

# Intelligent Emotion Recognition System Using Brain Signals (EEG)

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**Abstract**— Human emotion is a complex and psycho physiological state of mind which can be expressed as positive or negative reactions to external and internal stimuli. Typical communication channels that indicate emotions are voice and facial expressions. People who are paralyzed or have other severe movement disorders have no way of expressing their emotions thereby forming a wide communication rift between them and the outside world. Communication through eye tracking is one of the alternative ways of giving such disabled patients to interact with the outside world. This paper investigates the possibility of recognizing emotions using signal processing of Electroencephalography using discrete wavelet transform and feeding appropriate values to an adaptive neuro fuzzy inference system for classification. The system enables severely disabled as well as able users to interact with the system using eye movement in order to respond to detected emotion. The solution can be used to detect emotions of motor disabled people and provision a means of communication; also it is a learning tool for trainee neurologists. The prototype was built using Matlab successfully and it was evaluated by experts and the intended users very creditably stating it as a useful software for disabled people.

**Keywords**— *Signal processing, Adaptive neuro fuzzy inference system, Discrete wavelet transform, Relative wavelet energy, Intelligent Emotion Recognition System, Eye tracking.*

## I. INTRODUCTION

The measurement of electrical activity of human brain scalp through electrodes is called as Electroencephalography (EEG). The use of EEG signals is powerful as a vector of communication between men and machines measuring emotions as the signals measured from the central nervous system will give a relationship between psychological changes and emotions. The aim of this project is to design, develop and evaluate an interactive and intelligent emotion recognition system which uses brain signals for identification and classification of emotions and enables severely disabled as well as able users to interact with the system using eye movement. For this emotion experiment alpha band has been

used for the detection of happy, fear and disgust emotions. EEG recordings for the emotion analysis were obtained from a database for emotion analysis using physiological signals at DEAP [1]. These physiological signals contain recordings of 32 participants as each watched 40 one-minute long excerpts of music videos. The dataset is sampled 128Hz segmented in to 60 second trials and a 3 second pre-trial baseline removed. A band pass frequency filter from 4.0-45.0 Hz was applied [1]. The pre-processed signals are decomposed into five different frequency bands (alpha, beta, gamma, theta, delta) using Discrete Wavelet Transform (DWT) and *db4*. These numerical features are classified using Adaptive Neuro Fuzzy Inference System (ANFIS).

Eye tracking has been focused in the researching domain of human-machine interaction and computer vision in recent years as it plays an important role in many applications such as helping domain, psychology domain and human-machine interaction. OpenCv library has been used for motion and eye tracking of human eyes which interprets eye movements in real time to control a nonintrusive interface for computer users with severe disabilities in terms of responding to detected emotions via eye movements.

The next section II summarizes the research methodology by elucidating the data acquisition process, feature extraction using wavelet transform, and classification of emotions, eye tracking techniques and ways of interactions.

## II. RELATED WORK

Over the past decade many systems have been designed for research purposes, to test and analyze different techniques and methods for emotion recognition from brain signals. The following presents some collaborative Brain Computer Interface (BCI) researches in education and the related work done in the area of eye tracking and the ways of interaction methods used in various developed vision based systems.

EEG has several strong points as a tool for exploring brain activity compared to other approaches such as Positron Emission Tomography (PET) and Functional magnetic resonance imaging (fMRI) as it give immediate response, high time resolution and low cost [2].