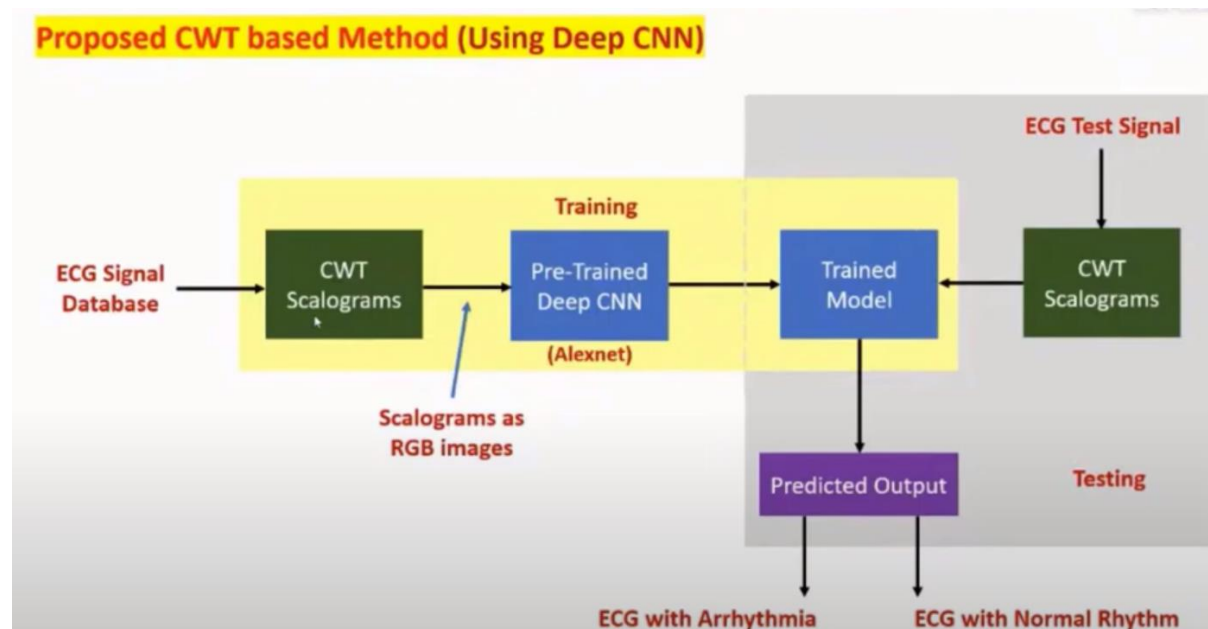
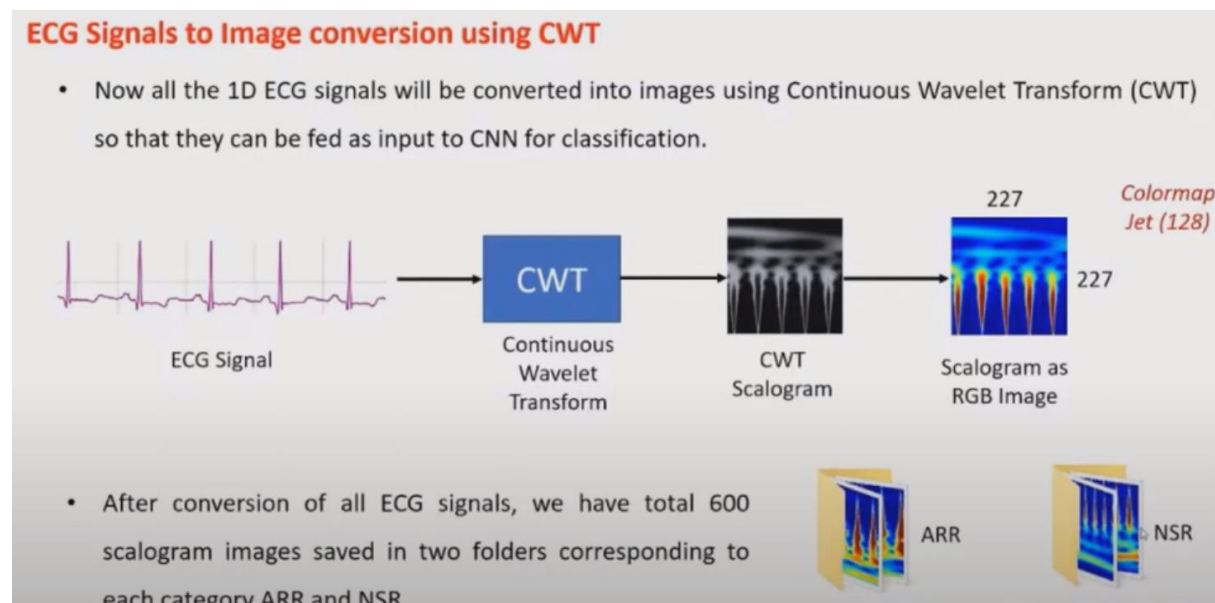


Report on ECG Signal Classification using Continuous Wavelet Transform and Deep Neural Network (CNN)

Methodology:



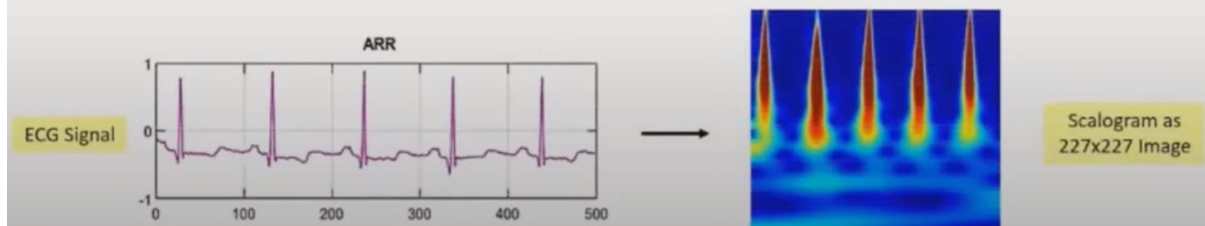
Procedure:



ECG Signals to Image conversion using CWT

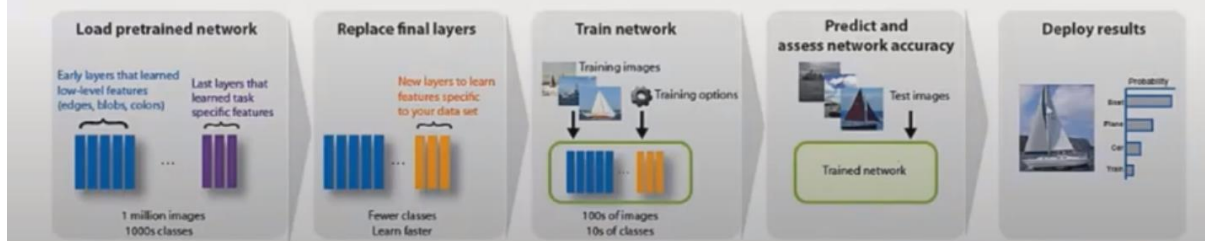
For Continuous Wavelet Transform (CWT), we take following parameters.

- Wavelet used is 'Analytic Morlet (*amor*)'.
 - This wavelet has equal variance in time and frequency.
 - Analytic wavelets are wavelets with one-sided spectra, and are complex valued in the time domain.
- These wavelets are a good choice for obtaining a time-frequency analysis using the CWT.



Transfer Learning via AlexNet

- For ECG signal classification, we will use a pretrained deep CNN: **AlexNet**.
- AlexNet has been trained on over a million images and can classify images into 1000 object categories.
- Fine tuning a pretrained CNN to perform classification on a new collection of images is called **Transfer learning**.
- Transfer learning is quick and easy rather than training a CNN from scratch which requires millions of input images, lots of training time and high speed efficient hardware.



ECG Signals Database

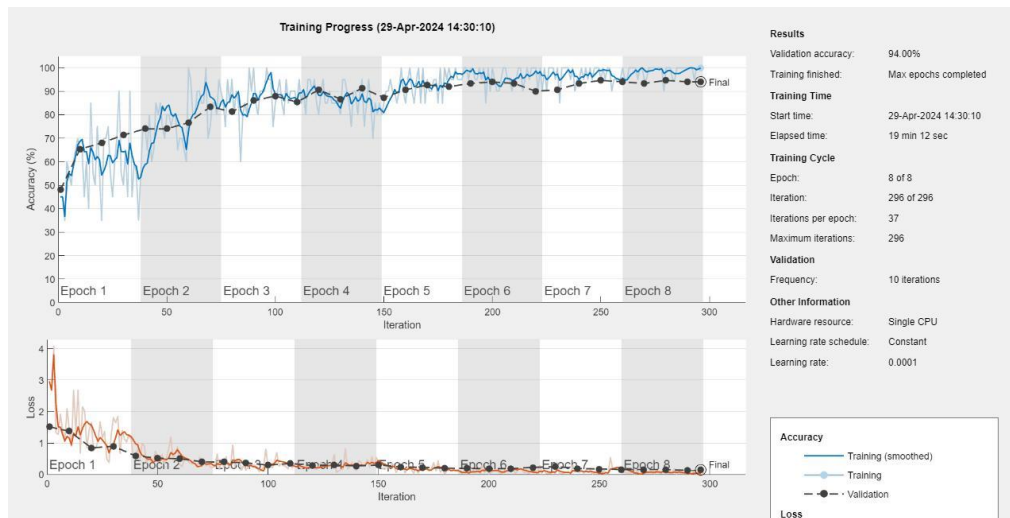
We use ECG signals of three categories:

- Cardiac Arrhythmia (ARR)
- Congestive Heart Failure (CHF) and
- Normal Sinus Rhythms (NSR).

These signals are obtained from 162 ECG recordings from three PhysioNet databases:

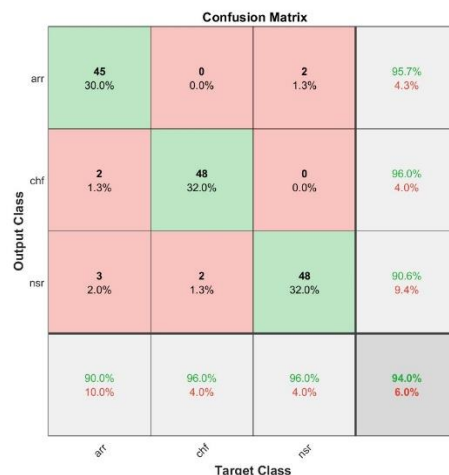
- MIT-BIH Arrhythmia Database (96 Recordings) [ARR Signals]
- MIT-BIH Normal Sinus Rhythm Database (30 Recordings) [NSR Signals]
- BIDMC Congestive Heart Failure Database (36 Recordings) [CHF Signals].

Results:



Validation Accuracy: 94.00%

Confusion Matrix:



Conclusions:

- ECG signals are important to diagnose various heart diseases. Besides manual inspection, computer-aided inspection can also play an important role in almost accurate diagnosis.
- Computer-aided diagnosis saves time, money, and the requirement of expertise availability.
- This machine interpretation can be accommodated in portable hardware devices also that can help people in early diagnosis and medication.
- Wavelets have established their significance in ECG feature extraction and helped deep neural networks to predict accurate results up to 99% accuracy.
- Symlet4 wavelet has proved to be a better choice for ECG signal analysis in DWT, and Analytic Morlet is found better in CWT of ECG signals.