Chapter 13

Smart Detection and Removal of Artifacts in Cognitive Signals Using Biomedical Signal Intelligence Applications

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ABSTRACT

A complete and detailed literature evaluation concentrating on the detection and elimination of artifacts from EEG data was described in the preceding chapter. Issue-wise solution suggestions and their limitations were also studied, which eventually led to finding the gaps in the recommended task and scope of the study activity. In this chapter, the complete explanation of system design and its implementation is addressed. The principal objective of the proposed research is to identify and eliminate the undesired signals known as artifacts from the collected EEG data. This chapter spoke about the design of the system and its implementation. In this chapter specifics of EEG acquisition methods have been discussed. The initial stage in EEG signal processing is recording EEG data from the individuals. It also looks into the categorization of EEG data by sort. The obtained EEG data was sorted into two categories: normal and epileptic.

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INTRODUCTION

These EEG signal artifacts are irritating and must be rid of before further processing for accurate diagnosis and treatment of the neurological illnesses (Shah & Dash, 2023). The initial stage in any EEG signals analysis is to gather the EEG data from the individual. So, an EEG acquisition equipment is deployed for this purpose (Beiramvand et al., 2023). EEG data base of the patients have been acquired from the hospitals as well as from the web data base. After the gathering of EEG data base, the EEG data is categorized based on their categories such as normal and epileptic (Hwidi, 2023). Following classification, the third stage is detecting the imperfections present in the acquired EEG signals, which are referred to as EEG artifacts in the neurological realm (Nandan Mohanty et al., 2023). Intrinsic and extrinsic artifacts are the two forms of artifacts. Intrinsic artifacts arise from the physiological activity of the subject such as ocular artifacts which includes eye movement and eye blinks, muscular artifacts which results from tongue movement, swallowing, chewing, cardiac artifacts and physical movement artifacts (Kanna & Vasuki, 2021). Extrinsic artifacts originate from environment or due to experimental mistake (Ravikumar et al., 2023). The examples of extrinsic artifacts include transmission line artifact, phone artifact, electrode artifact, sweat artifact etc.

The next step is to remove the contaminants from the obtained EEG data after recognizing the EEG artifacts (Kanna, Chandrasekaran, Khafel et al, 2023). This has been done by removing different sorts of artefacts from EEG using a variety of blind source separation (BSS) approaches (Zhu et al., 2023). The next step is to compress the data that has been gathered. This is done by combining wavelet transformations with neural network predictions to build a high-performance lossless compression approach (Kanna & Prasath Alias Surendhar, 2023). Finally, the numerous artifacts from the recorded EEG signals are removed/ reduced using signal processing methods (Ren et al., 2023). To eliminate power line and base line noise from the EEG data, a low pass filter is built whereas wavelet transform is applied for elimination of eye blink artifacts (Kanna et al., n.d.). Muscle artifacts, eye blink artifacts, and movement artifacts are also eliminated from the recorded EEG signals using a unique probability-based mapping approach (Singh et al., 2023).

Process to be Followed for System Design and Implementation

The step wise process is as follows and is shown in Figure 1.

1. EEG data is collected from hospitals and from online EEG database
2. The collected EEG database is classified based on their types.
3. Various contaminants from acquired EEG data are separated using Blind Source Separation (BSS) algorithms.
4. The acquired EEG signals are compressed using high performance loss less compression schemes utilizing wavelet transform and neural network predictors.
5. Using various signal processing approaches, minimize/remove various artifacts from recorded EEG data.