Chapter 11
Deep-Mental Workload Intelligent System:
An AI-Augmented System to Predict Employee Mental Workload Based on EEG Data Using Deep Learning

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ABSTRACT

Recently, the measurement of mental workload has emerged as a crucial aspect of well-being process in socio-technical organizations. Excessive mental workload reduces work productivity, whereas insufficient mental workload leads to the underutilization of human resources. Significant research utilizing machine learning algorithms, such as SVM and KNN, based on electroencephalogram (EEG) signals, has been used for stress classification in the past few years. However, issues with mental workload and classification accuracy persist across these studies. Therefore, this chapter proposes an AI-augmented web-based information system to assess mental workload by employing a deep learning model. The proposed deep learning algorithm is used for the classification and feature extraction from EEG signals to accurately classify mental workload status. The proposed AI-augmented system would become a significant tool for making more effective and precise predictions about employees' mental workload in organizations.

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INTRODUCTION

Mental workload, which is also known as psychological load, can be defined as the quantity of brain activity per unit of time, the rate at which brain resources are used or the psychological pressure a person is under (Qu et al., 2020). Recently, machine learning, is widely used in the study of mental workload to make a prediction based on a large scale of historical dataset. Understanding of the mental workload is crucial to the employer to increase the employees' performance in consideration of the fact that excessive mental workload can result in frustrated emotions, errors in decision-making and analysis whereas inadequate mental workload can cause waste of human resources and affect job performance (Alifah et al., 2019; Aoki, 2017; Chen et al., 2022a; Keikhosrokiani et al., 2012; Keikhosrokiani & Kamaruddin, 2022; Qu et al., 2020; Teoh Yi Zhe & Keikhosrokiani, 2021).

In this fast-paced world and data-driven organizations, most businesses are forced to make an effort in order to keep up with the demands from their consumers (Keikhosrokiani, 2021, 2022b). In fact, this scenario leads to an increased workload for employees to prioritize productivity and efficiency. This can result in fatigue in physical, psychological as well as emotional to the employee who is exposed to excess demands. Eventually, their working performance will become less efficient, and their productivity will be lowered. Workload prediction as well as workload management are important for employers to take care of the mental health of their employees. Consequently, this study aims to develop a web application, which is an intelligent web-based information system to predict employee mental workload using deep learning. The system applies deep learning techniques to classify the employee's mental workload based on an electroencephalogram (EEG) data set. Firstly, a deep learning algorithm is proposed to predict the employee mental workload using EEG dataset. Then a web-based information system is developed for monitoring employee mental workload and providing proper advice based on the level of mental workload. Finally, an analytical dashboard is created to keep track of employees' mental workload status.

This chapter reviewed the concept of mental workload, mental workload classification using EEG dataset, and different artificial intelligence algorithms used for the classification of mental workload. Then, the details of the proposed web-based system, as a tool to track employee mental workload in data driven organizations, are presented. Afterwards, the performance comparison of deep learning algorithms, system implementation, testing, and user interfaces are shown. Finally, the chapter is wrapped up with conclusion and future work.

BACKGROUND

Mental Workload

The term "mental workload" refers to the amount of cognitive effort or mental demand required to perform a task or activity. It can be influenced by a variety of factors, including the complexity of the task, the amount of information being processed, the level of skill or expertise required, and the time pressure or other constraints under which the task is being performed (Keikhosrokiani, 2019, 2022a, 2022b; Keikhosrokiani et al., 2018, 2020; Keikhosrokiani & Asl, 2022). Mental workload can have important implications for productivity, performance, and overall well-being. High levels of mental workload can lead to fatigue, stress, and decreased performance, while low levels of mental workload