IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

CARDIAC ARRHYTHMIA MONITORING SYSTEM THROUGH OPTIMIZED REGRESSIONS

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Abstract : Cardiac diseases are one of the disorders occurring in the heart and blood vessels due to various reasons. The coronary hard diseases directly impact the blood vessels and restrict blood pumping frequency that follows the blood vessel pumping towards the brain also. Frequent occurrences of cardiac health diseases directly impact the regular activities of the brain and muscles to interrupt the regular functionality. The proposed system considers the critical factor called blood vessel detection and coronary heart disease detection using blood clots present in the veins. The proposed system considers the heart disease data set collected from MIT BIH physionet website where the data consists of various heart diseases such as ventricular cardiac arrhythmia even more. In which the cardiac abnormal condition is detected based on the symptoms (SACHA). An optimized multi nominal regression (OMNLR) is implemented to detect the free contacts of normality in the heart data set. From the optimized multinomial Logistic regression and compared with various data for approaches.

INDEX TERMS - HEALTH CARE, INTERNET OF THINGS, HEALTH CARE MONITORING, PULMONARY DISEASES, MACHINE LEARNING.

I. INTRODUCTION

Cardiovascular diseases are severe disorders in the heart and blood vessels that create common abnormalities in the heart. Coronary health disease creates difficulty supplying blood, muscle pain, and obstruction in blood vessels to arms and legs. The initial condition of coronary health disease is reflected in pain generated by the heart muscles, rhythmic fever, and bacterial infection. Few peoples have heart disease from birth itself. Blood vessels need to be updated with the supply of enormous blood to pump the heart. The coronary health care system screens the abnormality of various heart issues and handles the malfunctions of nature by fixing the initial conditions. Variations in blood vessels, blood clots, and leg pain enable the complete process to get stuck up. Heart attacks and strokes are generally related to each other and are mainly employed because of the blockage present in the blood vessels. Blood flow to the heart and brain is essential to activate the organs for proper operation. Heart Attacks and strokes eventually happen to any coronary patient, and continuous monitoring is required. Various physical activities on harmful utilization of alcohol, hypertension, chronic Diabetics, and hypertension are reasons for heart attack and complicated coronary diseases. The fatty food that deposits over the walls of the blood vessels is also one reason for heart attacks.

The major problem behind heart disease and continuous stroke or due to an unhealthy diet. Physical activity and harmful utilization of alcohol. Risk factors behind the heart disease includes drugs act as the reason for coronary heart diseases. The effects of behavioral risk and various factors on the human body include blood pressure, blood glucose, and raised blood lipids over, weight, and obesity. The intermediate risk evaluation is measured during the development of coronary heart stroke and heart attack, and other complications are raised in the initial stage using a continuous monitoring system. Regular usage of tobacco, reduction of salt in the typical diet utilizing fruits and vegetables as a normal food intake, continuous physical activity need to be taken to avoid the chronic impact.

Drugs help control coronary heart disease and risk. The prevention of heart attack and stroke due to an abnormal flow of blood vessels must be detected in the initial stage. The various symptoms purses on heart attack detection are symptoms of rhythmic heart disease, shortness of breathing, irregular heartbeats that are evaluated with pain in the chest and, correct legs, and Shoulder. Symptoms of rhythmic fever include pain, swelling of legs and joints, nausea, stomach pain, and vomiting commonly occurring symptoms. People with low and medal income Primary Health Care programs for early detection of heart diseases and detection of early stages can save human life.

- The proposed system, heart disease detection using a machine learning algorithm, is implemented. An optimized methodology usingmulti-nominal Logistic regression as implemented in which the input data are collected from the MIT-BIH Standard benchmark website.
- The ECG data's abnormality is kindly monitored using the cardiac attack dataset. For the system, consider the Data Analytics technique to make available the presence of abnormality in the heart using the ECG data.

- In the initial stages, that training data is divided into 80% for training and 20% for testing data. The model is created using optimized multi-nominal Logistic regression. The symptoms multi-nominal regression algorithm combines the various historical parameters of the patient towards the detection of heart disease, and further, the classification accuracy is measured.

The remainder of the paper is built around a comprehensive literature review in section II. In section III, design perspectives are discussed following system tool selection. The adopted design methodology is described in Section IV, followed by detailed results and discussions. The journal has come to an end, with room for improvement.

II. ABBREVIATIONS & ACRONYMS

- **SACHA –** Symptoms aware cardiac health analysis
- **OMNLR -** Optimized multi nominal regression
- **MIT-BIH -** Massachusetts institute of technology and Beth Israel hospital
- **ECG -**Electrocardiogram
- **EDA -**Exploratory data analysis

III. BACKGROUND STUDY

D. Lo Presti et al. (2019) the author presented an emission learning algorithm-enabled heart abnormal detection system using wearable sensors. The physiological signals are collected from the human body through various sensors, such as heart rate sensor, BP sensor pulse oximeter sensor. The sensor is used to collect raw data from the human body. An optimized hysteresis response is created to analyze the abnormality in the given dataset. The exponential growth of variations in the data set and that related to cardiac arrest and chest pain are implemented here.

A. Elola et al. (2021) the author presented the out-of-hospital dataset, where the cardiac arrest analysis system by discriminating similar patterns of cardiac arrest patients as training data. Around the forest, the algorithm is created to determine the presence of cardiac abnormality with a five-fold cross-validation process. The presented model achieves the performance Matrix score of 76.2%, with the maximum score detected as sensitivity. The presented system needs to be improved by increasing the number of data sets towards a cardiac arrest. Moreover, other diseases related to cardiac are formulated here.

S. Saadatnejad et al. (2020) the author presented a novel ECG-based classification model using extended short-term memory-based neural network architecture. A neural network is used to analyze robust data collected in real time. The presented system accesses the lightweight architecture in which the proposed algorithm extracts the patients' real-time ECG data. The classification of devices and their data are implemented here to analyze the abnormality and its time to detect it using a machine learning algorithm. Further, the presented system needs to be improvised by combining more data collected from real-time.

B. Yao et al. (2022). The author presented a deep cardiac monitoring system using ECG data collected from various Optimization principles and reduced by 34% in real-time cases. The error estimation is implemented here, where the ECG signals are sensed and optimized with energy and background noise constraints. Most of the most detailed data are noisy. This data need to be filtered before making any evolution. The presented system considers a mobile cardiac Sensing System that collects the raw data from the patient and analyses the presence of abnormality in the ECG signal using a signal analysis framework.

H. Chung et al. (2019). The author presented a real-time rehabilitation for the cardiac system with the exercise of patient Healthcare monitoring proposed variable devices using a smartphone application. The presented system considered physiological data collected from the wearable sensors and make an efficient database model to compare the presence of the Healthcare system and have the medical station access for the emergency Care Unit.

T. Feng et al. (2019). The author presented CT and PET image-enabled myocardium tracking hardware systems using external sensors. The data-driven approach using the Data Analytics model required additional hardware and procedures for accurately detecting cardiac abnormality. Sensors help make the analysis. On the other hand, the machine learning algorithm presented here helps make classification easier.

Compared to external device-based approaches, a data-driven gating technique in PET imaging is advantageous as it does not require additional hardware procedures. The simulation study suggests that two major limiting factors in the performance of our method are the myocardium/body uptake ratio and the count rate of the whole field of view.

IV. SYSTEM DESIGN

The presented system is implemented using Python programming language, where a variety of inbuilt libraries are helpful to analyse the data collector from the patient using Data Analytics and data science tools. Python is a programming language with a robust infrastructure and analysis platform where data analysis of ECG data is thoroughly validated. Data cleaning and reprocessing are the initial stages of programming where the data need to be formalized into training data on testing data and accessible with frames of data. Data analysis using Python libraries, such as NumPy and sci-kit learn, are commonly utilized EDA libraries for machine learning analysis.

The presented system considers Google Collab Window for analyzing input data on the training data. Machine learning algorithms are called back from the sci-kit learn library along with decision tree algorithm, random forest algorithm, and support the term is used to train the heart disease data set. The visualization visualizations of the input data are covered using matrix laboratory, and hence the data analysis takes insight are kindy implemented for the heart disease prediction system. The proposed system considers an optimized multinomial Logistic regression algorithm created with the statistical data collector from the MIT-BIH data set. The detailed architecture and working model of the proposed system discuss in Section IV.

V. METHODOLOGY

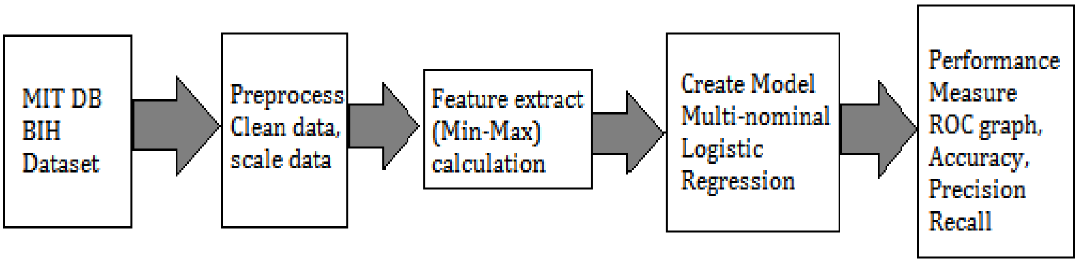

Fig 1. The system architecture of the proposed model

Fig 1. Shows the system architecture of the proposed model. Symptoms aware cardiac health analysis (SACHA) using optimized multinomial logistic regression (OMNLR).

Patient monitoring systems help monitor the remote access data of patience at every instant of time. It is required to provide a high level of care to the patients after high-risk post-surgical conditions that replace various physiological issues and changes. Monitoring systems are highly occupied with recent technologies helpful to make the automated computing and assessment of abnormal conditions. The development of artificial intelligence technology in medical equipment place and its significant role in detecting the normal condition of patience after surgery are regular care to be provided by wearables.

Implementation Summary

The data analysis methodology is adopted here to identify critical patterns of cardiac abnormality. The design is initiated with thereprocessing step.

The input dataset is completely read into the design analysis window and further scales the dimensionality. Since the data is unstructured, thepreprocessing step reduces the unwanted data.

The data is visualized, and features are extracted by evaluating the minimum and maximum value of the input pattern.

Data analysis using MIT BIH Dataset

The raw dataset is collected from Pysionet.org. The data is preprocessed to remove noise and unwanted values, junk values and visualize the plots.

Feature extraction

The transformed data provides the frequency constant and the peak vector values. Normalize the values to the nearest round-off filtering method. Visualize the graphs. Model the data into training data and testing data. Classify the training data and testing data to find the maximum match. Classify the cardiac abnormalities such as ventricular arrhythmia, cardiac arrhythmia, Heart attack, and Normal. Measure the performance by evaluating the Confusion matrix, calculating the accuracy using the formula below and visualize the results.

The performance analysis for each class of event is estimated by computing the parameters such as true positive (T_P), true negative (T_N), false positive (F_P) and false negative (F_N) parameters, where (T_P) and (T_N) represent the correct classification of the normal and abnormal ECG signals.

$$S_e = \frac{T_P}{T_P + F_N} \times 100 \tag{1}$$

$$P_p = \frac{T_P}{T_P + F_P} \times 100$$

$$Classification\ accuracy\ (\%) = \frac{Total\ correctly\ classified\ data}{Total\ number\ of data} \times 100$$

Efficient classification of Cardiac disease classification using the presented dataset. Comparatively good accuracy than existing approaches.

Algorithm

Optimized multinomial regression algorithm

it is a regression analysis algorithm in which the relationship between the input and the target values is identified by one more independent category of variables, namely softmax regression evaluation through a maximum entropy classifier.

The OMNLR model divides the input into dependent and independent variables. Based on the absolute values being continuous values, the classification takes place. The probability of occurrence increases as the input variable and the target variable correlate with each other. The softmax layer converges the linear feature with the probabilistic values; hence, the functional correlation makes sense of pattern matching. OMNLR model classifies the given input into multiple classes of category.

The OMLR model is evaluated with the common expression given below

log(odd_data) = log_i(p)=ln(r/(1-p)) = a+b1x1+b2x2+b3x3+.......

(2)

p=exp(log_i(p))/ 1+log_it(p)

Where: p denotes the probability of occurrence of a particular class, exp denotes the 2.72 exponential value considered a denotes the constant utilized in the equation, b denotes the coefficient of the predicted variable are independent values.

VI. RESULTS AND DISCUSSIONS

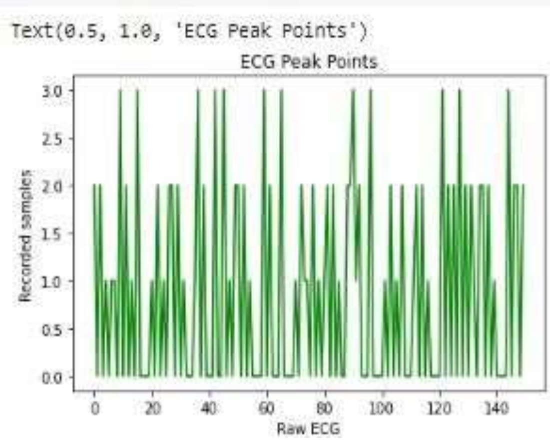

Fig 2. Raw ECG data

Fig 2. Shows the raw ECG data visualization with respect to time vs. peak value of the ECG is graphically shown here.

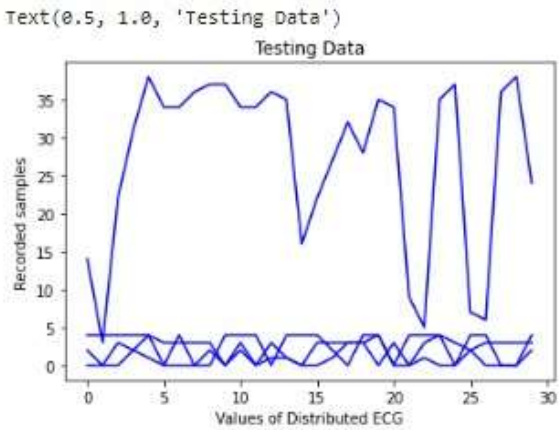

Fig 3.Test data

Fig 3. Shows the part of test data divided from the overall raining data.

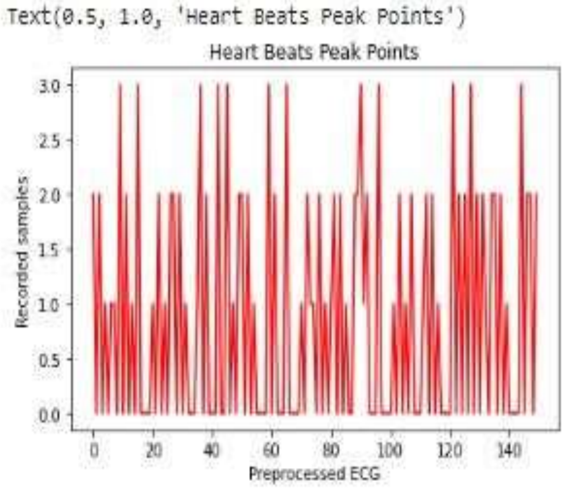

Fig 4. Processed ECG Data

Fig 4. Shows the processed ECG data after the cleaning process completed, junk values are removed and noise removal is done. the ECGdata visualization before fetching into OMNLR model is shown here.

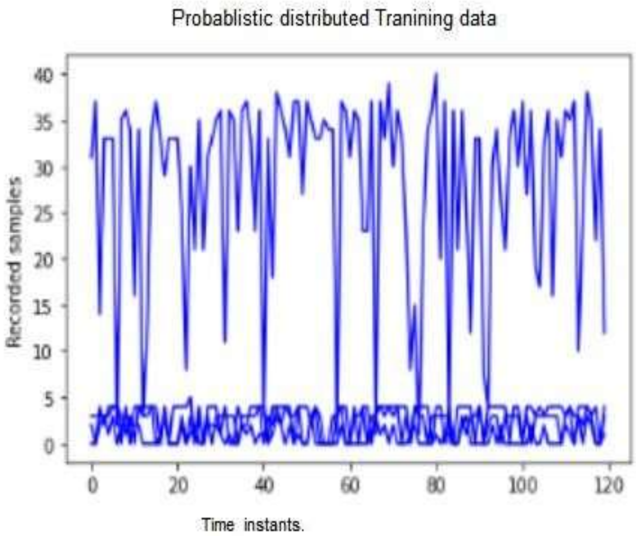

Fig 5. Training Data

Fig 5.shows the training data on probabilistic distributed values hence the instants of all data is displayed over here.

VII. TABLES

Table 1: Comparison of Proposed approach with Existing methods

S No	References	Methodology	Dataset	Quantitative measures
1	E. Alonso et al. (2020)	Live ECG + SVM classifier	OHPD	Acc=92.6%
2	S. Chandra et al. (2023)	Cloud based Bio sensor	Arrythmia Static data	Acc=97.8%
3	Z. Cui et al., 2021	Unsupervised model (ANN)	MICCAI 2017 MM-WHS datase	Acc=85.8%
4	Proposed method	Optimized multinomial Logistic regression model(OMNLR)	MITBIH arrhythmia dataset	Acc=98%

Table 1. shows the comparison of proposed approach with existing framework in which Live ECG data with SVM algorithm achieved 92.6%, Cloud based bio-senor enabled process achieved 97.8% accuracy. Unsupervised ANN model with MICCAI 2017 dataset achieved 85.8% is done.

The novel proposed model with optimized multi-nominal logistic regression (OMNLR) achieved 98% accuracy. The various challenges faced by the proposed approach during the analysis of unstructured dataset collected from the ECG samples. These data normally holds the noise factors rising from the external sources. Multiple machine learning algorithms need to be tested using hybrid technique.

VIII. CONCLUSION

Majority of the peoples impacted by the cardiac problems due to life style changes, irregular health maintenance, chronic diseases that impact the major organs such as diabetics etc. the light weight analysis model that considers the data and statistics behind each data on normal and abnormal condition. In the proposed system efficient model to test the cardiac abnormality is using Symptoms aware cardiac health analysis (SACHA) with optimized multinomial logistic regression (OMNLR) is tested. the optimization mechanism tune the data into adaptive weights adjusted till better prediction. The ECG data are converted and tested as frames of 1x1000 samples at a time. The accuracy of 98% is achieved with prediction duration of 52 seconds is formulated.

IX. ACKNOWLEDGEMENT

I am grateful to all of those with whom I have had the pleasure to work during this journal and other related projects. Each of the members ofmy Dissertation Committee has provided me extensive personal and professional guidance and taught me a great deal about both scientific research and life in general to the completion of my project journal titled "**Cardiac abnormality monitoring system through optimized regressions".**

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