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Prediction of Heart Abnormalities using Electrocardiogram Images by CNN Model

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ABSTRACT: The electrocardiogram (EKG) are indeed a crucial tools for detection cardiovascular issues, and our projects to digitize and analyze EKG papers records using machinery learn techniques sounds promisingly. By converts paper records into digital signal and applications vary techniques like feature extract, dimensions reducing, and classification algorithms, you are aims to automate the diagnoses processes, potential saving times and improving accuracies. our approach to splits the EKG report into lead, extractive waveforms (P, QRS, and T waving), and then converts them into a 1-D signals is logically. Using techniques such as smoothening, thresholds, and scales can help improving the qualities of the extracted signals, make them more suitable for analyzing. Apply dimension reductions techniques like Principle Components Analysis (PCA) is sensible for understands the data better and potential improving the efficiencies of the classifications processes. Employing multiple classifiers like k-nearest neighbor's (KNN), Logistic Regressions, Support Vector Machines (SVM), and an Voting Based Ensemble Classifier allows for comprehensive evaluations and comparisons of differs models. Assess the models based on metrics like accuracy, precision, recalling, f1-scores, and supporting is crucially for determined their effectiveness in diagnosed cardiac diseases. Ultimately, y'all final models aims to accurately diagnose conditions like Myocardial Infarctions, Abnormally Heartbeats, or determining if the patients is healthy based on the EKG reports. By translates the EKG findings into layman's terms, your systems could provides valuable insights to healthcares professionals and patients alike, aides in timely intervention and treatments.

Keywords: CNN, Logistic Regression, SVM, Streamlit, K-nearest neighbours (KNN)

I. INTRODUCTION

According to the World Health Organization, heart disease be the leading cause of death in high second-leading cause of death in low-income countries. It be remaining the leading cause of death globally for the last 20 years. This paper aims at analyzing various data mining techniques that have implanted in recent years for the diagnosis of heart disease. There be plenty of algorithms available currently that could detect and predict heart anomalies from clinical reports. However, in this project, focus more on the discovery and extraction ofe patterns from Electrocardiogram (ECG or EKG) image reports. By digitizing ECG records, the need for time-consuming manual intervention for the understanding of the report can be eliminated. Through digitization, automation of diagnosis and analysis can be achieved more quickly. Cardiovascular diseases be the primary cause of mortality globally, emphasizing the urgency of early prediction and classification. Electrocardiogram (ECG) be a pivotal, cost-effective, and non-invasive diagnostic tool for assessing heart health and identifying cardiovascular ailments. This study harnesses the power of deep learning methodologies to predict four significant cardiac irregularities: abnormal heartbeat, myocardial infarction, history of myocardial infarction, and normal cardiac status utilizing a dataset of ECG images from cardiac patients. Initially, the research delve into the realm of transfer learning, exploring the efficacy of pretrained deep neural networks such as SqueezeNet and AlexNet, albeit on a smaller scale. Subsequently, a novel Convolutional Neural Network (CNN) architecture be created specifically for the prediction of cardiac abnormalities. Furthermore, pretrained models and the newly proposed CNN model be repurposed as feature extraction mechanisms for traditional machine learning algorithms, including Support Vector Machine (SVM), K-Nearest Neighbors (K-NN), Decision Tree (DT), Random Forest (RF), and Naïve Bayes (NB). By utilizing these methodologies, the study aim to improve the accuracy and efficiency of cardiac abnormality prediction, thereby aiding in prompt intervention and potentially saving lives.

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II. METHODOLOGY

The methodology followed for detecting cardiovascular diseases below figure 1 shows typically involves several stages are:

- ECG dataset Collection
- Pre-processing & feature selection
- Extracting signals & convert to 1D signals
- Dimensionality reduction
- Prediction

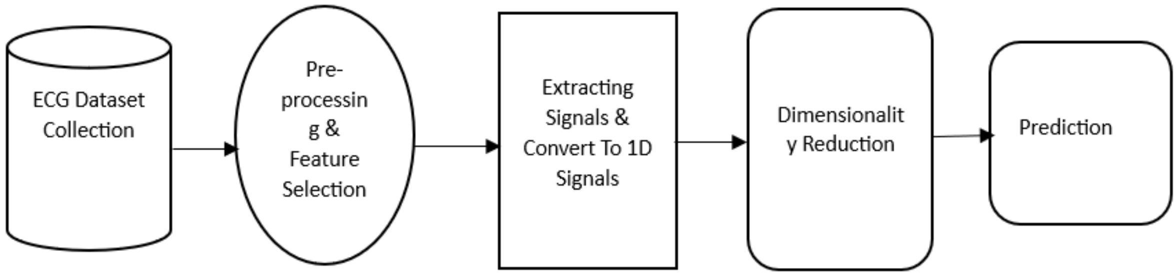

Figure 1: Flow Diagram

ECG dataset Collection: Collect a comprehensive data of ECG recordings representing various cardiovascular conditions, ensuring sufficient diversity and size. sources: https://data.mendeley.com/datasets/gwbz3fsgp8/2.
Pre-processing: Remove noise from the ECG signal using filters (e.g., median, low-pass, high-pass). Segment the signal into individual heartbeats (PQRST complexes). Normalize the signal to a standard format.
Feature Selection: Extract relevant features from the pre-processed ECG signals. These features could include Time-domain features (e.g., mean, standard deviation of intervals) Frequency-domain features (e.g., spectral analysis) Morphological features (e.g., amplitude, slope, width of ECG waves).
Feature selection techniques may be employed to reduce dimensionality and improve classification performance. Supervised learning with labelled data (if available). Reinforcement learning for abstractive detection, where the model learns to detecting cardiovascular disease. Consider domain-specific knowledge incorporation to assure the generated result are accurate and clinically relevant.
Extracting signals & convert to 1D signals: Extract the only necessary signals by applying gaussian filter, grayscale, threshold and convert that signal to 1D signal.
Dimensionality Reduction: It will reduce Features and storage.

III. SYSTEM ARCHITECTURE

The below Figure 2 is a system architecture serves as the foundational blueprint outlining the structure, behavior, and various perspectives of a system. It provides a conceptual model how different components interact and work together to achieve specific objectives.

1. **Upload ECG Image from web:** User uploading an ECG image from the web typically involves selecting the image file from a web page or a file sharing platform.
2. **ECG Image Processing:** Remove noise, artifacts, and inconsistencies from ECG signals. Extract relevant features form the pre-processed ECG signals. These features might include time-domain features, frequency-domain features, or morphological features.
3. **ML Model:** Using ML algorithms (e.g., CNN, SVM, Random Forest, Neural Networks) to classify electrocardiogram signals into different categories (e.g., normal, arrhythmia). Train the classification model using labelled ECG data. This information should be annotated by medical experts. Perform cross-validation to assess the model's performance and prevent overfitting. Consider ensemble methods for improved accuracy and robustness.

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Result: Model will predict the cardiac diseases, to detect whether a patient has/had Myocardial Infarction, Abnormal Heartbeat.

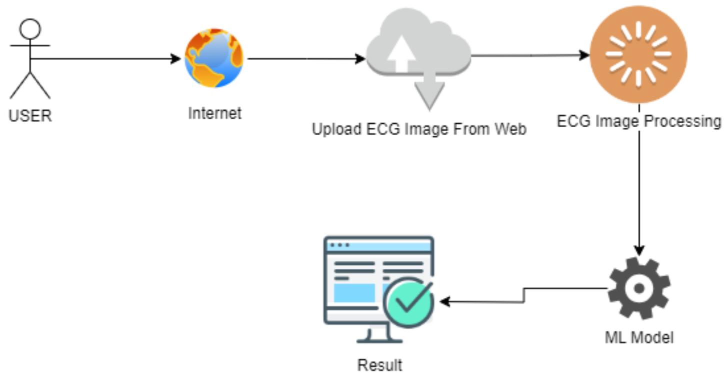

Figure 2: System Architecture

IV. FUTURE SCOPE

In the future, advancements in Cardiovascular Detection using ECG images are likely to focus on implementing the same on mobile apps.

V. RESULTS

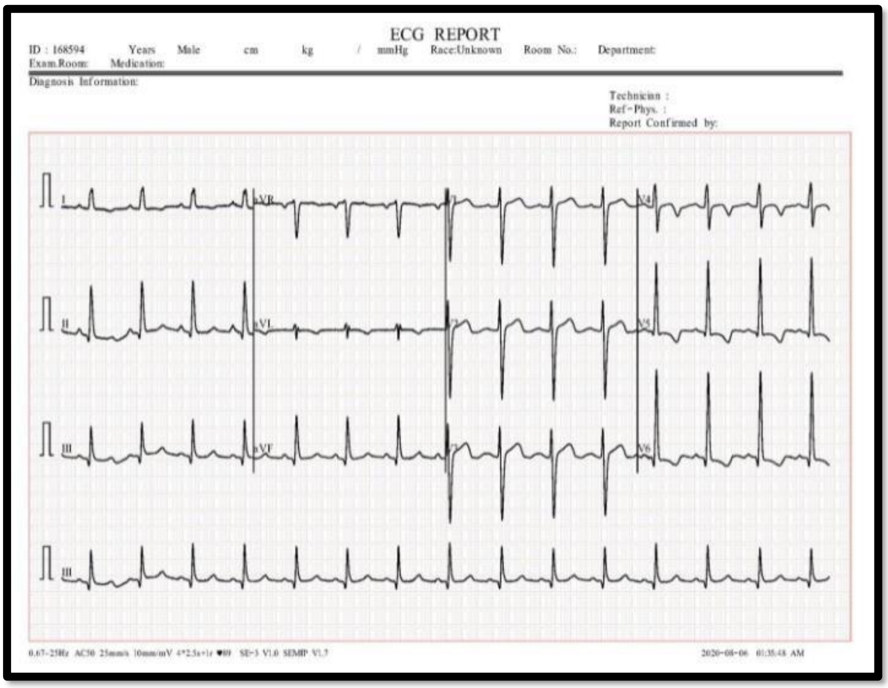

Figure 3: Input Image

The above Figure 3 shows the uploading an ECG image from the web.

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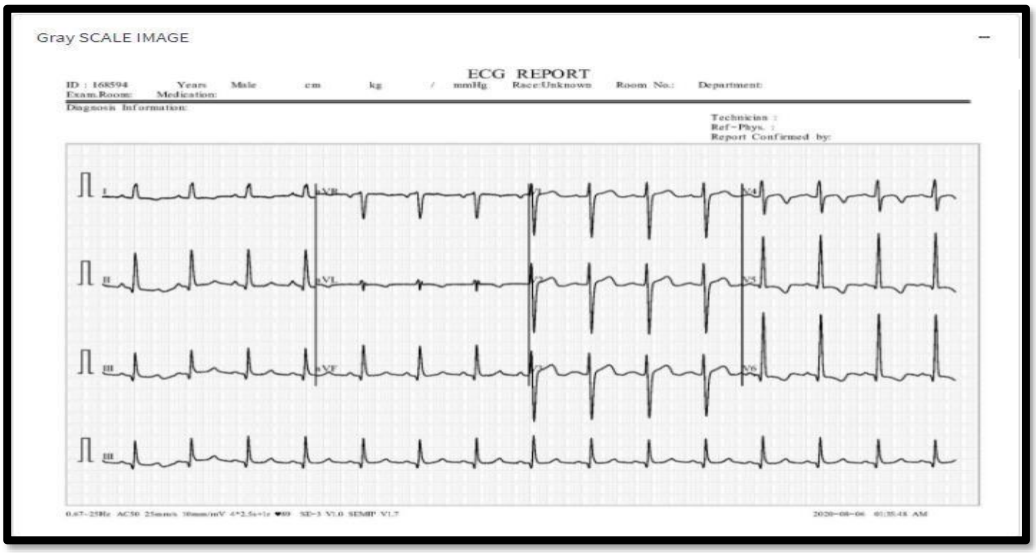

Figure 4: Gray-scale

The Figure 4 shows Convert all ECG images to grayscale because eliminates color distractions, allowing medical professionals to focus more on the patterns and details within the waveform. It also reduces file size, making it easier to save & transmit the images.

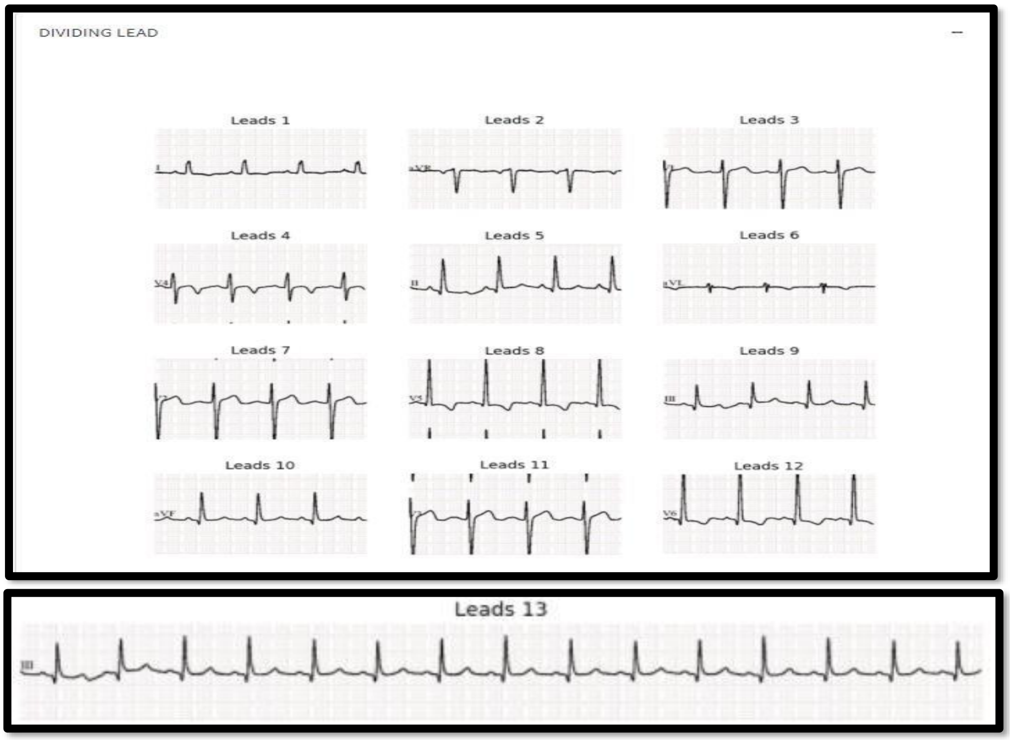

Figure 5: Dividing into 12-leads

To ready leads (1-13) for subsequent processing, each individual lead image undergoes transformations including gridline removal, conversion to grayscale, application of Gaussian filtering, and execution of thresholding to produce a binary image.

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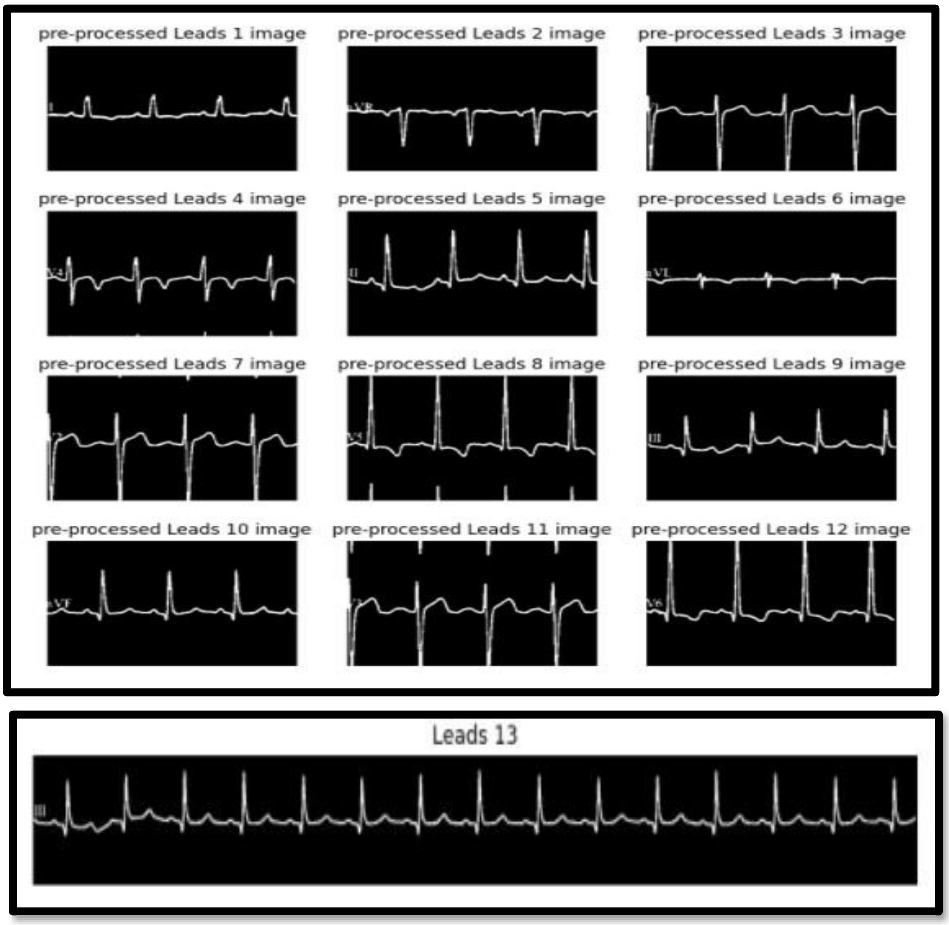

Figure 6: Pre-processing

The altered image is traced to isolate the signals through contour detection techniques, and the values are standardized using MinMax Scaling. The normalized result is then stored in CSV format as a 2D signal.

1D Signals

	0	1	2	3	4	5	6	7	8
0	0.8781	0.8628	0.7991	0.7105	0.5939	0.4702	0.3533	0.2647	0.297

Figure 7: Transform into one dimensionality signal

We transformed all the 1D rows into columns using transpose. With both 1D and 2D files and cropped 1-13 leads images, we perform different supervised classification algorithms.

Dimensional Reduction

	0	1	2	3	4	5	6	7
0	-1.5831	4.6774	-0.6037	-3.3532	-1.2244	0.3372	-3.0771	0.6421

Figure 8: Performance Dimensionality Reduction

The Figure 8 shows the dimensionality reduction by using PCA technique.

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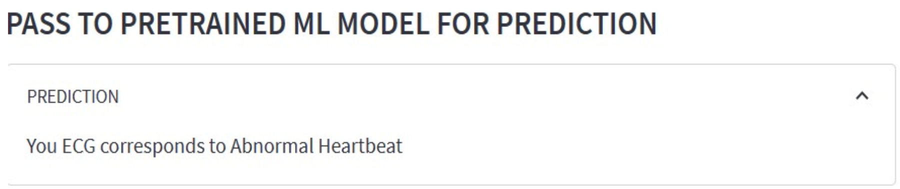

Figure 9: Result

The figure 9 shows the forecasting of the uploaded image.

VI. CONCLUSION

The empirical results show that we can produce faster and accurate predictions for heart patients by applying the given predictive model to the ECG images of new patients. This study can also be extended to include multiple different heart diseases if the feature selection from images is done correctly and optimally along with increased accuracy of our model.

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