Schizophrenia (SCH) is one type of psychiatric disorder and it is characterized by either positive psychotic symptoms or negative psychotic symptoms. In the whole world population, 1% of the people are being affected by SCH. Known causes for SCH include neurochemical imbalance, an imbalance in cerebral blood flow, molecular biology and genetic predisposition. 90% of the SCH cases remain untreated in the world. Worldwide almost 94% of SCH is being affected by cognitive deficits and in India, nearly 6-7 million people suffer from this disorder. Hence understanding of SCH itself is a greater challenge to the medical society and this leads to lack of diagnosis and wrong treatment. Leaving them untreated is also a very big societal concern. The diagnosis of SCH is completely based on the Diagnostic Statistical Manual for Mental Disorders IV (DSM-IV).

The neuropathology and etiology of SCH have relationship with brain abnormalities. Therefore, many researchers began to investigate SCH using variety of noninvasive brain imaging methodologies to study about brain volume deficits and abnormalities in the white and gray matter. However, such techniques are not fully incorporated into clinical practice. Therefore, this research has motivation to find suitable clinical diagnosis tool to assist the existing diagnostic methods.

Electrical activity of the brain can be studied using Electroencephalogram (EEG) rhythm which reflects graded potential generated from many neurons. EEG has some advantages over other imaging methods in terms of low cost, high temporal resolution, non invasive, does not expose the subject either to high-intensity magnetic fields or ionizing radiation unlike other imaging methods and does not require to time lock with
stimulus like Evoked Potential and Event Related Potential. Therefore, the objective of this thesis is to analyze EEG of SCH in order to determine whether it can be used as a pre-screening tool or not.

The protocol involves recording conventional EEG and during the mental activity. The conventional method of EEG recording follows the conditions namely eyes closed, Hyperventilation (HV), Post-Hyperventilation (PHV), and photic stimulation at various frequencies. Two modified visual odd ball paradigms are designed to stimulate mental activity and named stimulus1 and stimulus2 and EEG is recorded. The study design methodology is approved by the Institutional Ethics Committee of Madras Medical College, Chennai, India. Thus totally 52 SCH and 29 normal subjects are selected for this study as suggested by doctors. EEG is recorded initially with conventional recording and then during presentation of stimuli. Artifact in the EEG signal is removed using pre processing, especially eye blink artifact is removed using AMUSE algorithm.

Initially EEG signal is analysed using power spectrum analysis. The power spectrum study is carried out in to two ways namely, absolute power analysis and peak power and frequency analysis. The amount of power in a specific band of frequencies is known as absolute power. To study the characteristic changes of EEG, absolute power of delta (δ), theta (θ), alpha (α), and beta (β) band are calculated and they are selected as features. EEG signal is filtered with band pass filter and then the Welch power spectrum is used to estimate the power from EEG signal. The EEG signal band powers are calculated for all 16 channels and then averaged for each subjects groups. These power values are analyzed in various recording conditions used. In this analysis, by statistical test αₚ is found to be more discriminative for SCH. The maximum amount of power in a specific band and its corresponding frequency are called peak power and peak frequency. In this analysis, peak power and peak frequency of δ, θ, α, and β bands are considered as features.
16 channels average for each group is considered for analysis. This type of analysis is carried out at all recording conditions used. Out of eight features analyzed, $\theta_{PF}$ becomes statistically significant because it provides maximum difference between normal and SCH in all recording conditions.

The non linearity of brain signal is studied by complexity analysis. It is decided to determine Information Entropy (InEn), Shannon Entropy (ShEn), Spectral Entropy (SpEn), Higuchi’s Fractal Dimension (HFD), Kolmogorov Complexity (KoC) and Approximate Entropy (ApEn) because these are the most popular features used to analyze the nonlinearity of the brain signal. 16 channel averages of each subject groups at various recording conditions are determined. In this analysis, both HFD and ApEn become more discriminative features than other complexity measures. Similarly, stimulus2 and PHV are found to be primary recording conditions because at these two conditions all features are significant.

The significant features are grouped according to the recording conditions. In addition to that, five feature group combinations such as ‘st12’, ‘con’, ‘const1’, ‘const2’ and ‘all’ are formed to analyse the classification performance. Significant features from each analysis are grouped according to these 11 features set combination and then it is tested with Back Propagation Network (BPN) classifier. Out of data from 52 SCH, data of 36 subjects are used for training and the data from remaining 16 SCH are utilized for testing and validation. Similarly, 20 normal subjects’ data are used to train the classifier and the remaining 9 normal subjects’ data are used to test and validate the performance of the classifiers. Out of three analysis, the feature set corresponding to the combination const2 with features from complexity analysis provide the highest sensitivity of 88%, specificity of 75% and accuracy of 82%. The significant features from all the three analysis are joined according to the 11 feature set combination and these new additional 11 feature sets are tested with BPN classifiers. The BPN designed with
feature set corresponding to ‘All’ has produced maximum sensitivity of 96 % and specificity of 90 %.

Another widely used classifier namely Support Vector Machine (SVM) is also used to see whether this will improve the classification performance. SVM produces highest sensitivity of 98 % and specificity of 95 %, for the feature set corresponding to ‘const1’ when all the three analysis features are combined together. Thus it can be concluded that SVM classifier is better than BPN and 98% sensitivity is obtained by SVM when the conventional recording EEG features are combined with stimulus1 activity features.

To determine cost effective pre screening tool which can assist the existing diagnostic methods for SCH subjects, EEG signal is analysed for both normal and SCH subjects. Signal analysis is carried out by both the power spectrum method and non linear methods. From these analysis, three features such as $\alpha_{pr}$, $\theta_{PF}$ and HFD are identified as significant features to discriminate SCH from normal. This research also tries to find out the recording condition and combination of the features which will be helpful to detect SCH with high classification accuracy. Two classifiers namely BPN and SVM are used to classify the features. SVM classifier produced 98% sensitivity for the feature set corresponding to ‘const1’ which includes features from conventional EEG and during the presentation of stimulus1. Thus, it can be concluded that EEG can be used as pre screening tool to detect and classifying the features of SCH, because 98% sensitivity is achieved by this research. From this result, it is also inferred that in addition to conventional recording EEG, mental activity EEG strongly supports for classification of SCH.