IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁘ Peer-reviewed & Refereed journal ⁘ Vol. 13, Issue 9, September 2024

DOI: 10.17148/IJARCCE.2024.13904

Cardiovascular disease prediction using ECG

Sumanth Sharma S[1], Sandeep N K[2]

PG Scholar (MCA), Dept Of MCA, Vidya Vikas Institute of Engineering and Technology, Mysore, Karnataka, India.[1]

Assistant Professor, Dept Of MCA, Vidya Vikas Institute of Engineering and Technology, Mysore, Karnataka, India. [2]

Abstract: The intent is to create an ECG image-based machine learning system for the detection of cardiovascular disorders. After digitizing ECG recordings, the system preprocesses them using methods including contour detection, noise reduction, and grayscale conversion before extracting important features such the A, BCD, and E waves. To classify the ECG data into distinct disease categories, such as normal, myocardial infarction, and aberrant heartbeats, these properties are examined using machine learning models, such as SVM, KNN, and Random Forest.

By automating the analytical process, the project overcomes the drawbacks of the present manual approaches and increases the speed and accuracy of diagnosis. Clinical decision-making is aided by the real-time feedback and result visualization made possible by an intuitive web interface. The study comes to the conclusion that improvements in image processing and machine learning greatly improve the capacity to identify heart conditions from ECG pictures. To enable a wider range of applications in clinical settings, future work will involve enhancing feature extraction algorithms and growing datasets.

I. INTRODUCTION

The research focuses on automating the diagnosis of cardiovascular illnesses using electrocardiogram (ECG) images using machine learning and image processing techniques. By digitizing ECG records and putting in place an automated system, it solves the conventional difficulties with manual ECG analysis and increases diagnosis accuracy and efficiency. The system's main components include image preprocessing methods that target the A, BCD, and E waves that indicate heart activity, such as color conversion, noise reduction, and feature extraction. Following the analysis of these signals, a machine learning model classifies the ECG data into different categories related to cardiac diseases, including myocardial infarction, irregular heartbeats, and normal heart function.

Through a web-based interface, users can input ECG images for real-time analysis and receive classification results based on the machine learning model's findings. The system is designed to be user-friendly and accessible.

II. RELATED WORK

1.The Study by Nandan S and Mithun Sathya focuses on using ECG pictures to predict cardiovascular illnesses.
Makes use of sophisticated machine learning and image processing algorithms.
Places a strong emphasis on model training and feature extraction for illness prediction.

2.Research by Mohammed El-Habibi: - Offers an automated method for ECG image interpretation utilizing CNNs and deep learning. Shows how spatial dependencies in ECG images are captured by CNNs for the purpose of disease categorization.
Emphasizes deep learning's potential for diagnostic imaging in the future.

3.The evaluation conducted by M. A. A. Ferreira et al. contrasts feature extraction methods with classification algorithms in order to diagnose heart disease.
Talks on how crucial it is for model predictions to be transparent and interpreted.

4.The study by Abubaker and Babayiğit looks on deep learning and machine learning techniques for categorizing cardiovascular disorders using ECG pictures.evaluates various techniques to enhance detection accuracy.

5.Research by Mitra and Morshed: focuses on using 12-lead ECG pictures and deep learning algorithms to diagnose heart disorders. demonstrates how deep learning can help medical practitioners identify diseases more accurately.

6.A comparison of various AI methods for the prediction of cardiac disease is presented by Hossain et al.
gives information about the advantages and disadvantages of various algorithms.

DOI: 10.17148/IJARCCE.2024.13904

III. EXISTING SYSTEM

Existing System: Users of the existing platform for diagnosing cardiovascular disorders can upload ECG images to a web-based system, which uses image processing methods to decrease noise and artifacts, such as thresholding, Gaussian filtering, and RGB-to-grayscale conversion. After extracting important features including the A, BCD, and E waves, the images are classified into groups such as normal, myocardial infarction, aberrant heartbeat, or history of myocardial infarction using a pre-trained machine learning model. The accuracy of the system is contingent upon the quality of the input photos; low resolution or noise levels can impact the outcomes. Furthermore, variability may be introduced by feature extraction techniques, and the size and bias of the dataset can restrict the model's capacity to generalize. Deep learning models and improved feature extraction methods could be used as improvements to deal with these problems.

IV. PROPOSED SYSTEM

Proposed System: The suggested system uses advanced image processing techniques, such as RGB to grayscale conversion, Gaussian filtering, and contour recognition to improve signal clarity, to improve cardiovascular illness identification through ECG image analysis. Deep learning models are integrated to detect intricate patterns and enhance classification precision, utilizing pre-trained models to provide instantaneous feedback.

Deep learning and improved feature extraction techniques allow the system to increase efficiency and accuracy while delivering quicker findings to support clinical judgments. It also has an easy-to-use web interface for uploading ECG images and visualizing results, and it is resilient enough to tolerate variations in image quality and adjust to different datasets.

V. METHODOLOGY

A. Data Collection

Four groups of ECG images—Normal, Myocardial infarction, Abnormal heartbeat, and History of Myocardial infarction—make up the dataset used in this study.

B. Preprocessing of ECG Images

RGB to Grayscale Conversion: To focus on changes in signal strength and minimize complexity, the RGB ECG pictures were transformed to grayscale.
Noise reduction: To smoothen the images and lessen noise from outside interferences, Gaussian filtering was utilized.
Image Resizing: To guarantee uniformity in subsequent analysis, all photographs were scaled to standard dimensions.
Thresholding: Grid lines and other artifacts were removed from the images using thresholding techniques in order to extract the ECG signals from the background.
Contour Detection: The A, BCD, and E waves—the essential waveforms for further analysis—were extracted from the ECG signals using contour detection.

C. Feature Extraction

The contour approaches were utilized to extract the significant characteristics of the ECG data following preprocessing. The positions and forms of the A, BCD, and E waves in relation to the ECG signal were used to identify them. To utilize in classification models, these features were normalized and transformed into a one-dimensional signal.

D. Machine Learning Model Selection

To categorize the ECG images, a number of machine learning techniques were tested:
k-Nearest Neighbours (KNN) and Support Vector Machine (SVM)
Random Forest from Naive Bayes
A labelled dataset of ECG pictures was used to train each model, and the model with the best accuracy was chosen to be used in the end.

E. Hyperparameter Tuning

To adjust each model's hyperparameters, grid search was used. To avoid overfitting, the models underwent cross-validation, and the F1 score, recall, accuracy, and precision were used as performance indicators.

F. Model Evaluation

A different validation set was used to test and evaluate the models. The evaluation metrics that were applied were:
Accuracy: The proportion of cases that are accurately classified.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 9, September 2024
DOI: 10.17148/IJARCCE.2024.13904

Precision and Recall: To assess the ability to differentiate between various heart diseases.
The harmonic mean of recall and precision is the F1 score.
Random Forest, the model with the highest performance, was chosen to be used in the web application based on these metrics.

G. Web Application Development

Users can input ECG images for analysis using an easy-to-use interface in this web-based application that was developed with Flask. Users can see real-time feedback and outcomes of the classification, along with confidence scores and anticipated categories

VI. APPLICATION

The research's goal is to use machine learning algorithms on electrocardiogram (ECG) images to diagnose cardiovascular disorders. The photos undergo multiple rounds of analysis by the system, which include preprocessing, feature extraction, and classification. To separate important ECG components such the A, BCD, and E waves—which correlate to the P, QRS, and T waves in a conventional ECG—convert the RGB images to grayscale, reduce noise, resize them, and look for outlines. Different machine learning algorithms are used to classify different cardiovascular conditions, such as Random Forest, Naive Bayes, Decision Tree, SVM, and KNN. The system is a web application that is easy to use and allows users to upload ECG images for automated analysis. The study draws attention to issues including the system's reliance on the quality and fluctuation of the images as well as the necessity of improving feature extraction and classification precision. To further increase the system's diagnostic efficacy, future improvements should consider growing datasets, improving algorithms, and perhaps adding real-time monitoring features.

VII. CONCLUSION

This Report uses sophisticated machine learning and image analysis to diagnose cardiovascular problems, which is a significant advancement. We used preprocessing methods such as grayscale conversion of RGB images, noise reduction, and contour identification to create a reliable automated system for cardiovascular condition assessment from ECG data. The Pan-Tompkins algorithm was one of the feature extraction techniques we employed to successfully detect important waveforms including the A, BCD, and E waves. SVM, KNN, Naive Bayes, and Random Forest were the machine learning models we evaluated; the Random Forest classifier produced the best accuracy. This article presents an automated, non-invasive technology that has the potential to revolutionize the detection of cardiovascular disease, in addition to highlighting noteworthy technical accomplishments. To improve patient outcomes and healthcare delivery, future research should concentrate on growing the dataset, improving feature extraction techniques, and evaluating the system in clinical settings.

REFERENCES

[1]. Cardiovascular Disease Prediction Using ECG Images: Nandan S. & Mithun Sathya
[2]. Automated Detection of Cardiovascular Diseases Using Deep Learning and Electrocardiogram (ECG) Images: A Convolutional Neural Network Approach: Mohammed El-Habibi
[3]. Evaluation of Heart Disease Diagnosis Approaches Using ECG Images: M. A. A. Ferreira et al.
[4]. Detection of Cardiovascular Diseases in ECG Images Using Machine Learning and Deep Learning Methods M. B. Abubaker & B. Babayiğit
[5]. Heart Disease Prediction Using Machine Learning: C. Boukhatem,

