

Study Of Behavior Addiction Using EEG Signals Analysis

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Abstract: Mobile phone is currently one of the main sources of information and communication. The use of mobile phones has increased significantly over the past two decade. Although mobile phones were initially limited to only calls and messages, with the development of technology mobile phones are also upgraded and smart phones have taken places in the market. Smart phones are used for many reasons and video games are one of them. There are several positive usages of mobile phones but mobile game addiction is one of the leading cause of psychological and physiological issues among users. The purpose of this study is to investigate the difference between mobile game addicted and non-addicted users using electroencephalography (EEG). In this study mobile users are asked to play a mobile game and their brain signals were recorded by BIOPAC equipment and a data acquisition software. EEG signals were recorded from occipital, parietal, frontal, and lobes of the brain. For this study participants were asked to play a video game and a 60 seconds time window was chosen for signal analysis. This study is conducted into two parts, in the other stage a survey based data was collected and CGS manual study 2010 was employed for this purpose, and results of this survey was concluded that five participants were addicted and 10 were not addicted. This survey study is used as prior information to categorize the participants into addicted and non-addicted groups. Cluster analysis technique was used to categorize the addicted and non-addicted participants.

Index Terms: EEG analysis, Addiction, Psycho-physiology, Mobile Game

1 INTRODUCTION

Symptoms of video game playing addiction are very close to the other addiction types with characteristics of compulsive behaviors like isolation from other activities [1], lack of interest, more closeness to other addicts like them, hiding their spent time in playing, aggression, anger, and out of control feeling due to not getting apart of game playing activity, repetitiveness of game playing activity most of times. Even in those times playing games was not easy and accessible as today. People caught in games had to go to arcades for playing and spent a lot of money on this activity [2]. The above mentioned social pathological problem was more supported by Mark Griffiths [3] by pointing out the case studies based on the internet/computer game playing addictions. It was observed that the subset of behavioral addictions components like "salience, mood modification, tolerance, withdrawal, conflict and relapse" are justified by the objects under consideration in those case studies. But the author concluded that all of the subjects were seem to be addicted but following the "Addiction Components Criteria" only two of the five subjects could be declared addicted. Others did not match the all specifications of being called "computer game addicts".

It was observed by author that the objects using computer for other applications than game were lacking the specific characteristics of being called the addicted, so maybe it's the software or application that can cause the user to become addicted. e.g., any specific features of game can cause the addiction to its players or users. But as a matter of fact behavioral addictions do exist in reality and may be treated in

a bit different way than treating the substance based addictions[3, 4]. Brown [5] defined a six point criteria which may be summarized as "Saline, Euphoria, Tolerance, Withdrawal symptoms, Conflict, Relapse and Reinstatement". Recently more research is emphasized on problematic mobile phone use. Which is mostly due to game playing or social networking. A scale was developed and validated by research on a large number of health effect related to mobile phone use in adolescents. From this study it was concluded that there are two categories for the problematic mobile phone use, one is for personal entertainment and other is for social connectivity and interaction [6]. Another point in this research was the root cause of the problematic game involvement whether it is game itself or the nature of the player or some special features of player or game played. There are very few physiological studies in this area that support the evidences of neural features. Many studies have invaded the problematic game addiction psychologically and suggested that game addiction may be harmful enough to be categorized as other addictive disorders. Especially if we talk about some specific countries like US, China and South Korea, there are professional gamers (pro-gamers). There are currently employed by KeSPA (Korean e-Sports Association), they as with other sports players, have contracts, an annual salary, and belong to teams in game village. But the point here is that behavioral. Keeping in mind all the above mentioned factors we have tried to find any physiological measure to differentiate the addicted and non-addicted mobile game players from the EEG signal of a limited set of objects.

2 METHODOLOGY

In this study mobile users are asked to play a mobile game and their brain signals were recorded by BIOPAC equipment and a data acquisition software (ACKNOWLEDGE). EEG signals were recorded from occipital (O1, O2), parietal (P3, P4), frontal (Fp1, Fp2), and lobes of the brain. Participants were asked to play a video game and a 60 seconds time window was chosen for signal analysis. The frontal lobes deals with emotions, personality, and behavior control. The parietal lobe deals with arithmetic, logical understanding, and perception. Therefore the occipital lobe deals with visual tasks. The players were carefully selected for this experiment by

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including the non-gamers, addicted gamers and those who play game just to kill time or as leisure activity. And survey confirmed our results which were more clearly interpreted during the EEG signal analysis. All the preliminary steps were carried out before analyzing the data as shown in Figure-1. The whole process starts with acquisition of EEG data the removal of EOG artifacts, signal preprocessing, and then applying the cluster analysis tool using Matlab software.

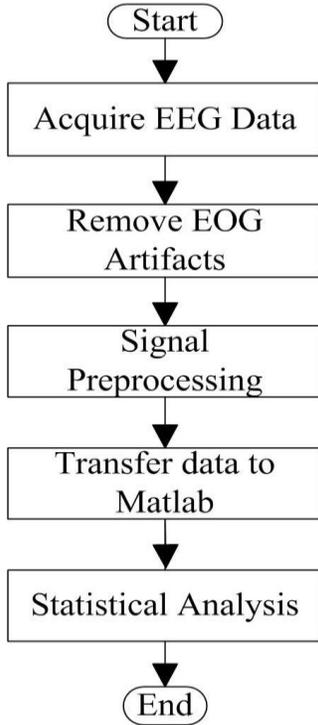


Figure-1: Flow diagram for EEG data processing steps

3 RESULTS

When we calculated the clustering based on mean it categorized the data according to one parameter i.e. mean and same with standard deviation based clustering results. The combined mean and standard deviation based clustering gave us confined results of a specific category that is on the mean of data and also very closely distributed among the mean value. These findings were observed in Occipetal area of theta frequency clearly. The figures shown below is cluster from occipital area (O2) of theta frequency wave. Figure-1 is mean based single dimensioned cluster and Figure-2 is standard deviation based single dimensioned cluster, Figure-3 shows the two dimensional mean and standard deviation based cluster.

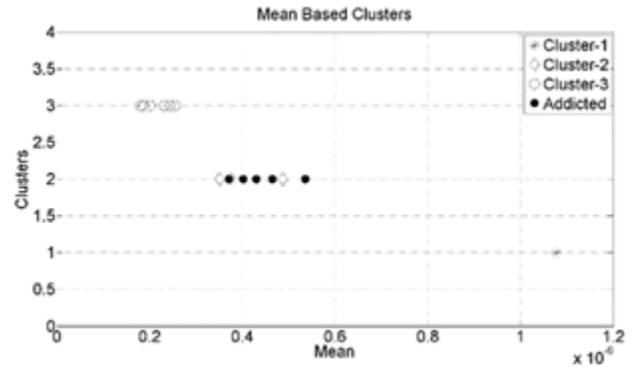


Figure-1: Mean based single dimensioned cluster

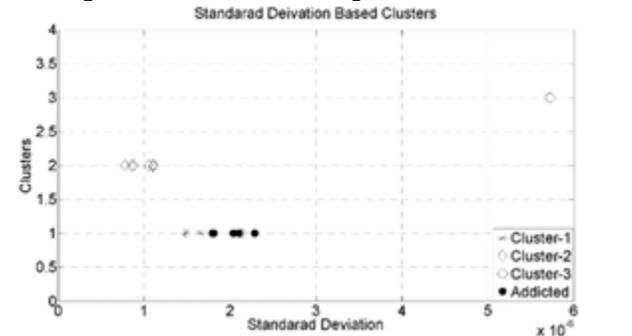


Figure-2: Standard deviation based single dimensioned cluster

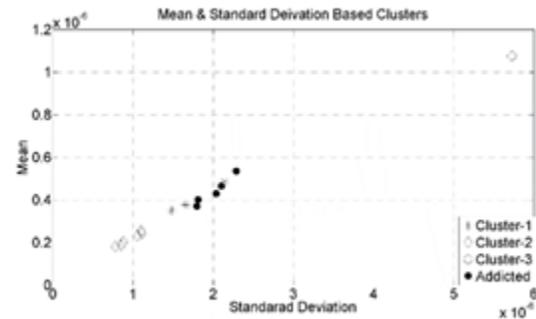


Figure-3: Two dimensional mean and standard deviation based cluster

In the following figures from the O1 of theta range, it can be observed in Figure-5 that mean and standard deviation based single dimensional as well two dimensional clustering results showing in Figure-6 and Figure-7 categorized the all addicted players in the same cluster.

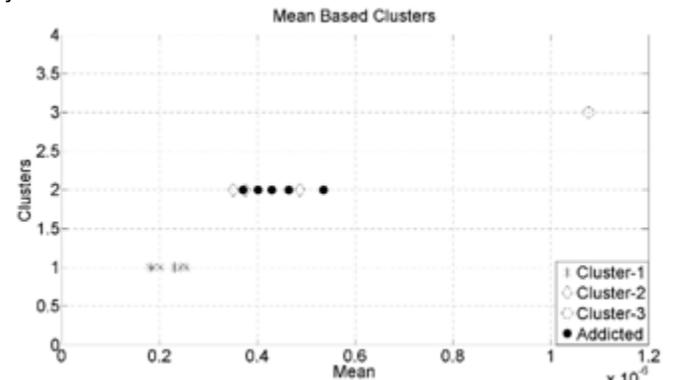


Figure-5: Mean based single dimensioned cluster

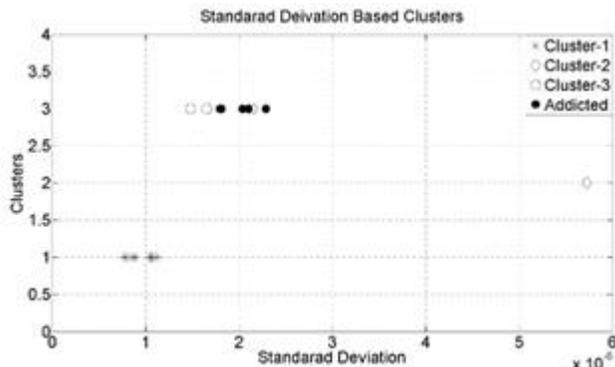


Figure-6: Standard deviation based single dimensioned cluster

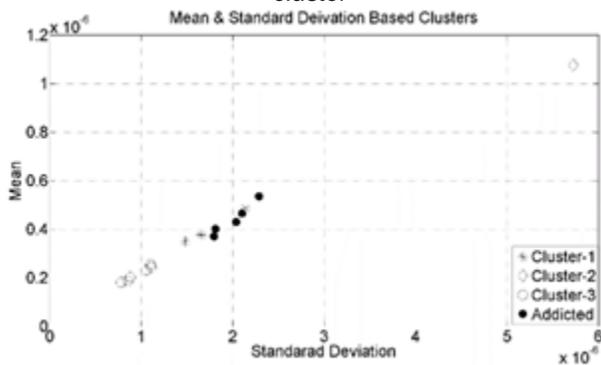


Figure-7: Two dimensional mean and standard deviation based cluster

4 CONCLUSION

The main reason to investigate the mobile game addiction correlates was that already some research regarding certain magnitude and variability in amplitude of EEG was shown in different papers by this lab. This arose curiosity about the different factors which may be invaded and related more with mobile game addiction using EEG data. It was observed that theta, alpha, and SMR (sensory motor Rhythm) has some differentiation in game addicted and non-addicted players using their EEG samples. From that study and other researches in similar area it was observed that by further research we can confirm the exact variables and indicators for game addiction. As a preliminary step in this regard I carried out the following experiment. The data plots of signal and its PSD clearly showed that the three clustering plots showed the confirmation of our surveyed results in almost most of the regions but specifically in theta and delta range of PSD during game playing. The clustering of theta at O1 and O2 distinctly separated the addicted subjects from the non-addicted, in case of delta plots there was one or two person showing non synchronized results from our expected findings. Prior researches also had implemented some more techniques for analyzing the EEG data and I am also implementing them into my further research. This clustering analysis helped to distinguish the addicted and non-addicted samples. So it may be used as first step to preliminary analysis. More promising technologies can confirm our results and can be used as confirmatory analysis.

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