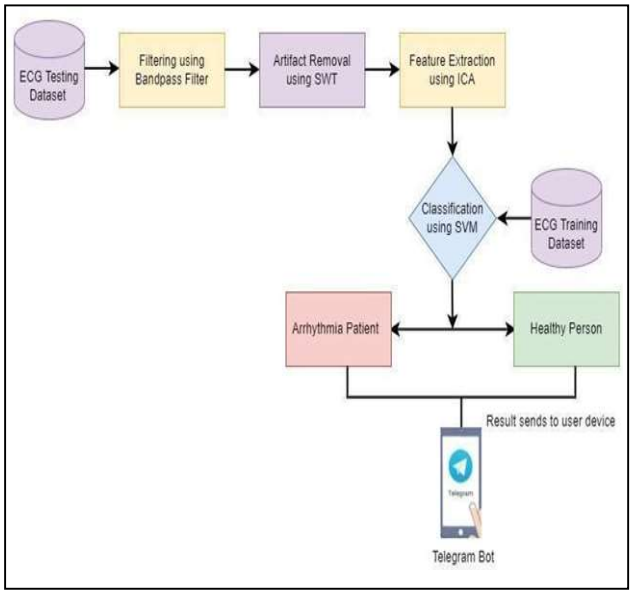

Fig.1. Arrythmia Prediction using AI Tools and Bot

III. Proposed Work

This proposed work dataset collects signal from the heart the use of ECG sensor, and 5-50 Hz range of bandpass filter used for filtering, and SWT method used for artifact removing and ICA used for feature extraction. SVM used for classification result as Arrhythmia if features are matched, if the criterion aren't matched then the end result is proven as healthy. The result is sent to the user's mobile by using Telegram Bot. The proposed work is shown in Fig.1.

A. Arrythmia-Bot Algorithm

In this section we will design proposed algorithm name as

Arrythmia-Bot Algorithm

Start:

//Variable declaration: Age= A, Sex=S, Cp=C, Trestbps=Tb, Chol=Cl, Fbs=F, Rest_ECG=R, Thalach=Tl, Exang =E, Old Peak=Op, Slope=Sl.

1. Training and Testing dataset collected by electro-cardiography sensor.
2. Filtering and artifact removal are two techniques of pre-processing

a. 5-50 Hz range of bandpass filter used for filtering
b. SWT method used for artifact removing: $S(k) = f(k) + e(k)$

3. Features are as follows: Age, Sex, Cp, Trestbps, Chol, Fbs, Rest ECG, Thalach, Exang, Old peak, Slope, Thal, Target. Which is extracted by ICA

IF(A>= 18) THEN "Allow for Test"
// Age as feature 1
IF (S==0) THEN "Female"
//Sex as feature 2
ELSE IF (S==1) THEN "Male"
IF (C==1) THEN angina disease"
// Cp as feature 3
ELSE IF (C==2) THEN "atypical angina"
ELSE IF (C==3) THEN "non-angina pain"
ELSE
"asymptomatic type of heart disease"
IF (Tb>=94 && Tb<=100) THEN "Normal"
//Trestbps as feature3
ELSE
"Abnormal"
IF (Cl>=126 && Chol<=564) THEN
"Normal"
//Chol as feature 4
ELSE
"Abnormal"
IF (F>=120) THEN "Arrhythmia"
//Fbs as feature 5
ELSE
"Not"
IF (R>1) THEN "Abnormal"
//Rest as feature 6
ELSE
"Normal"
IF(Tl>=71&& Tl<=202)
THEN "Normal"
Else
"Abnormal"
// Thalach as feature 7
IF(E==1) THEN "angina"
ELSE
"Not"
//Exang as feature 8
IF (Op>=0 and Op<=62) THEN "ST depression prompted with the aid of exercise"
// Old Peak as feature 9
IF (Sl==1) THEN "Unsloping"
// Slope as feature 10
ELSE IF (Sl==2) THEN
"Flat"
ELSE (1)
"Down sloping"

4. SVM used to classify the training and testing dataset by following categories H(xi)=
$if w.\ x + b \geq 0$=+1 "$Arrhythmiapatient$" (2)
$if w.\ x + b < 0$ =-1 "$Healthyperson$"(3)

5. Send message using Telegram Bot

6. End

IV. Result

Experimental results of the proposed system will be discussed in this segment.

A. Dataset Collection

The training dataset collected from MIT-BIH Atrial Fibrillation database. According to the dataset, there were recordings of 23 channels of ECG of patients with arrhythmia. The frequency of ECG collected data is 250Hz accompanied by 12-bit resolution which ranges between -10 to +10 millivolts. The sample of arrhythmia disease prediction dataset are shown in TABLE I.

No.	A	S	C	Tb	Cl	F	R	Tl	E	Op	Sl	Target
1	61	1	3	146	230	1	0	153	0	2.2	0	1
2	35	1	2	133	254	0	1	183	0	3.4	0	1
3	40	0	1	133	200	0	0	170	0	1.3	2	1
4	53	1	1	121	233	0	1	175	0	0.9	2	1
5	59	0	0	122	350	0	1	160	1	0.7	2	1

TABLE I
SAMPLE DATASET COLLECTION FOR ARRHYTHMIA PREDICTION

B. Classical Result

In Table II, by calculating F1 score, Recall and Precision we find that SVM is the suit- able machine learning technique for arrhythmia disease prediction. Precision is calculated by equation 4, Recall by equation 5, F1 score by equation 6 and

equation 7 is used to calculate Accuracy of Table 2 and graph shows in Fig.2.

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + Fals\ \ Positve} \quad (4)$$

$$\text{Recall} = \frac{True\ Positive}{True\ Positive + False\ Negative} \quad (5)$$

$$\text{F measure} = 2 * \frac{Precision * Recall}{Precision + Recall} \quad (6)$$

$$\text{Accuracy} = \frac{True\ Positive + True\ Negative}{True\ Positive + True\ Negative + False\ Positive + Fal\ \ Negative} \quad (7)$$

TABLE II
F1 SCORE, RECALL, PRECISION BY USING SUPPORT VECTOR MACHINE

Training Accuracy	Testing Accuracy	F1 Score	Recall	Precision	Time
0.923	0.812	0.88	0.87	0.88	1 Min 2Sec

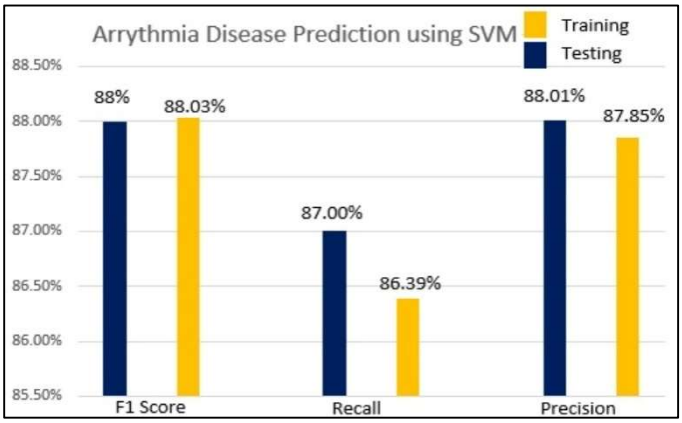

Fig.2 F1 score, Recall, Precision by using Support vector machine

C. Performance Analysis

Performance of the proposed method are analyzed by McNemar's Test as shown in TABLE III.

Others Machine Learning Algorithms for Testing (P)	Proposed Support Vector Machine (SVM) Algorithm(Q)			
	n01	N10	Z	Comment
Back Propagation Neural Network (BPNN)	7	29	11.65	Reject
k-Nearest Neighbor (kNN)	5	28	14.78	Reject
Linear Discriminant Analysis (LDA)	6	20	11.22	Reject
Quadratic Discriminant Analysis (QDA)	6	23	12.08	Reject

The performance analysis for the proposed work is compared with different types of machine learning techniques by using MCNemar's numerical test. In this paper SVM is the control algorithm let P, another competitor algorithm as BPNN, kNN, QDA and LDA is Q. The null speculation right at this point visualizeseach procedure
will distribute the identical mistakes frequency. Here the null hypothesis was neglected, when Z is going above 2.87, that's the necessary cost for $\chi 2$ distribution for 1 degrees of freedom of possibility is 0.04. Table 3 clears that the significant variation in overall result is discovered by using McNemar's test despite the fact of comparing the currently proposed SVM system with all other 4 class methods.

D. Complexity Analysis

Training time complexity of proposed work using support vector machine is O(n2), here n is the number of input and if n is very large amount of data then it will complex. Run time complexity of proposed system is O(k*d), here k is the number of support vector and d used for dimensionality of the data.

E. Arrythmia Prediction using Bot

After all steps like filtering, artifact removal, feature extraction and classification, the next step is sending results to the user's device using Telegram Bot as shown in Fig.3.

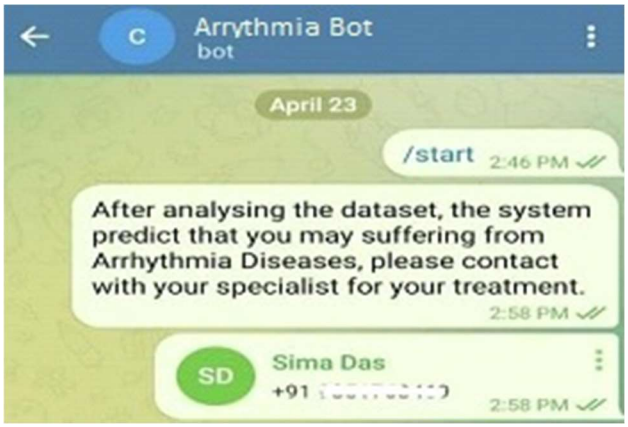

Fig.3 Screenshot of Telegram Bot

V. Conclusion and Future work

Conclusion and future work will be discussed in this section. The current proposed model is an end to end model, data collected from a wearable ECG device, pre-processing is done by two steps: filtering in the range between 5-50 Hz band, artifact removal using SWT, feature extraction and selection using Independent component analysis. Support vector machine used to classify databases as arrhythmia patients and healthy people. After classification results are sent to the end user by using Telegram Bot. The proposed system accomplishes the performance of arrhythmia detection using ECG signals and machine learning techniques.

In the future we will apply different machine learning and deep learning techniques for different types of disease prediction.

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VII. Biographies

Sima Das was born in Durgapur, West Bengal, India. Sheis M.Tech in Computer Science and Engineering on August, 2020 from Maulana Abul Kalam Azad University of Technology (Main Campus), West Bengal, India.

Her employment experience included theshe is former Assistant Professor of Camellia Institute of Technology and Management, Hooghly, West Bengal India and Currently working as an Assistant Professor of Bengal College of Engineering and Technology, Durgapur, West Bengal, India. Her special fields of interest included Artificial Intelligence, Machine Learning, Deep Learning, Internet of Things, Cyber Security, Smart Healthcare.

Sima Dashas awarded the Research Excellence Award from Global Innovation & Excellence Award 2021. She is Associate Member of Institute of Engineers and Professional Member of IEEE. She has many books, book chapters, conferences and journals. She is also an editor and reviewer of different international journals.

SayantanMalick was born in Singur, West Bengal, India. He is completed her M. Tech in Computer Science and Engineering on August, 2014 from Maulana Abul Kalam Azad University of Technology, West Bengal, India.

His employment includes that he is Assistant Professor of Camellia Institute of Technology and Management, Hooghly, West Bengal India and former employee as a Lecturer of Bidyanidhi Institute of Technology and Management, Malda, West Bengal, India. His special fields of interest included Web Development, Artificial Intelligence, Machine Learning, Internet of Things, Robotics, and Image Processing.

SayantanMalick has attended many tech fests as participant. He helped students of the institution to build many robotics projects that are commercially successful. He has vast experience on the projects of real time data processing and imageprocessing.

Souvick Majumder was born in Purba Burdwan, west bengal , India . He is studying B.tech now from Camellia Institute of Technology and Management .He is a final year student of B.tech in Computer Science and Engineering . He is very interested in technology.He has habituated some computer languages like C ,C++, JAVA , python , Java script etc. He also likes to learn new technical things, for that He has recently started studying Artificial Intelligence, Machine Learning, Cyber security etc.

He also has some knowledge about web development and web designing is his one of favorite things,some smaller websites, clones of some famous websites belong to his project works. And his life goal is to become a full-stack developer.

Devdip Mallick is studying B.tech now from Camellia Institute of Technology and Management .He is a final year student of B.tech in Computer Science and Engineering .He has habituated some computer languages like C ,C++, JAVA , python , Java script etc.