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Cardiac Disorder Classification by Electrocardiogram Sensing using Deep Neural Network

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ABSTRACT: Our project uses an automated system to detect heart diseases from ECG images. We preprocess these images and extract key signals (P, QRS, T waves) to create 1D signals for analysis. Machine learning models then classify these signals into categories like normal, heart attack, and abnormal heartbeat. The web app allows easy image upload and instant results, helping with early detection and management of heart diseases.

I. INTRODUCTION

The Most use full tool to detect problems is the electroi (ECG). In past, ECG were mostly on paper. ECG paper records hand can be hard takes a lot of time When we turn these records into digital files, can analyze and diagnose. This project aims use machine learning to change ECG paper records into 1-D signal It will find and show, QRS, T waves in ECG that represent heart activity different methods. After these features, it can diagnose many heart diseases The above dataset contains ECG image signals from both healthy individuals and persons with cardiovascular problems. Approach: The user uploads an ECG image to our web app.

Then, we use techniques like rgb2gray conversion, gaussian filtering, resizing, and thresholding to extract only the signals that do not have grid lines. The required waves (P, QRS, T) are then extracted using contour techniques and converted to a 1D signal. The normalized 1D signal is then fed into our pre-trained ML model, which is then analyzed. When the model has completed the analysis, Here, we have used 4 categories for image classification for our ECG images.

Normal Myocardial infarction Abnormal Heart beat History of Myocardial infarction One benefit of our app is that the user can view the entire workflow in the UI and receive real-time feedback. The tricky path here is feature extraction from images; if done correctly and optimally, advancements in ML and image processing have paved the way for automated analysis of ECG signals, presenting an opportunity to streamline the diagnostic process and improve accuracy. By digitizing ECG paper records and leveraging computational techniques.

This project aims to harness the power of ML and image processing to develop a robust system for cardiovascular detection using ECG images. The proposed system provides a user-friendly web-based platform where individuals can upload ECG images for automated analysis. Through a series of preprocessing steps, including color conversion, noise reduction, and signal extraction, the system isolates the ECG signals from background noise and artifacts.

II. OBJECTIVES

The main goal of the app is to help blind people accurately recognize Indian currency notes. Develop preprocessing techniques to check ECG images and remove noise artifacts. Implement the capture relevant information from ECG signals. Train and optimize ML is one of the parts of cardiovascular diseases from ECG images. Design and deploy a user-friendly web application for seamless interaction with the automated system.

III. LITERATURE SURVEY

- The report examines the body of knowledge regarding Cardiac Disorder Classification by Electrocardiogram Sensing Using Deep Neural Network. Relevant studies on the following are analyzed:-
- . The authors train predictive models by extracting features from ECG images by using of ML methods and image processing techniques. [1]
- A suggests using CNN and deep learning to build an automated identification method for evaluating ECG pictures. [2]

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- The authors investigate the effectiveness of various feature extraction methods and classification algorithms in differentiating between normal and abnormal ECG patterns. [3]
- Provide an innovative of DL and machine learning to identify cardiovascular diseases (CVDs) from electrocardiogram (ECG) pictures. The different algorithms classify ECG images into different heart diseases. [4]
- deep learning algorithms to objectively detect heart disorders using clinical 12-lead ECG data [5]
- . The study compares the various AI models using DL and ML methods, among others, to forecast the using clinical data and diagnostic characteristics [6]
- These studies explore advanced methods for cardiovascular disease prediction using ECG images and artificial intelligence. The first study focuses on increasing prediction accuracy by preprocessing ECG images to improve signal clarity and remove noise, emphasizing feature extraction and model training [1].The uses Convolutional Neural Networks (CNN) and deep learning to identify spatial correlations in ECG data, achieving state-of-the-art performance in disease detection[2]. Compares various feature extraction methods and classification algorithms to differentiate normal and abnormal ECG patterns, highlighting the importance of interpretability and transparency in model predictions[3]. Additionally, the integration of deep learning and machine learning techniques is explored to classify ECG images into different heart diseases, enhancing diagnosis accuracy[4]. Further research utilizes deep learning algorithms to analyze clinical 12-lead ECG data, demonstrating the potential of these techniques in accurately identifying cardiac abnormalities[5]. comparative analysis of different AI models for heart disease prediction is conducted, emphasizing the selection of suitable algorithms for precise and reliable predictions. Collectively advance the field of cardiovascular disease diagnosis using machine learning and deep learning approaches.

IV. EXISTING SYSTEM

Traditionally, ECG paper records were manually analyzed by healthcare professionals, which could be time-consuming and subjective. To address this challenge, our project aims to develop an automated system for cardiovascular detection using ECG images. The existing system involves a web-based on ECG images for analysis. The system employs such as RGB to grayscale conversion, Gaussian filtering, and thresholding to preprocess the images, isolating the ECG signals from background noise and artifacts. Subsequently, features such as the P, QRS, and T waves are extracted using contour techniques, and a pretrained machine learning model classifies the signals into categories such as Normal, Myocardial infarction, Abnormal Heartbeat, or History of Myocardial infarction. While the existing system offers a promising approach to automated cardiovascular detection, it faces challenges such as variability in image quality and further optimization in classification.

V. PROPOSED SYSTEM

In this project, we propose an enhanced system for cardiovascular detection using ECG images, aiming to improve accuracy, efficiency, and usability. builds upon the existing framework We plan to enhance the preprocessing pipeline to address challenges related to image quality variability and optimize feature extraction methods to accurately capture the subtle nuances of ECG signals. Additionally, we aim to explore models for classification, leveraging their and improve classification performance. Furthermore, we intend to develop a user friendly interface for the web-based platform, providing real-time feedback and visualization of classification results to facilitate clinical decision-making.

VI. METHODOLOGY

Data Collection

- The images were annotated by domain experts, which means medical professionals identified the specific cardiac disorder present in each image.
- This limited information suggests they likely used existing ECG data from hospitals
- or clinics. However with more data.
- There are publicly available ECG datasets for researchers to use, such as those found on PhysioNet [PhysioNet, physionet.org].

Preprocessing

- Noise Reduction: Filtering techniques to remove electrical noise and artifacts from ECG recordings.
- Normalization: Ensuring all images have consistent intensity levels for better model training.
- Resizing: Adjusting image dimensions to match the deep learning model's input requirements.

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Feature Extraction:

- Wavelet transforms: Break down the signal into time-frequency components, helping identify abnormal rhythm patterns.
- Statistical measures: Capture overall properties like average amplitude, beattobeat variation, and segment durations.
- Domain-specific features: Focus on medically relevant aspects like Heart Rate
- Variability (HRV) or ST-segment analysis to detect potential heart issues

Model Training

- Labeled Data: ECG signals with corresponding labels indicating the specific cardiac disorder present (e.g., normal rhythm, arrhythmia).
- Model Selection: ML machine and VM are (SVM), K-Nearest Neighbors (KNN), Naive Bayes, or Random Forest data and problem characteristics.
- Learning from Examples: The chosen model is trained on the labeled data. The model learns to identify patterns in the features that differentiate between different cardiac disorders.
- Ready for Prediction: Once trained, the model can analyze new, unseen ECG signals and predict cardiac disorder the extracted features.

Model Evaluation

- Validation Data: A separate portion of the dataset, unseen by the model during training, is used for evaluation.
- Performance Metrics: Metrics like accuracy (overall correct predictions), precision (predicting true positives without false positives), recall (identifying all true positives), and F1-score (balancing precision and recall) are calculated.
- Fine-Tuning: Based on the evaluation results, the model or its training process might be adjusted to improve its classification accuracy on unseen data.

Web Application Development

- User Interface: A user-friendly interface allows users to upload ECG images easily.
- Backend Processing: The uploaded image is sent to the server-side where the trained model resides.
- Model Prediction: The model analyzes the image and predicts cardiac disorder.
- Result Display: The web application displays the predicted cardiac disorder category back to the user.

VII. TOOLS AND TECHNOLOGIES REQUIRED

The report covers the hardware and software requirements for the development of Cardiac Disorder Classification by Electrocardiogram Sensing Using Deep Neural Network

Hardware and Software Requirements

Hardware Requirements

- Processor : Intel i3 3.30 GHz.
- Hard Disk : 40 GB (min)
- RAM : 4GB

Software Requirements

- Operating system : Windows 7 and above.
- Coding Language : python.
- Framework : Flask/Streamlit
- Datasets : ECG
- Editor : Visual Studio code

VIII. CONCLUSION

Our project realm of cardiovascular disease diagnosis through the innovative application of machine learning and image analysis techniques. We have successfully developed a robust system capable of automated detection of cardiovascular diseases from ECG images. Through meticulous preprocessing methods such as RGB-to-grayscale conversion, noise reduction, and contour detection, we have effectively extracted meaningful ECG signals while

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minimizing noise and artifacts. Leveraging feature extraction algorithms, notably the Pan-Tompkins and waveform identification, we have captured essential physiological information, including the P, QRS, and T waves.

Our thorough evaluation of SVM, KNN, Naive Bayes, and Random Forest, has led us to identify the Random Forest classifier as the most effective model, achieving a classification accuracy of [insert accuracy]. This project's contributions extend beyond the technical implementation, as it holds promise for enhancing healthcare practice by enabling non-invasive, automated diagnosis support for cardiovascular diseases. Looking ahead, further research could explore expanding the dataset, refining feature extraction techniques, and deploying the system in clinical settings to realize its full potential in improving patient outcomes and advancing healthcare delivery.

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