Classification of Arrythmia using SVM with PCA

Introduction:

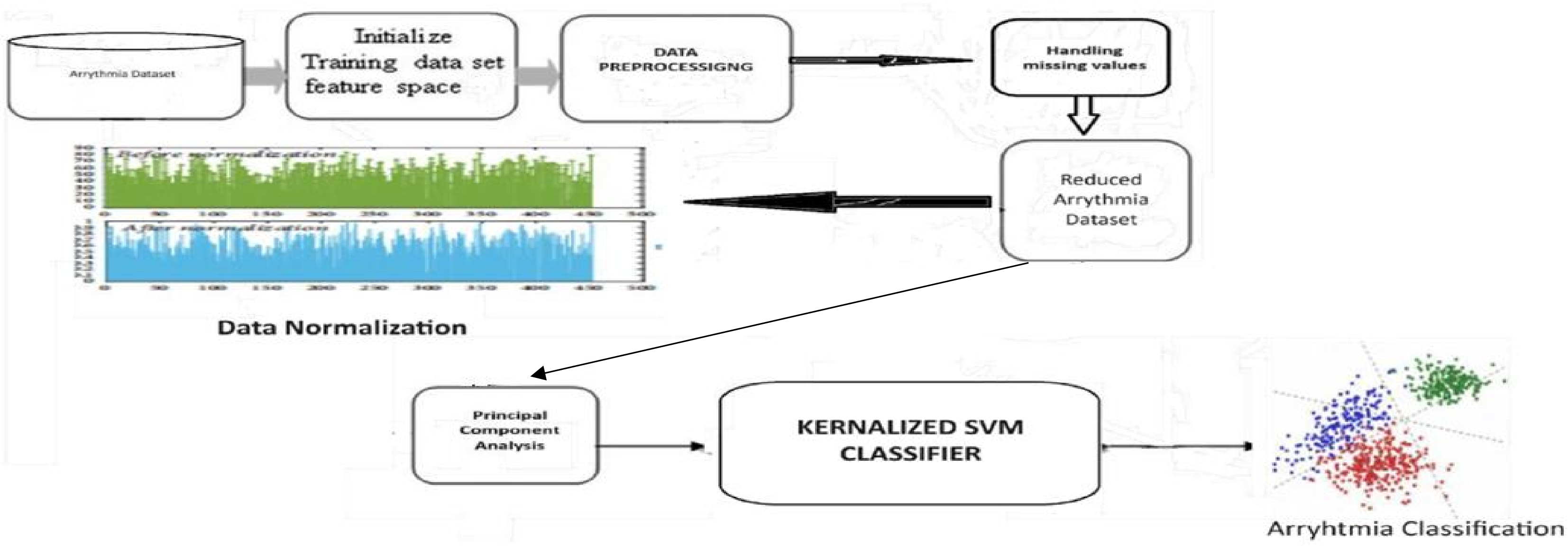
Arrhythmia refers to an abnormal heart rhythm, which can be too fast (tachycardia), too slow (bradycardia), or irregular. Proper classification of arrhythmia is crucial for accurate diagnosis and effective treatment, as different types have varying implications and management strategies.This study mainly focuses on the classification of arrhythmia which is based on electrocardiogram (ECG) data by using Support Vector Machines (SVM) in addition with Principal Component Analysis (PCA). ECG data which contains critical information about the electrical activity of the heart, are analyzed to identify arrhythmias, potentially life-threatening irregular heartbeats.

Objectives:

- To improve the precision and reliability of arrhythmia detection to assist clinicians in making timely and accurate diagnoses, thereby reducing the risk of misdiagnosis and improving patient outcomes.
- To utilize PCA to reduce the dimensionality of high-volume ECG data, retaining essential features while minimizing noise.
- Accurately classify detected arrhythmias into one of 16 specific types.

Methodology with Architecture Diagram:

It involves collecting the dataset which is relevant to Classification of Arrhythmia.Preprocessing the collected Dataset.These includes filtering techniques like Removal of Noise.And then after Applying PCA to the Preprocessed ECG data to reduce its Dimensionality.Selecting a subset of the Principal Components that will retain the essential characteristic of the ECG Signals which ensures the SVM Classifier receives the most relevant features,enhancing the performance and reduce the computational complexity.



1.Data Collection: The process begins with collecting ECG (Electrocardiogram) data, which contains signals that represent the electrical activity of the heart.

2.Data Preprocessing: Raw ECG data is often noisy. Filtering techniques are applied to remove noise and artifacts.

3.Feature Extraction: Extract features from the ECG segments, such as time-domain features (e.g RR interval) and frequency-domain features.

4.Dimensionality Reduction:

Principal Component Analysis (PCA): PCA is applied to the extracted features to reduce the dimensionality while retaining most of the variance in the data. This helps in reducing computational complexity and avoiding overfitting.

5.Training and Classification:

Support Vector Machine (SVM): The reduced feature set from PCA is fedded into the SVM classifier. SVM is the supervised learning model that finds a optimal hyperplane for classifying the data into different arrhythmia classes.

- **Training Phase:** SVM is trained using labelled data to learn the decision boundaries.
- **Testing Phase:** The trained SVM model is used to classify new, unseen ECG data.

Results & Highlights:

The model Achieved 99.5% of Accuracy.

The model of SVM Algorithm with PCA efficiently classified 16 types of Arrythmia.

Conclusion:

This work classified 16 forms of Arrhythmia using Support Vector Machines (SVM) combined with Principal Component Analysis (PCA). Arrhythmia classification is crucial in cardiology for the accurate diagnosis and treatment of heart rhythm disorders. By leveraging SVM, a powerful machine learning method, and PCA for dimensionality reduction, this approach seeks to enhanced classification accuracy and speed.

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