Unveiling User Preferences through EEG Signal Classification for Neuromarketing Insights

Muhammad Muzammil[1], Maha Siddiqui[1], Mamoona Salman[1]

1. Student at the National University of Science & Technology

Abstract

Contemporary marketing strategies are deeply rooted in the effective promotion of consumer products through advertising campaigns, aiming to enhance sales and brand awareness. The reproducibility of products hinges on a multifaceted evaluation, encompassing market consumption, reviewer feedback, and overall ratings. In contrast, Neuromarketing delves into the realm of unconscious processes to ascertain consumer preferences, enabling decision-making insights and behavior predictions.

Electroencephalography (EEG) emerges as a pivotal tool in unraveling the complexities of consumer decision-making processes. The integration of machine learning and deep learning methodologies in the analysis of EEG signals offers a robust framework for predicting relevant consumer preferences. While traditional machine learning approaches necessitate extensive signal processing and feature engineering for classification, deep learning methods leverage raw brain signals, thereby circumventing time-consuming preprocessing.

This project presents a comprehensive exploration of EEG signals through the lens of a Support Vector Machine (SVM) model. Leveraging a publicly available EEG neuromarketing dataset, the study systematically evaluates changes in EEG signals across diverse brain regions. The findings underscore the nuanced patterns of brain activity associated with the formation of consumer preferences, specifically distinguishing between preferences such as liking and disliking.

I. Introduction

Neuromarketing is a cutting-edge research field dedicated to uncovering the intricacies of decision-making, which involves the study of brain responses that explain the consumer's behavior towards products and services [1]. Electroencephalography (EEG) is a widely used technique in neuromarketing, allowing the capture of electrical brain surface activity by attaching electrodes [2]. Many application domains were identified including, advertisement assessment, product choice/preference, product, packaging, brand perception, and politics [3]. Both machine learning and deep learning approaches can be employed to predict relevant consumer preferences from brain activity. The former requires extensive signal processing and feature engineering for classification whereas the latter relies on raw brain signals and thus avoids time-consuming preprocessing [4]. In recent years, most neuromarketing studies have been conducted based on Support Vector Machine (SVM), Linear Discriminant Analysis (LDA), Artificial Neural Network (ANN), Naïve Bayes, k-Nearest Neighbor (kNN), and Hidden Markov Model (HMM). Specifically, some algorithms have been used for the classification of EEG signals in terms of likes and dislikes with varying results. For example, KNN was employed to measure consumer preferences for aesthetics shown as virtual three-dimensional objects [5]. The accuracies varied from 74.6% to 97.99%. The aim of this study is to build a classification system that distinguishes the EEG characteristics of consumers' preferences between like and dislike based on kNN.

II. Materials & Method

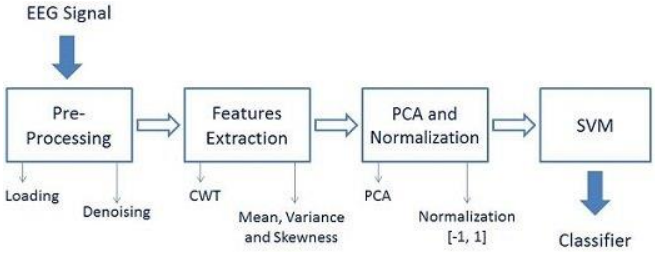
Dataset

The dataset used in this study was made available by Yadava et al [6], which includes EEG recordings from 25 participants, aged between 18 and 25 years. EEG signals were recorded with a 14-channel Emotiv Epoc+ (wireless device for neuro-signal data acquisition complying with the international standard 10–20 system) while participants watched different e-commerce product images for 4 s on a computer screen. The stimuli consisted of 14 different product categories (shirts, shoes, ties, school bags, mufflers, belts, bracelets, gloves, sunglass, sweaters, socks, wall clocks, pens, and wristwatches), each containing three different images, resulting in 42 different products 42 (=14 × 3). After each image, participants had to indicate their liking or disliking of the presented product. A total of 1050 (=42 × 25) EEG data were therefore generated for all users. After each image was presented, the preferred choice of the user was collected. The recording sampling rate was 128 Hz.

III. Support Vector Machine

Implementing a Support Vector Machine (SVM) on an EEG dataset for predicting "like" and "dislike" involves several steps.

1. Preprocessing the EEG Data
2. Feature Extraction
3. Labeling
4. Splitting the Dataset:
5. Choose an SVM Kernel
6. Model Training
7. Parameter Tuning
8. Model Evaluation:
9. Iterative Improvement.
10. Cross-Validation:



IV. Current Status

We have just started the project and all of us don't have any prior knowledge regarding machine learning algorithms and how to implement them. So initially we have decided to implement SVM and check how it will work. Obviously, we also must do data pre-processing. So, we will first do some more research and try to learn how to implement different algorithms.

V. Division

Group Members	Division of Tasks
Muhammad Muzammil, Maha Siddiqui	Preprocessing of EEG data
Maha Siddiqui, Mamoona Salman	Feature Selection
Mamoona Salman, Muzammil, Maha	Implementation of SVM model
Maha Siddiqui, Mamoona Salman	Final report

We will do a collaborative task on each part.

VI. Result

In the end, we want a high-accuracy modal that can predict the customer choice based on the EEG signal provided in the dataset. We will add the result once we finish implementing the model and check its accuracy.

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