Decoding the patterns of human brain activity for different cognitive states is one of the fundamental goals of neuroimaging. Recently, researchers are exploring new multivariate techniques that have proven to be more reliable, more powerful, more flexible and more sensitive than standard univariate analysis. Multivariate techniques are so powerful that these can decode the patterns in Functional Magnetic Resonance Imaging (fMRI) data without selection of voxels, moreover they have the ability to decode the brain activities even with Electroencephalography (EEG) signal which is considered as a weak signal. In this study, simultaneous data for EEG and fMRI is collected to evaluate if EEG can produce comparable results under same conditions i.e. subjects, time and analysis techniques. There is no such study reported which has compared the accuracy of both modalities under same circumstances but a few studies have compared the performance of EEG and fMRI techniques through separate data collection. During the analysis of EEG and fMRI using MVPA, an average accuracy of 64.1% and 65.7% is found for fMRI and EEG respectively. Furthermore, this thesis presents a hybrid algorithm which is a combination of Convolutional neural network (CNN) for feature extraction, likelihood ratio based score fusion for prediction. The CNN model is specially designed with one convolutional and one pooling layer for one dimensional EEG data. The proposed algorithm is applied to three different real time EEG data sets. A comprehensive analysis is done using data of 34 participants and the validation of proposed algorithm is done by comparing results with the current recognized feature extraction and prediction techniques. The results showed that the proposed method predicts the novel data with improved accuracy of 79.9% compared to wavelet transform-SVM which showed an accuracy of 67%. In conclusion, the proposed algorithm has outperformed the current feature extraction and prediction methods.