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Measurement Of Attentıon Levels From Eeg Sıgnals Wıth Bıosensors Usıng Elman Feedback Artıfıcıal Neural Network

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Summary
In this study, Neurosky Biosensor, which measures EEG signals while students are studying and sends them to the computer via bluetooth, was used by using Elman Feedback Artificial Neural Network. Attention levels of people were examined from EEG signals with biosensors. For this purpose, brain signals were examined through EEG biosensors by following three different ways: reading aloud-silent, telling the truth-lying and listening to different music (Turkish Art Music, Classical Music and Rock Music). EEG biosensors produce numbers between 0 and 100. If the numbers are close to 100, the attention level is high, if it goes towards zero, the attention level is low. For this, the data received from the people were recorded on the Arduino Nano with the HC-05 Bluetooth module. For Elman Feedback Artificial Neural Network, the number of hidden layers is 2, the number of hidden layer neurons is 60, the training function Traingdx and the transfer function Tansig are used.
In this study, unlike other studies, the signals received with the biosensor are associated with an electronic circuit. The obtained EEG signals were processed with an electronic circuit to light up 10 LEDs, each of which corresponds to 10% attention level, from minimum to maximum, varying according to attention levels.
Keywords: *Attention level, Neurosky, electroencephalogram, voice-quiet reading, true-lying, music types, ANN with feedback.*

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I. INTRODUCTION

Emotion plays a nuclear role in human behavior, such as perception, attention, decision-making, and communication [1]. Positive emotions contribute to healthy life and e_cient work, while negative emotions may result in health problems [2]. EEG signals e_ectively reflect the brain electrical activity, and have been widely applied in many fields, including cognitive performance prediction [3], mental load analysis [4,5], mental fatigue assessment [6], recommendation system [7] and decoding visual stimuli [8,9]. Many tasks such as driving a car require human operators to be vigilant. Vigilance is a term with varied definitions, but the most common usage is sustained attention or tonic alertness, an ability to sustain attention to a task for a period of time [10]. Long-term and monotonous driving often lead to the decrease of vigilance levels [11,12], which is one of the major factors causing traffic accidents. Statistics Show that approximately 10–20% of road traffic accidents are due to drivers' decreased vigilance levels [13,14].
With this study, concrete results were obtained by investigating what affects people's attention.

II. METHOD AND MATERIALS

With electroencephalography or EEG brain imaging technology, fluctuations in the spontaneous electrical activity of a large group of neurons in the cerebral cortex, which has a shirred shape and gray shell, are recorded from the surface. These electrical signals obtained from certain parts of the brain are converted into a mathematical value and passed through various formulations and provide information about activities such as attention, motivation, emotional interest, cognitive workload, and sleepiness [15]. However, appropriate skin preparation and electrolyte administration should be performed to ensure a high-quality EEG signal is obtained [16].

2.1. Elman Feedback Artificial Neural Network

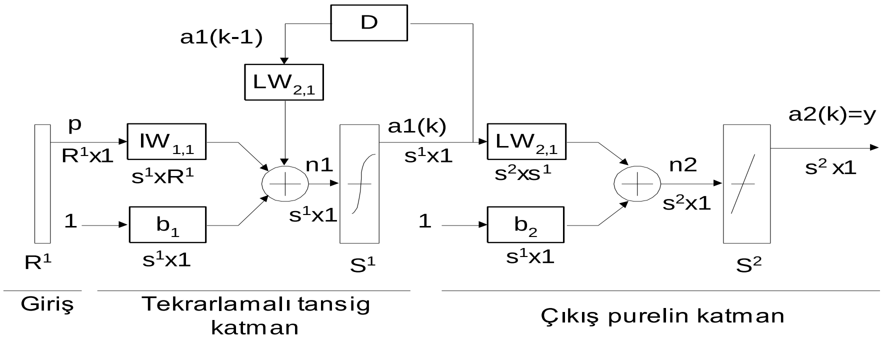

Figure 1. Structure of the Elman Feedback network[17]

Elman's recurrent neural networks are also multilayer networks (input layer, recurrent hidden layer, and output layer). While the hidden layer neurons use nonlinear sigmoid activation functions, two type activation functions (nonlinear sigmoid and linear) are used for the output layer neurons[18].

2.2. Brain Wave Measurement with MindWave Mobile 2

2.2.1. Data Collection

In this study, EEG data were obtained from 30 volunteers, 15 females and 15 males, by means of EEG Biosensors. Individuals with a chronic disease (hypertension, diabetes, chronic liver, kidney, lung disease, hematological disease, etc.), hematological disease, malignancies, pregnancy history, those who had a surgical operation in the last 6 months, alcohol and cigarette users were not included in the study. Recordings are made as shown in Figure 3.

With MindWave Mobile 2, EEG (Electroencephalography) headphones produced by NeuroSky, you can measure your attention and relaxation level and send the data you measured to computer, Android or iOS devices wirelessly via Bluetooth. With this device, you can learn how your brain responds to many activities, including your favorite music.

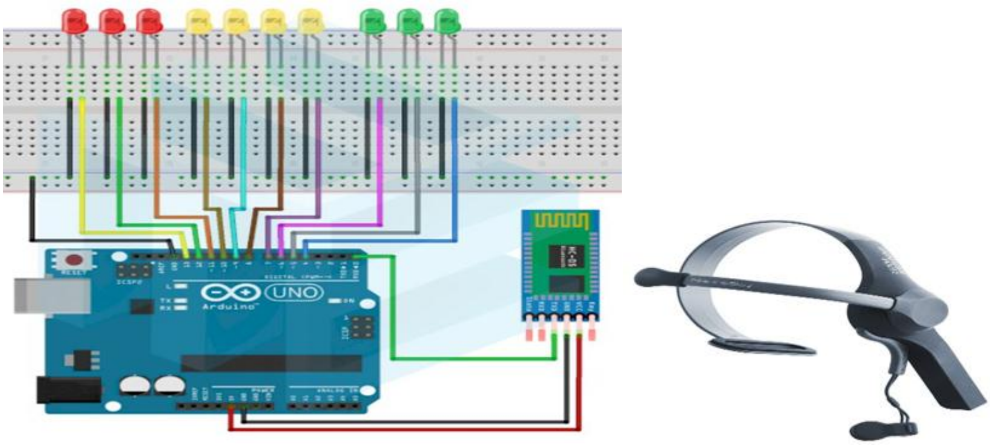

Figure 2. Receiving the signal from the EEG biosensor[19]

III. Electronic Circuit Used

With EEG biosensors, the data received depending on the attention level are transferred to Arduino. Here, when the attention threshold values determined in the code blocks are reached, digital outputs are received. As a result of these digital outputs, 10 LEDs, each corresponding to 10% attention level, are on. In other words, when the attention level is 100%, all of the LEDs on the card are coded to give light.

Figure 3. Displaying the attention level with an electronic circuit (LED circuit, each of which corresponds to 10% attention level)

IV. RESULTS

As a result of this study, it was observed that the red LED group was lit when people were concentrating, and the blue LED group was lit when they were calm and relaxed. As a result of the experiments, people; It was observed that they concentrated 18.80% more during silent reading compared to reading aloud, 16.69% when lying, compared to telling the truth, and 42.96% more when listening to classical music than when listening to rap music. It is predicted that this result is due to the fact that moving the lips while reading aloud causes inefficiency in reading.

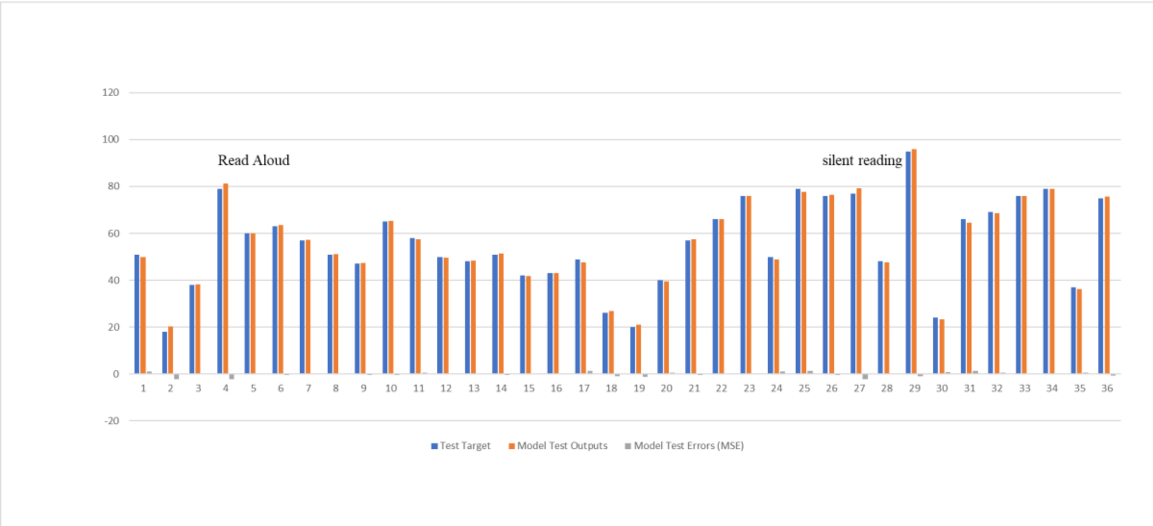

Figure 4. The effect of reading aloud and silently on attention using Elman feedback neural network.

In the second part of the study, in order to examine the effect of listening to different types of music on the level of attention, as a result of the experiments made by listening to classical, Rap and Turkish Art music, individuals listened to classical music by 42.96% compared to listening to Rap music; 31.54% while listening to Turkish Classical Music compared to listening to classical music; It has been measured that they are 60.95% more careful while listening to Turkish Classical Music compared to listening to Rap music. When the data is interpreted, these values are due to the fact that Turkish Classical Music appeals to people's worlds of emotion and thought, both verbally and musically; It is predicted that classical music causes people's body functions to be placed in a stress-free environment and Rap music is caused by people's inability to concentrate due to their words being spoken too fast.

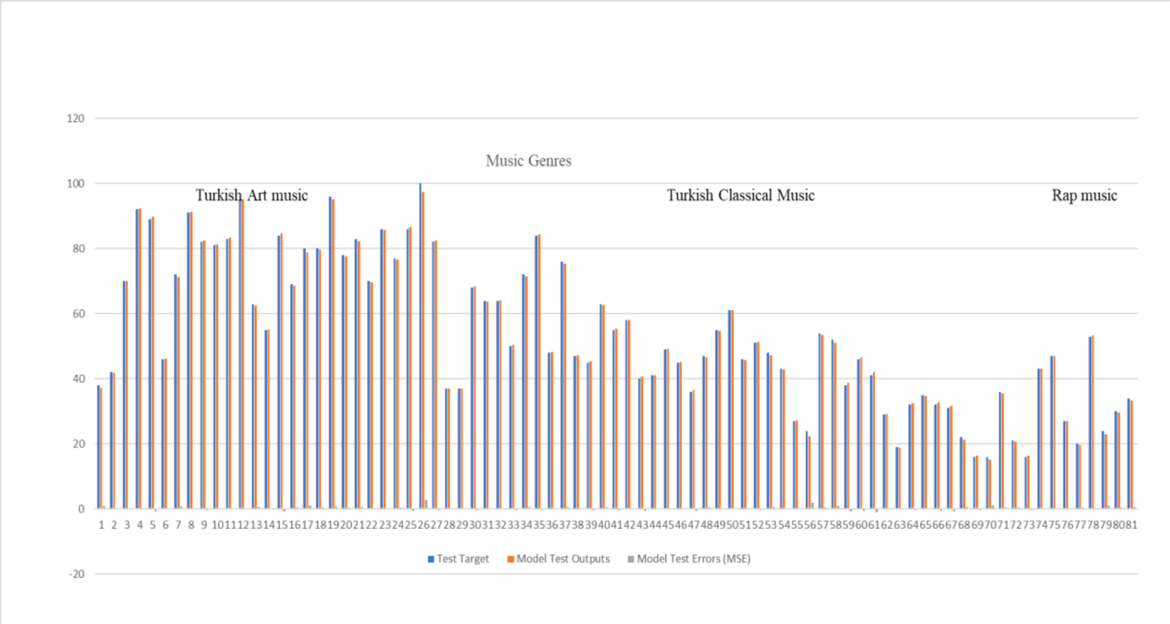

Figure 5. The effect of Turkish art music, Pop music and Classical music on attention using Elman feedback artificial neural network.

In the third part of the study, individuals were asked to tell the truth and lie in order to examine the effect of truth-lying on the level of attention. As a result of the experiments, it has been observed that individuals are 16.69% more careful when lying than telling the truth.

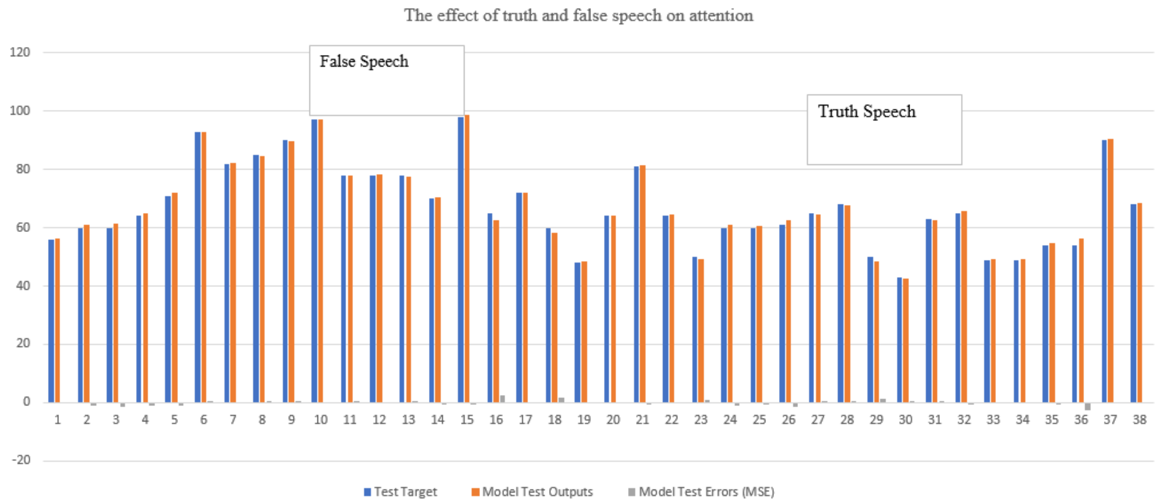

Figure 6. The effect of telling truth and lying on attention using Elman feedback neural network.

V. DISCUSSION

In this study, it is aimed to examine the effects of reading aloud-silent books, telling truth-lies and listening to different music on attention levels with EEG biosensors. Determining attention levels is very important in many ways. In the light of the data obtained; During silent reading, listening to Turkish classical music is more meaningful than other types of music, and lying is more meaningful than telling the truth. In addition, in this study, it has been tried to bring innovation to the literature in terms of obtaining and evaluating EEG signals through biosensors for attention level measurement.

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