EEG Signal Analysis In Detecting Pornography Addiction : A Systematic Literature Review

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***Abstract*--- The increasingly rapid digital development greatly affects addictive behavior, one of which is pornography addiction. Pornography is the depiction of sexual subjects with the aim of being a means of venting sexual arousal. Pornography addiction is an addiction to compulsive sexual activity along with the use of pornographic content. The continuous use of pornographic content can have a negative impact on individuals both in terms of health and social. One of the technological development in the health sector is the discovery of a tool that can describe brain activity. Brain-Computer Interface (BCI) provides a communication channel between humans and external devices by decoding brain activity patterns. EEG is one of the most widely used methods in BCI due to its economic efficiency and high transient resolution. EEG-based BCI image with Naïve Bayes method is expected to be able to classify someone who has addiction and non-addiction towards pornographic content.**

Keywords--- Brain Computer Interface (BCI), EEG, Addiction, Addiction, Porn, Pornography

I. INTRODUCTION

One of the technological development form in the health sector is the discovery of a tool that can describe brain activity, namely the Brain Computer Interface. By decoding brain activity patterns, the Brain-Computer Interface (BCI) creates a communication channel between humans and external devices. [1].

Because of its cost-effectiveness and excellent temporal resolution, electroencephalography (EEG) is one of the most commonly utilized BCI technologies. [2]. The EEG is comprised of electrodes that monitor brain activity from the scalp. The brain contains 100 billion neurons, and information is sent from one neuron to the next via neuron firing. The EEG electrodes measure changes in the electrical potential of the neuron. Each electrode node has a letter for locating a lobe, as well as a number or other letter for identifying the hemispheric area, which can be found on either the right or left side of the scalp. The electrodes are separated by a specified distance. [3].

The steps of EEG-based BCI operation are as follows: recording, feature extraction, and classification. The fundamental approach in feature extraction in BCI with motor pictures is event-related desynchronization (ERD)/event-related synchronization (ERS) analysis. The overall accuracy of EEG-based BCI motor imagery is heavily dependent on the extraction of informative aspects of the ERD/ERS pattern that corresponds to a specific body part [4].

Pornography is the depiction of a sexual subject with the aim of being a means of venting sexual arousal. A pornography addiction is an addiction to compulsive sexual activity in conjunction with the use of pornographic content, regardless of the

negative consequences on the individual's physical, mental, social or financial well-being. Pornographic content can be sourced from various electronic media, print media, to the internet [3]. Based on data released by “Pornhub” which is one of the most popular porn sites in the world, revealed that in 2019, there were more than 42 billion visits to its website. [5]

Exposure to pornographic content can increase the incidence of sexual violence such as cases of harassment and rape. As many as 40 percent of the 28 percent of women who have experienced sexual violence, reported that they reported that pornography played a role in the incidents of harassment they experienced. In some cases, the perpetrator had watched pornography before harassing the woman, in another case the abuser used pornography during the harassment, and in other cases the perpetrator forced his victim to participate in the making of a pornographic film [6].

There are some researchers which related with this research topic. But only a couple of them discuss specifically. This literature review aims to identify and analyse recent research of detecting pornography addiction by conducting a Systematic Literature Review (SLR).

II. METHODOLOGY

A. *Review Method*

This paper reviews many research works related to EEG Signal Analysis In Detecting Pornography Addiction. There are three steps in reviewing the literatures, those are planning stage, conduction stage, and reporting stage.

The first stage is to figure out what materials you'll need for your literature study. The writer was looking for a lot of information on how to use a Brain Computer Interface in a variety of situations. The focus was then refined to the use of brain-computer interfaces (BCI) in the detection of pornography addiction, specifically EEG-based BCI. The writer creates a review protocol for the following one in order to limit the scope of the study by defining research questions, literature sources, search strategy, selection criteria, data extraction methods, and synthesis procedure.

The conduction stage is the next step. At this point, the review procedure is used to conduct the literature review. This process entails conducting a search, gathering, selecting, and extracting the resources required, and then synthesizing the literature. The final step is to format the report in the IEEE Xplore double-column A4 format.

B. *Research Questions*

The following research questions might be used as a guide to keep the reviews on track:

RQ1. What are the impacts of pornography addiction?

RQ2. What kind of BCI method are mostly used in detecting pornography addiction?

RQ3. How the EEG based Brain Computer Interface could detect the pornography addiction?

To address the research question, the complete parts of the selected publications will be analyzed.

C. *Seacrh Strategy & Selection Criteria*

The first stage in gathering literature is to conduct a search for all relevant material on the research topic. Begin by searching for terms such as "porn addiction," "EEG-based BCI," "pornography," and so on. IEEE Explore, SCOPUS, Springer, etc. were used to search and obtain literature.

In addition, the writer apply filtering to the search results based on the following selection criteria :

1. Search results The search results are limited to papers published between 2016 and 2022.
2. Journal and conference paper is a type of source.

To manage those literatures, Mendeley Desktop is used as a reference management tool.

Because the research is still in its early stages, the writer select all the related paper. There isn't any specific reselecting process.

Table 1 Selection Criteria

Inclusion Criteria	1. Papers which related with Pornography addiction 2. Papers which related with EEG based BCI
Exclusion Criteria	1. Papers which unrelated with Pornography Addiction

III. RESULTS

In the following table would shows the number of papers by searching result filtered results and selected paper. But There are several papers which doesn't written but used to clear some statements on this paper. The following table is the results of "Porn Addiction" keywords results in SCOPUS.

Table 2 Number of Selected Paper

Search Results	Filtered Results	Selected Paper
55	37	15

Following the review methodology outlined in the preceding section, the results were acquired.

A. *The Impacts of Pornography Addiction*

Based on the review, almost all of the selected paper discuss the effects of pornography addiction on a person.

Though other labels have been proposed, such as sexual compulsivity, hypersexuality, out of control sexual behaviors, dysregulated pornography use, and problematic pornography use, to mention a few, sex addiction and porn addiction remain the most commonly used phrases. [7] In another study has discuss about perceived addiction to internet pornography (PAtIP). PAtIP has been associated to anxiety and depression, spiritual challenges such as resentment toward God and feelings of moral failure, lower self-esteem, relational difficulties, alcohol usage, and decreased sexual satisfaction, among other things. [8]

Pornography addiction could lead into Compulsive sexual behavior disorder (CSBD) which has been included in the eleventh revision of the International Classification of Diseases (ICD-11) as an impulse control disorder [9]. Individuals with CSBD engage in a wide range of sexual behaviors. Examples include masturbation, pornography, phone sex, cybersex, strip club trips, paid sexual services, excessive fantasizing about sex and sex activities, and sex with consenting individuals. Although masturbation, pornography use, cybersex, having multiple sexual partners, and searching for sexual fantasies are the behaviors most commonly reported by people with CSBD, unsatisfying or unprotected sexual intercourse and having multiple sexual partners are the behaviors most commonly described as problematic for people with CSBD. Individuals with CSBD are more prone to suffer the most visible negative consequences as a result of the latter activities, even if the former are the ones with which they spend the most time.

Another study [10] has revealed Males with higher trait impulsivity and impulsive action tendencies in uncertain settings, as well as stronger desire responses, reported significant symptoms of Internet Pornography-use Disorder (IPD). IPD is a term used to describe a specific type of Internet-use Disorder (IUD) that is characterized by a loss of control over the consumption of pornography on the Internet. This effect was only observed when individuals were exposed to pornographic content, not when they were in a neutral context. The study's samples included fifty heterosexual male pornography consumers, aged 23 on average, who stated that they are heterosexual and enjoy pornography depicting heterosexual intercourse. To recruit participants, local ads at the University of Duisburg-Essen and online marketing in the university's internal networks were used.

B. *Method Are Mostly Used In Detecting Pornography Addiction*

Addictive behaviors are mirrored in brain activity. Magnetic resonance imaging, EEG, neuroendocrine, and cognitive studies could show that people with hypersexual or pornographic experiences have different brains. [11]

The pornography addiction with MRI was studied by [12]. The ventral striatum was discovered to be linked with pornographic materials. They chose 19 men, with an average age of 25. The Internet Addiction Test (sLAT) was used to assess the participant's cybersex addiction. The study looked at whether participants experienced negative consequences of cybersex addiction, such as loss of control, social problems, and mood regulation. Additional questionnaires have been distributed to the participants. They administered the Sexual Excitation Scale (SES), Hypersexual Behavioural Inventory (HBI), and Brief Symptom Inventory (BSI) to all participants.

In addition to the assessment tools, participants were required to value a task with 120 trial images taken with an MRI machine. The fMRI scanner is a 7T whole-body research scanner (Magnetom 7T, Siemens Healthcare, Erlangen, Germany) with 32-channel signal generation and reception. SPM8 (Statistical Parametric Mapping, Welcome Trust Centre for Neuroimaging, London) was used to process the image data. According to the findings of the MRI, ventral striatum activity revealed the subjects' moment-by-moment sexual arousal in response to various pornographic images. The MRI image for the neural response to pornography images is shown in the figure below.

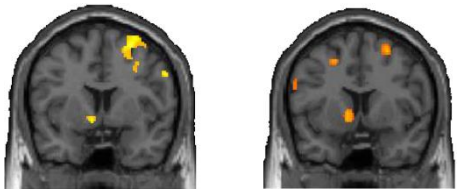

Figure 1 fMRI Image of The Brain Responding to The Pornography Content

EEG based BCI has ever been used for analyze the porn addiction to learning disabilities. The [13] study used EEG signals to examine porn addiction in children with learning disabilities. They have chosen 13 children from the clinic as participants (male = 9, female = 5). They measured the EEG signal with their eyes open and closed using 19-channel EEG devices and BrainMarker. Following the collection of signals, a psychological team conducted the questionnaire session. For data analysis, they used pre-processing and a bandpass filter. The noise data will be removed during the pre-processing step. The bandpass filter will remove the unwanted frequency. They select theta, alpha, and beta bands for further investigation.

In the other study, machine learning approach for porn addiction detection was ever been used by [3], but still correlated with EEG data imagery. The International Islamic University Malaysia (IIUM) researchers prepared the data collection for 14 Indonesian teenagers using an electroencephalogram (EEG) device. EEG data was collected from 14 participants ranging in age from 9 to 13 years old, but only 11 participants' data were used in this study. The data set includes 7 addicts and 4 non-addicts, with data on both closed and open eyes for each participant. For eyes open and closed data, there are five band waves: alpha, theta, gamma, delta, and beta. Each band wave was divided into two basis functions based on Valence and Arousal data. A participant is involved in 880 instances, and all of the data received is in numerical values. Pre-processing of EEG raw data removes unwanted artifacts such as background noise and movement data. Then, to obtain the relevant features, the Mel Frequency Cepstral Coefficient (MFCC) feature extraction method is used. They used three classification method in their research, those are Multi Layer Perceptron, Naïve Bayes Classifier and Randrom Forest Forest.

C. *Detect The Pornography Addiction EEG Based Brain Computer Interface*

The first step to detect the pornography addiction with EEG Based BCI is determine the method for the classification until the data extraction method. Then, begin to find and gather participants with the pre-defined criteria. For the next step, begin to collect dataset from the experiment activity.

The study from [14] they collected the dataset Using a 19-channel Brain Maker gadget. P4, O2, P8, T8, C4, Cz, Fz, F4, Fp2, F8, Fp1, F7, F3, C3, T7, P7, P3, O1 and Pz are the channels. In the raw data, each subject completed nine activities totaling 10 minutes, including eyes closed and open, happy, calm, sad, fear, memorize, executive task, and recall. The map of the placement of electrodes is shown on the following figure.

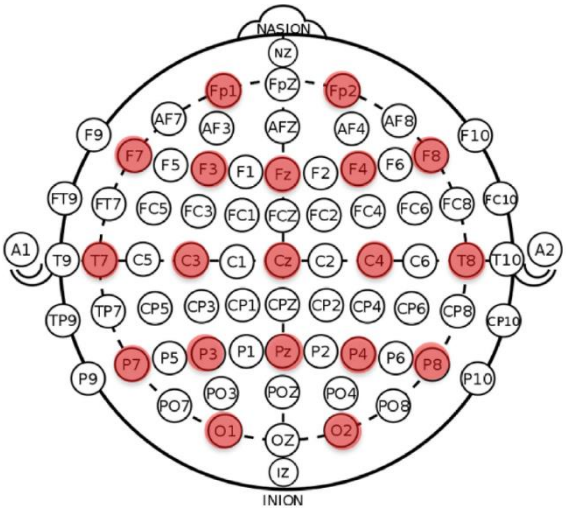

Figure 2 The Placement of Electrodes on The Scalp

They employed two stimuli in this experiment. The emotional state of the IAPS is the first stimulation. Images of happy, calm, sad, and fearful emotions were shown as part of the stimulus. Each emotion was represented by an image that was shown for one minute. The executive task, which consisted of erotic visuals, was another stimulant. A psychologist contributed the photographs. They used both stimuli because they wanted to see how porn addicts and non-porn addicts reacted to them. They inferred the emotional state of the subjects during the executive task based on EEG signals obtained in multiple emotional states utilizing IAPS's regular approach.

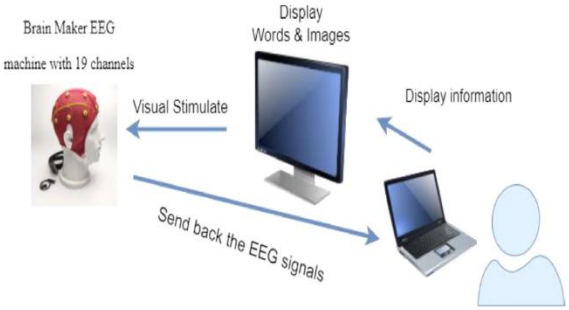

Figure 3 The Experimental Set-Up

There are several steps to analyze EEG Signals. The research from [15] devised a method for analyzing EEG signals. Pre-processing, feature extraction, and classification are the steps. The goal of preprocessing is to reduce data noise. The goal of feature extraction is to extract useful information from data. The classification, which forecasts the data group, is the final stage. The architecture of EEG data processing is depicted in the diagram below.

Another study by [16] has discuss about butterworth bandpass and stationary wavelet transform filter. This study compares the effect of these two filtering method on EEG Signal. To compare the influence of a filter on an EEG signal, two measures are used; mean square error (MSE) and peak-to-noise ratio (PSNR). The study's findings reveal that the stationary wavelet transform outperforms the Butterworth bandpass filter in all channels which they used. But The stationary wavelet transform have lower MSE valuecompared to the Butterworth bandpass filter.

IV. CONCLUSIONS

The issue of pornography is shown by analyzing the review paper. From the harmful effects of pornography addiction to how to diagnose pornography addiction, this article will cover all you need to know. For identifying pornography addiction, EEG-based BCI is the most widely used approach. The process of gathering datasets begins with the recruitment of people who meet certain

requirements, followed by many phases of BCI testing. From preprocessing through feature extraction and classification, this technique involves numerous processing phases.

Further investigation of papers linked to the topic of recognizing pornography addiction is required for more precise information. More recent and direct research on the identification of pornographic addiction are also required.

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