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Classification of Heartbeats Using Convolutional Neural Networks

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Abstract: ***When there is a suspicion of a heart attack, an electrocardiogram (ECG) is a crucial test. It measures the electrical activity of the heart, which is manifested through small electric impulses when the heart beats. The subsequent process of analyzing ECG patterns is time-consuming but vital in determining the likelihood of cardiovascular disease by medical professionals. This project utilizes ECG image data to automate the interpretation of ECG recordings, aiming to assist clinicians in detecting life-threatening Myocardial Infarction. By taking an ECG image as input, the system classifies and attempts to categorize the final result into five classes: Non-Ectopic Beats, Supraventricular Ectopic Beats, Ventricular Ectopic Beats, Fusion Beats, and Unknown Beats.***

Keywords: Heart assault, Electrocardiogram (ECG), ECG document patterns, Automates interpretation, ECG image data, Clinicians, Detection of life-threatening Myocardial Infarction, ECG photograph.

I. INTRODUCTION

Computer-aided technology is necessary to simplify and automate this evaluation process.

The raw data from ECG signals is complex and challenging for humans to comprehend, which creates difficulties in analyzing new ECG signals. This project utilizes ECG report images and automates the interpretation of ECG patterns, potentially assisting clinicians in identifying life-threatening Myocardial Infarction. By taking ECG data in the form of CSV files, the system classifies and aims to categorize the final outcome into five distinct categories: Non-Ectopic Beats, Supraventricular Ectopic Beats, Ventricular Ectopic Beats, Fusion Beats, and Unknown Beats.

A. Related Work

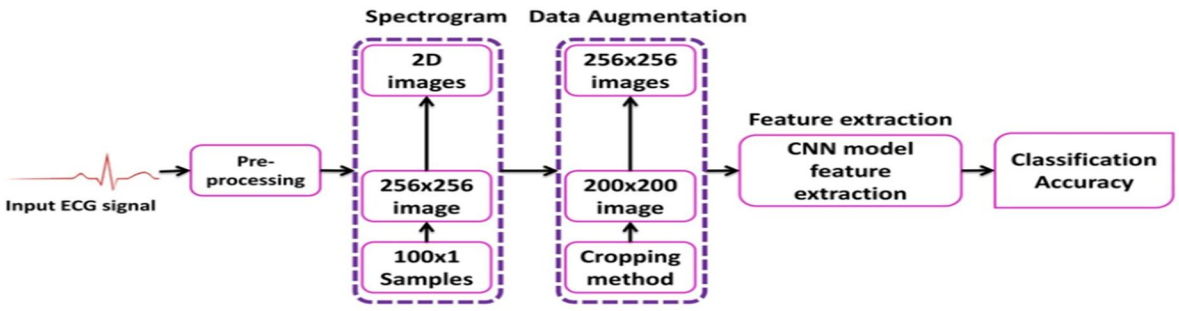
1) In the study titled "Deep ECGNet: A Deep Learning Approach for ECG Classification" by Shashikiran A. and Raghavendra D. Patil, a CNN-based deep learning model called Deep ECGNet is introduced. This model aims to classify ECG signals into various arrhythmia classes.

2) The research paper by H. Huynh et al. titled "CardioNet: A Deep Convolutional Neural Network for Detection of Cardiovascular Diseases" presents a CNN architecture called CardioNet. This architecture is designed to automatically detect and classify cardiovascular diseases using ECG data.

3) The work conducted by Ramachandran et al., titled "ECG Classification with CNNs: A Comparative Study," compares different CNN architectures for ECG classification. The study evaluates the performance of these architectures on various benchmark datasets, providing insights into the effectiveness of CNNs for this task.

II. METHODOLOGY

A. Proposed Architecture



B. Proposed System

The proposed system utilizes Convolutional Neural Networks (CNN) for training the model and classifying the output after preprocessing and extracting features from ECG data.

The ECG datasets are collected and undergo preprocessing using the OpenCV library. Subsequently, they are transformed into images, which are then fed into the CNN for classification. The classification process aims to assign the ECG images into one of the five predefined classes: Non-Ectopic Beats, Supraventricular Ectopic Beats, Ventricular Ectopic Beats, Fusion Beats, and Unknown Beats.

Advantages

1) *Automated Feature Learning:* CNNs automatically learn relevant features from ECG data, eliminating the need for manual feature extraction. This reduces human effort and potential bias.
2) *Extraction of Spatial and Temporal Information:* CNNs capture spatial and temporal dependencies in ECG data through convolutional layers. They extract local patterns and learn hierarchical representations, enhancing the understanding and classification of complex ECG patterns.
3) *Robustness to Noise and Variations:* CNNs demonstrate resilience to noise, artifacts, and variations commonly present in ECG signals. They effectively handle changes in signal amplitude, frequency, and morphology, making them suitable for real-world ECG analysis.

C. Proposed Algorithm

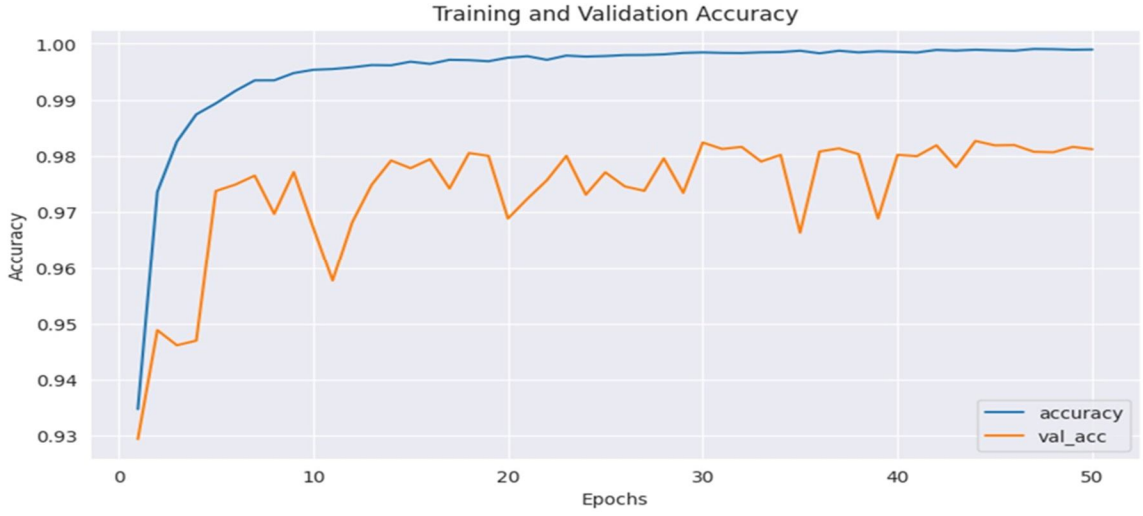
Convolutional Neural Networks (CNNs) are popular deep learning algorithms employed for tasks like image and pattern recognition. They leverage specialized layers like convolutional and pooling layers to extract hierarchical features from input data. By taking advantage of their architecture and weight sharing, CNNs excel at capturing spatial relationships and patterns in images. Their remarkable ability to automatically learn and classify complex features has led to impressive performance in diverse computer vision applications.

D. Proposed Classifiers

The Random Forest classifier is a popular supervised machine learning algorithm widely utilized for classification and regression tasks. It constructs multiple decision trees based on different samples from the dataset and makes predictions by aggregating the majority vote of the trees for classification or averaging the predictions for regression.

III. RESULTS

Output Screens



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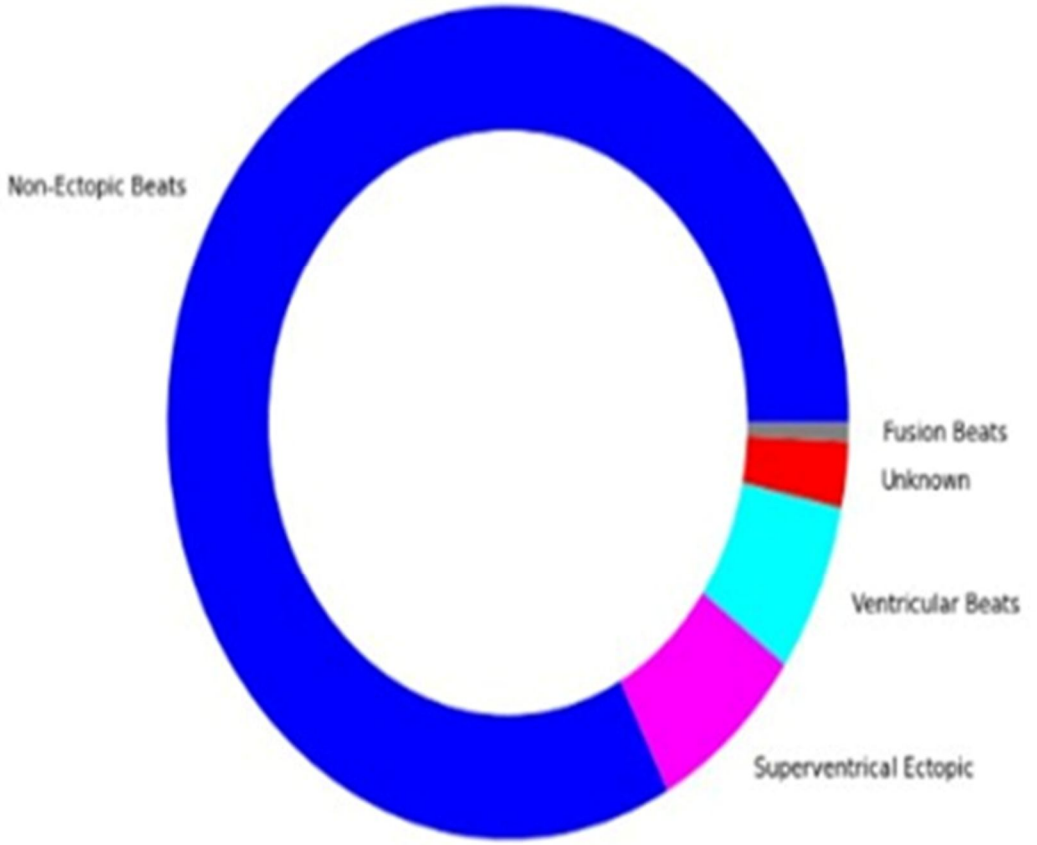

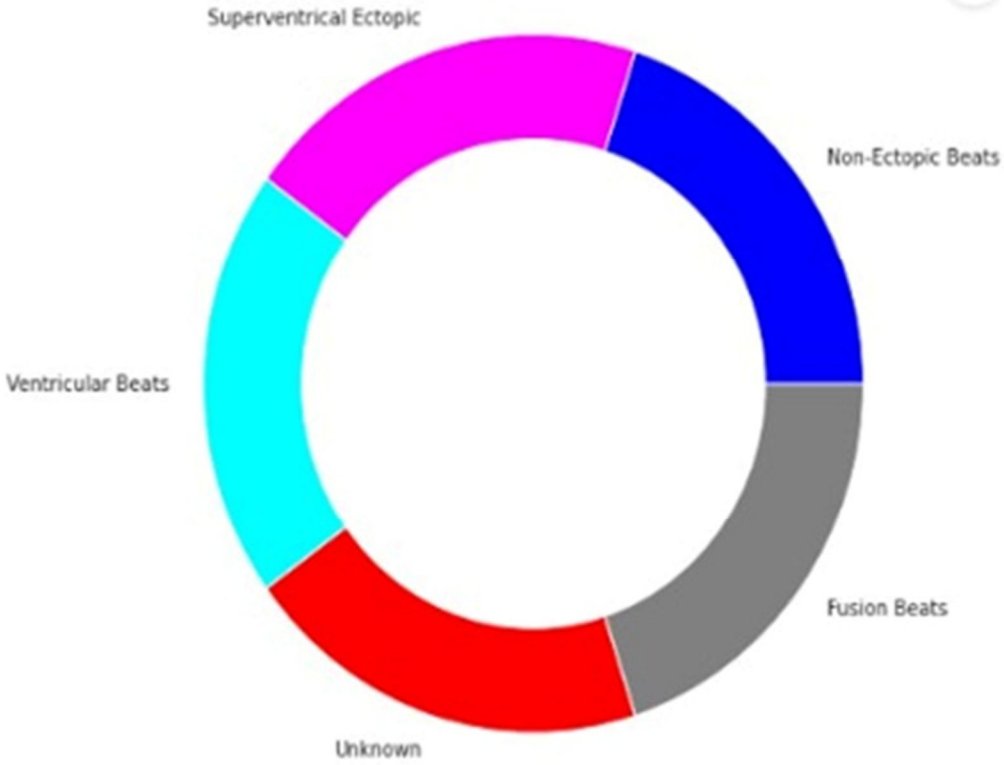

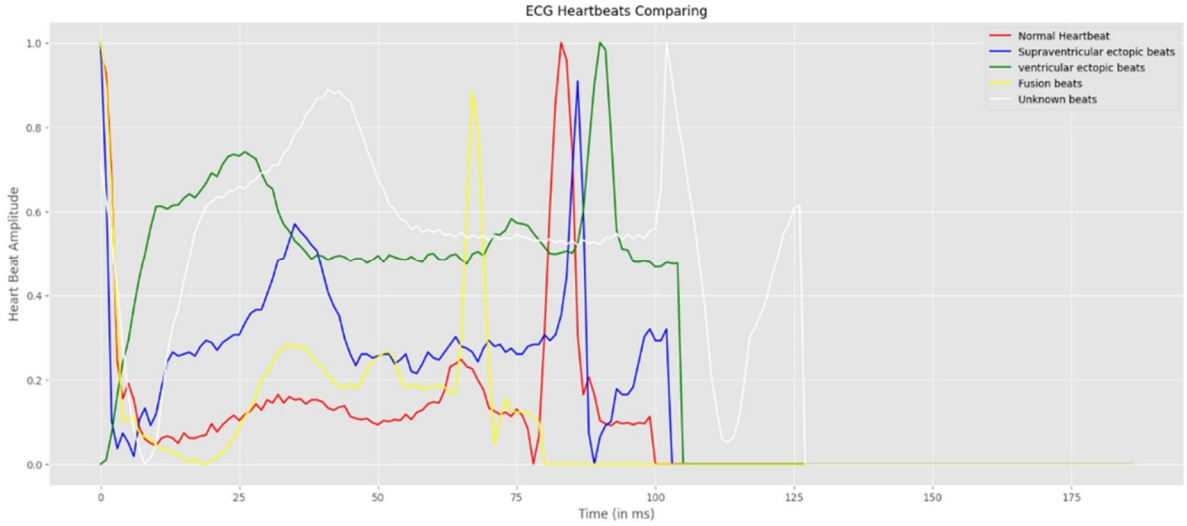

IV. CONCLUSION

The project named "ECG Classification Using CNN" is designed to classify 12-lead ECG reports. It involves a procedure that utilizes a CNN-based feature extractor to extract features from input images. These features are then combined with the heart rate information, either obtained from the image or manually provided. The system classifies the ECG reports into three categories: N, S, V, F, Q.

The CNN model has been trained using a dataset consisting of 12-lead ECG images representing different types of beats, including non-ectopic beats, superventricular ectopic beats, ventricular ectopic beats, fusion beats, and unknown beats.

This project holds potential for application in the medical field, where healthcare professionals can utilize it to classify ECG reports and predict the occurrence of Myocardial Infarction (heart attack).

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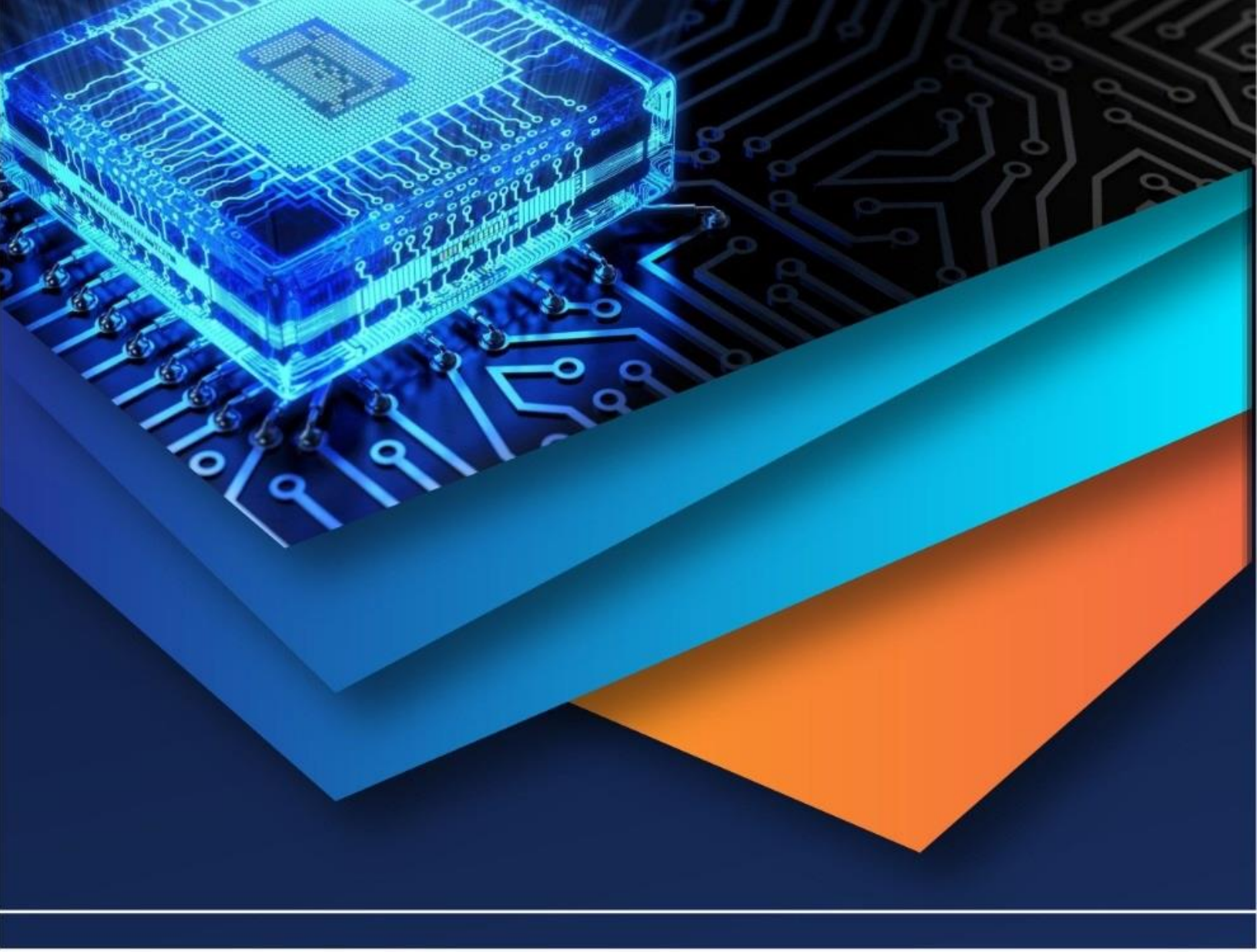

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