# CSE-4878 Machine Learning and Data Mining Lab

# A Review on Sleep Disorder Classification

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# 1st Paper

# 1. Title - Use of machine learning to identify risk factors for insomnia

# 2. Journal -

Use of machine learning to identify risk factors for insomnia by A. A. Huang and S. Y. Huang, published in PLOS ONE in 2023.

# 3. Methodology -

Four machine-learning methods were carried out in this paper XGBoost, Random Forest (RF), Adaptive Boost (ADABoost), and Artificial Neural Network (ANN).

#### 4. Dataset -

NHANES (National Health and Nutrition Examination Survey) Dataset

#### 5. Year - 2022

#### 6. Limitation -

The dataset used included individuals from 18 years and above only and it was taken from only citizens of the United States of America, therefore it is not demographically diverse.

# **2nd Paper**

# 1. Title - Classification of Sleep Disorders

# 2. Journal -

Applying Machine Learning Algorithms for the Classification of Sleep **Disorders** by Talal Sarheed Alshammari, published in IEEE Access in 2024.

# 3. Methodology -

The k-nearest neighbors, support vector machine, decision tree, random forest and artificial neural network (ANN) deep learning algorithms were used in this paper.

#### 4. Dataset -

Sleep Health and Lifestyle Dataset was Obtained from Kaggle.

#### 5. Year - 07 March 2024

#### 6. Limitation/Future works -

#### • Limitation:

This dataset has a limitation in the amount of data.

# • Future works:

Future work will focus on developing MLAs using unsupervised learning in addition to assessing the dataset on a new model and comparing its performance against existing state-of-the-art models.

# 3rd Paper

# 1. Title - Obstructive Sleep Apnea (OSA) Detection

#### 2. Journal -

**RAPIDEST**: A Framework for Obstructive Sleep Apnea Detection was published in IEEE Transactions on Neural Systems and Rehabilitation Engineering in 2023.

# 3. Methodology -

The Convolutional Neural Networks (CNN) is used in this paper.

#### 4. Dataset -

Three open datasets that have been used:

- The Sleep-EDF dataset,
- The University College Dublin Sleep Apnea Database (UCDDB) dataset,
- The Wisconsin Sleep Cohort (WSC) dataset,

Which are available from the public repository PhysioNet and National Sleep Research Resource.

#### 5. Year - 24 November 2022

#### 6. Limitation/Future works -

#### • Limitation:

This paper works only to identify rare patterns in the sequence of sleep stages. It cannot determine what type the disorder patient got. It is also hard to find the rarity score of the individual segment because the author of this paper computed the rarity score over the whole-night sleep stages.

#### • Future works:

Future work will focus on determining the type of sleep disorders. To overcome the false alarm problem, we may need the dataset labeled with anomaly events to determine the rarity score for EEG signals for each 30-s epoch, which demands further research.

# 4th Paper

# 1. Title - Central Sleep Apnea Detection

#### 2. Journal -

Central Sleep Apnea Detection by Means of Finger Photoplethysmography published by IEEE Journal of Translational Engineering in Health and Medicine in 2023.

## 3. Methodology -

This paper worked on a machine learning approach that combines multiple decision trees to improve prediction accuracy.

#### 4. Dataset -

The dataset used in this paper comprises 266 patients with suspicion of SA which were prospectively recruited across four different sleep clinic centers of which three were located in the USA (where all centers were part of the United Health Services Group in Miami, Florida) and one in Belgium (Ziekenhuis Oost Limburg, ZOL, Genk).

# 5. Year - 12 January 2023

#### 6. Limitation/Future works -

#### • Limitation:

The limitation of this paper was the low number of predominant CSA patients (only 4 patients in the study dataset) and CSA patients with central apnea-hypopnea index,  $cAHI \ge 30$  (only 6 patients in the study dataset).

#### • Future works:

To improve the study's reliability and generalizability, future research should prioritize a larger sample size, particularly focusing on patients with severe CSA and  $cAHI \ge 30$ .

# 5th Paper

# 1. Title - Simultaneous Sleep Stage and Sleep Disorder Detection from Multimodal Sensors Using Deep Learning

#### 2. Journal -

Simultaneous Sleep Stage and Sleep Disorder Detection from Multimodal Sensors Using Deep Learning was published in MDPI in 2023.

## 3. Methodology -

There is an ensemble of six parallel CNN classifiers, including three networks classifying the sleep stage (one for each modality—EEG, ECG, and EMG) and three networks classifying the sleep disorder (one for each modality—EEG, ECG, and EMG).

#### 4. Dataset -

Sleep Disorders Center of the Ospedale Maggiore of Parma, Italy, available through the PhysioNet CAP Sleep database

#### 5. Year - 2023

#### 6. Limitation/Future works -

#### • Limitation:

The experimental testing setup presented in this study was limited to a closed-set scenario, where the training and testing sets of samples were mutually exclusive. However, both sets represented the same groups of patients.

#### • Future work -

Future research will test if the system can be generalized to accurately categorize data from patients unseen in the training process.

# **Solution:**

Most research on sleep disorder detection focuses on a single condition, typically either insomnia or sleep apnea. Our objective is to develop a comprehensive model capable of detecting both disorders, thereby expanding the scope of analysis. Additionally, existing studies often rely on datasets that are limited to specific countries or narrow age ranges. By utilizing a broader and more diverse dataset, as well as integrating multiple datasets for comprehensive analysis, we aim to achieve more accurate and generalizable results.