

# Early Detection of Autism using SVM Classifier

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## Abstract

The Autism Spectrum Disorder (ASD) is a Neuro development disorder caused due to damage in the activity of the brain. In this project, the brain waves were collected from the normal and autism subjects using Neuromax 32. The raw signals were extracted by placing the electrodes on the scalp of the subjects. The signals were normalized and allowed to pass through the band pass filter. The filter output is allowed to be subjected to DWT. The features were extracted from EEG signals. Features such as variance, kurtosis, and Shannon entropy are extracted. By using mathematical expressions, the features were extracted. The variations in the features of the normal and autism signals are noticed. The output of the features is given as input to the classifier algorithm named Support Vector Machine (SVM) to classify the signals as normal or abnormal. The EEG datasets are used to train the algorithm and then testing is done to identify the accuracy of classifier.

**Keywords:**

## Introduction

Autism Spectrum Disorder is caused due to damage in brain neurons. It is a neurodevelopment disorder. The child who is affected by this disorder finds difficulty in social communication and repetitive behaviors. They cannot easily interact with others because of deficit in non-verbal communication. They do some restricted or repetitive behavior or repetitive body movements such as rocking and hand-flapping. They failed to develop an appropriate relationship with others. They will not share their emotions or interest with others. They have abnormal eye contact, body language and facial expression or gestures. In their routine life, they always insist on the same route, lack of rigid thinking. They show extreme anxiety or extreme

sorrow on small changes. There may be a strong attachment with particular past but not as a whole object for example they may be fascinated by what of a car but not as a toy. Autism is a spectrum disorders because its symptoms varies widely. Based on the symptoms, the severity can be identified. The center for Disease Control (CDC) determined that approximately 1 in 59 children is diagnosed with an ASD. Boys are diagnosed with autism four times than girls. It is estimated that globally every 1 in 160 children have been diagnosed with ASD. Traditionally when parents found uneven behavior or developmental delays in their child, they usually consult a pediatrician. Doctors and clinicians monitor the child's behavior for making a diagnosis. In recent days, due to rapid

development in medical field its possible to identify the autism early. Electroencephalogram (EEG) is a tool widely used to analyze the brain functions. With the help of EEG, the autism can be identified. If the autism is identified early and if the therapy is started,

the severity can be reduced and the child can have independent life. This proposed method is used for early intervention of autism of children from the age group of four.

### Proposed Methodology:

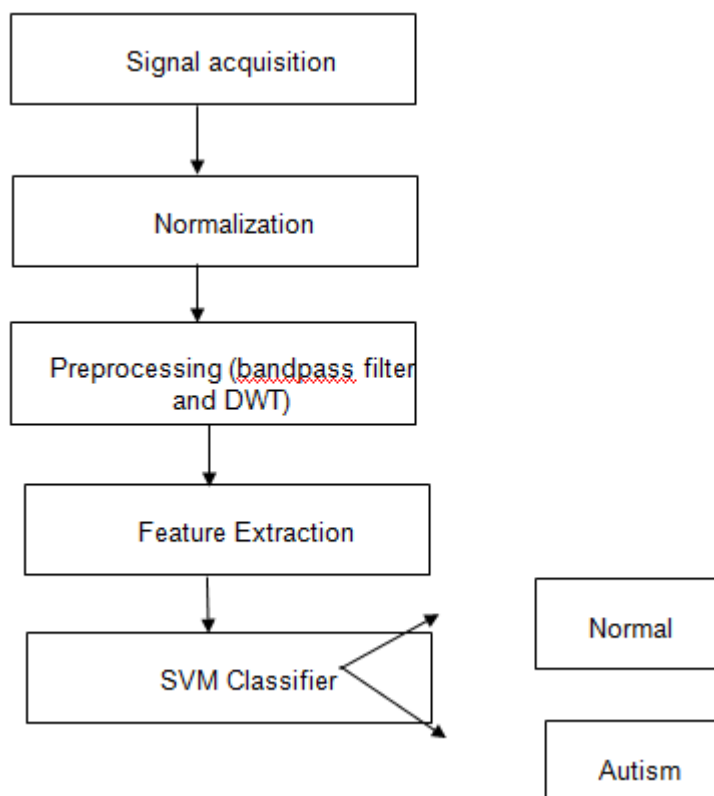


Figure 1. Flow chart of proposed work

The figure 1 shows the process flow of the proposed work. For acquiring the signal the subjects were sedated and the electrode gel will be applied on the scalp for placing the electrodes on the scalp. The EEG signals have been acquired from autism subjects using neuromax 32 equipment. A high resolution video monitoring is also done to monitor the subjects unwanted movements. The acquired signal is normalized between 0 and 1 and then subjected to preprocessing. Preprocessing is a method where the unwanted signals are removed. The useful EEG signals ranges from 0.1 -60 Hz. So a bandpass filter is applied to acquire the required frequency. The preprocessed data were used for extracting the features. The features are useful information within a signal. Many features can be extracted from the time series of EEG signal such as using statistical features or nonlinear features (entropy). The features that are extracted are Mean,

Kurtosis, Power, variance, wavelet entropy, Shannon entropy. From this extracted features Shannon entropy, kurtosis, and variance shows a difference between normal and abnormal signal. The extracted features were given as input the classifier. Here the classifier used is SVM. For signal processing applications, SVM provides a better results and the accuracy of classification is also higher.

### Results and Discussion:

The EEG data from autism children were collected by using a 10-20 electrode configuration using Neuromax 32 equipment.

The figure 2 shows the graphical representation of acquired normal signal. The x axis represents the number of samples and y axis represents the amplitude of acquired signal.

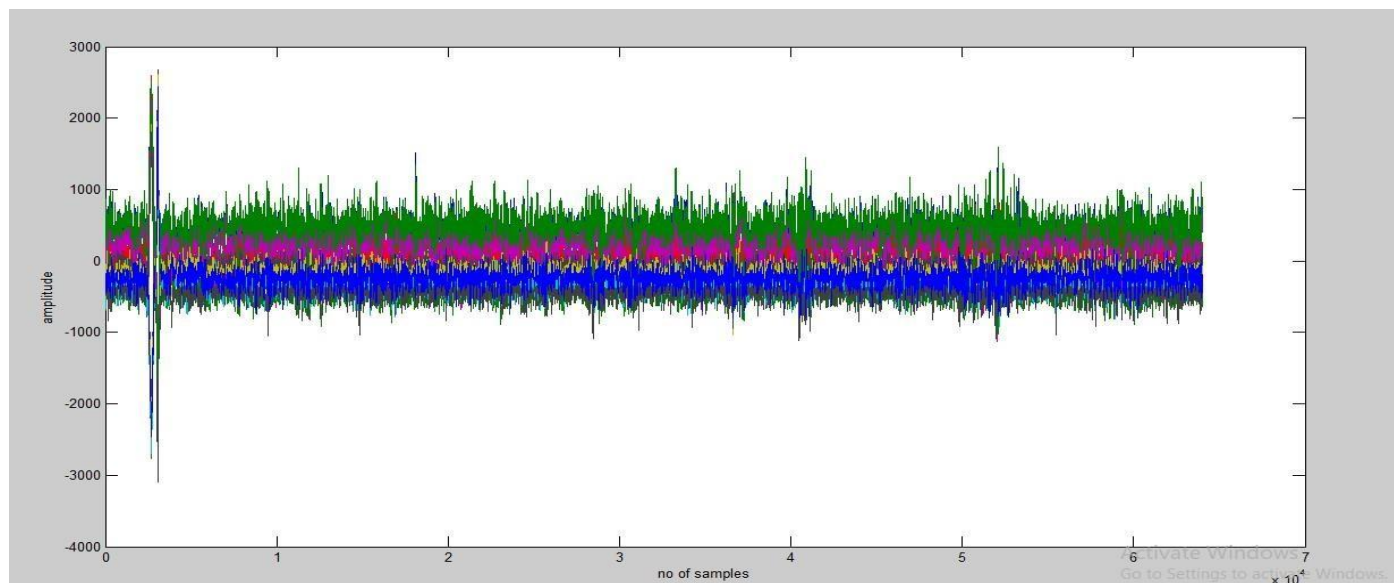


Figure 2. Normal signal

The obtained signal is normalized between 0 to 1. Normalization means reducing the amplitude of the signal to required level.

The normalized signal is then subjected to preprocessing. In preprocessing, the unwanted noise are removed by using a bandpass filter of range 0 to

60Hz. Figure 3 shows the discrete wavelet transform output. The filtered output is subjected to DWT and corresponding detail and approximation co-efficients are obtained. From these co-efficients features are extracted. In this work db4 wavelet is used.

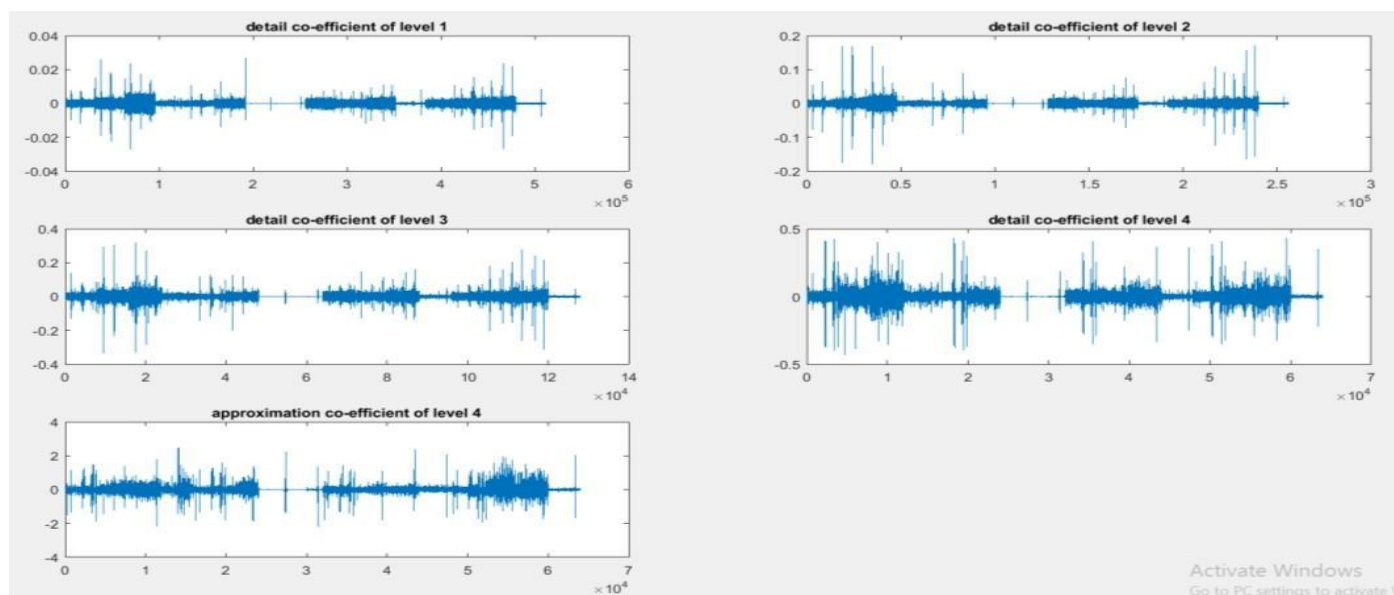


Figure 3. DWT Output

The process of extracting the hidden information from the signal is called as feature extraction. There are many features that can be extracted from EEG signal. But the features that shows variation between normal and autism were selected. The features selected are variance, kurtosis, and Shannon entropy. The extracted features are given as input to SVM classifier. In SVM there are two stages such as training and

testing. The training stage is used to train the classifier with the data set. Once the training is over, then the classifiers accuracy will be calculated by testing the classifier with random subjects EEG signal. The SVM classifier will classify the signal as normal or abnormal signal. Figure 4 shows the SVM classifier output for the normal subject and this figure indicates that autism is not present.

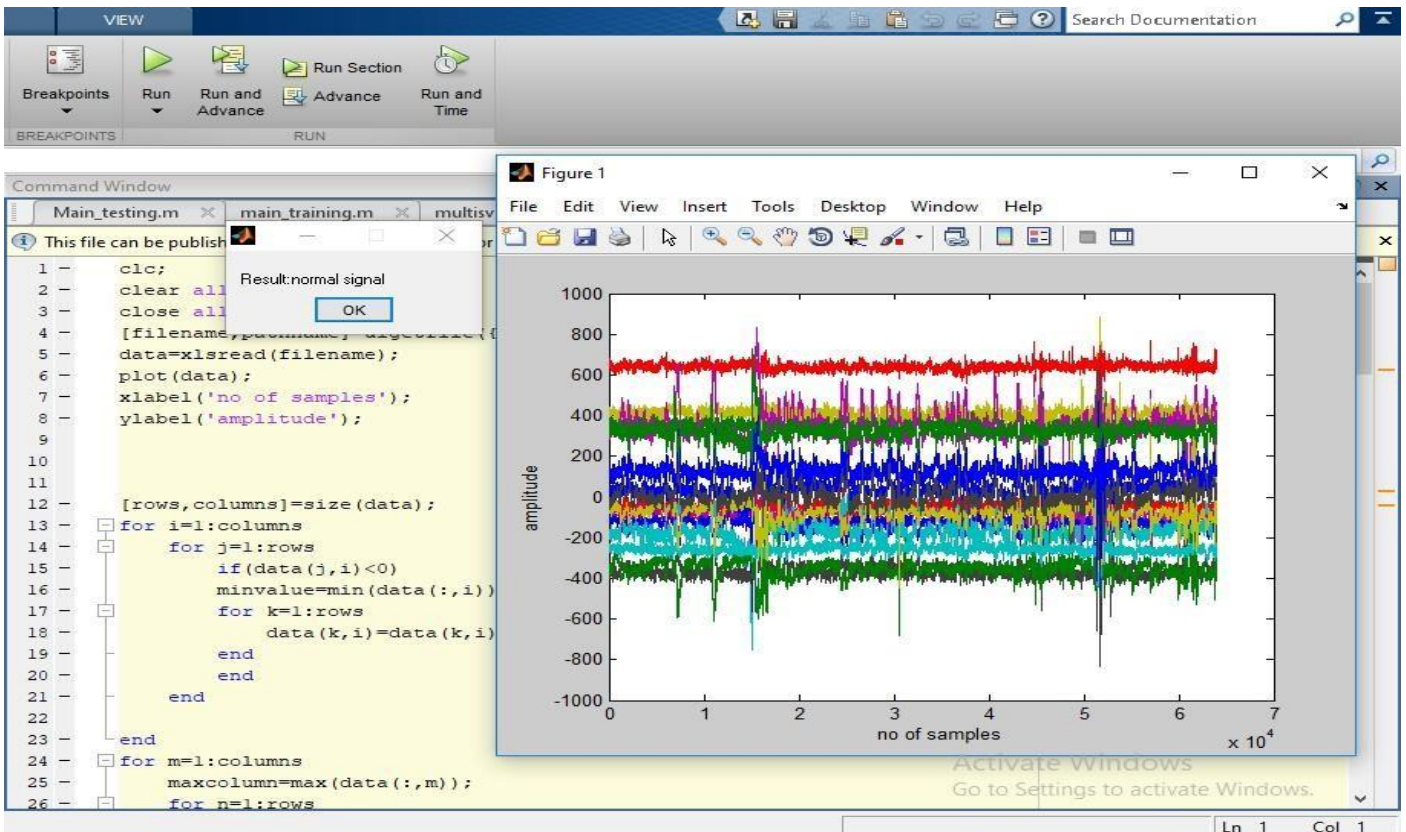


Figure 4. SVM output for normal signal

Figure 5 shows the SVM output of autism subject.

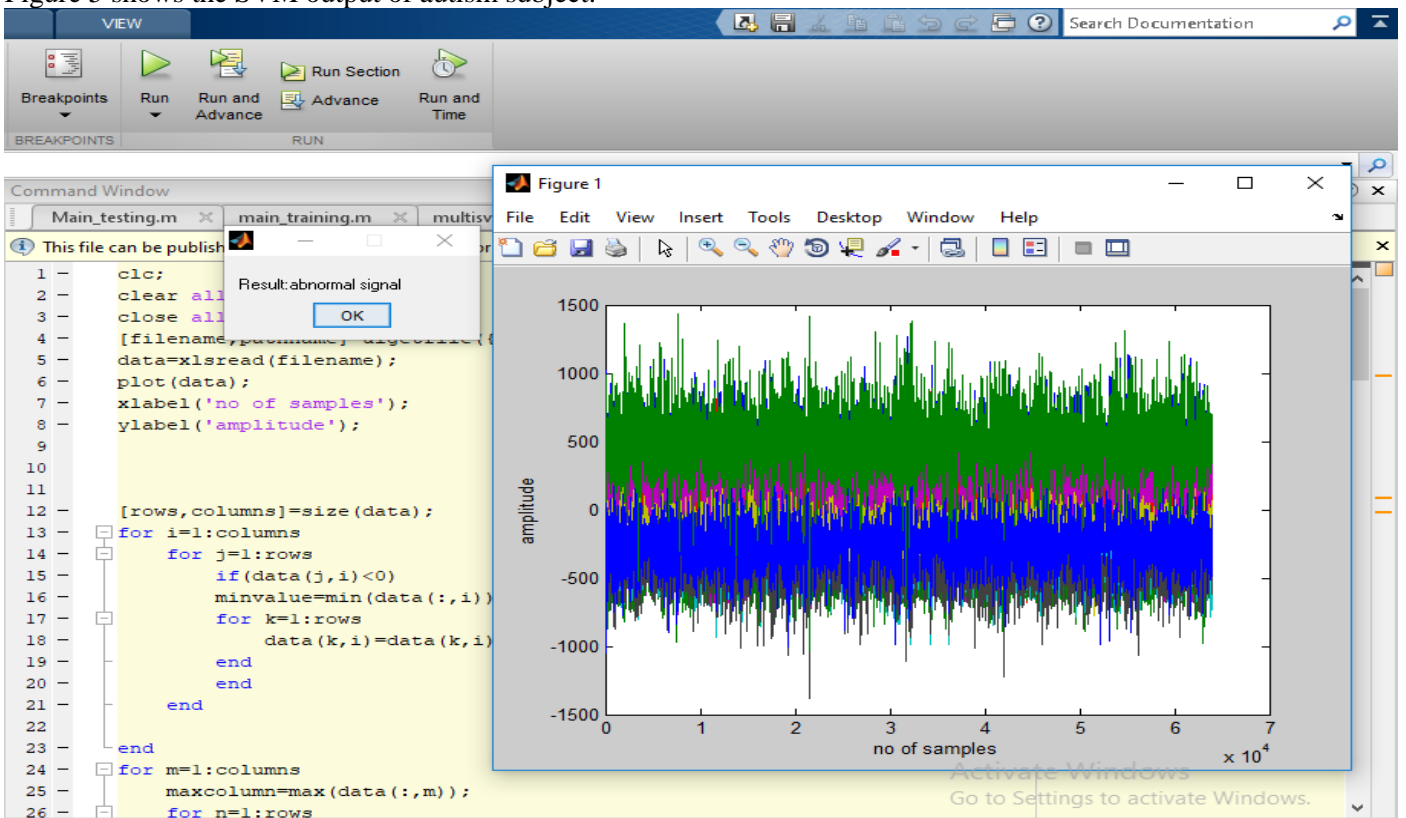


Figure 5. SVM output for abnormal signal



## CONCLUSION

The EEG signals have been used for extracting features due to its nonlinear and non-stationary characteristics. It has been identified that the obtained features were helpful to generate feature space based on symmetric nature for classification of EEG signals for autistic classification, the input feature set for SVM classifier for classification. In SVM classifier for training process we have included 8 abnormal signal and 3 normal signal. 2 normal and 2 abnormal signal was tested in the testing phase. The accuracy percentage for the SVM classifier is 75% i.e., out of 4 tested signal 3 signal produce correct result.

## FUTURE SCOPE

In future, the system can be obtained can be enhanced to classify and focus on early stimulation to ensure optimum cognitive growth and behavioral development which can provide basics for them entally disabled people can lead their life on their own. Also the system can be developed to be useful for classifying the children's mental disorder and identifying the abnormality through an Embedded based system with the huge number acquired EEG signals and also enhance to achieve high accuracy.

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