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Research Article

The Analysis Of Neuromuscular Devices: A Transformation Of Human Physiology Into Customizable Intelligent Technology Using Deep Learning Method

Pratyaksh Soni[1*], Gouri Sankar Mishra[2], Pradeep Kumar Mishra[3], Aditya Kumar[4]

[1*,2,4]Department of Computer Science and Engineering, SSET, Sharda University, Greater NOIDA, U.P., India. pratyaksh@mvyapari.com. aditya.kumar1@sharda.ac.in, gourisankar.mishra@sharda.ac.in
[3]School of Computer Science and Application, SSET, Sharda University, Greater NOIDA, U.P., India. pradeepkumar.mishra@sharda.ac.in

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ABSTRACT

In this era, development in neuro-interface technology is one of the key scientific focuses. Technology-oriented advancements result in machine learning techniques, particularly deep learning methods, that help in handling complex computations and large amounts of data. This paper explores the model where neuromuscular devices in human-like robots by leveraging the neurotransmitter data, help to identify the change in human emotions and behaviors. The data neu muscular devices get through a change in impulse, run through deep learning algorithms, and are ultimately converted into AI. The convergence of AI and neuromuscular devices has helped to boost healthcare solutions. Drawing on the Theory of Neuro transmission and the theory of Reinforcement learning, this study analyzes the Integration of Neuromuscular Devices and Personalized AI to enhance Human Physiology. Healthcare practices have been revolutionized and human physiology has been enhanced by the synergizing integration of Neuroscience, AI, and biomedical engineering in this research paper we can find out the ultimate impact of neuromuscular devices on human physiology based on the data collected by 98 individuals.

Keywords—neurotransmitters, human emotions, sensors, AI, Cloud services, deep learning

1. Introduction

Deep learning is based on artificial neural networks (ANNs). It is a subset of machine learning using multilayered neural networks to trigger strong and complex decision-making power in the human brain. (LeCun et al., 2015).

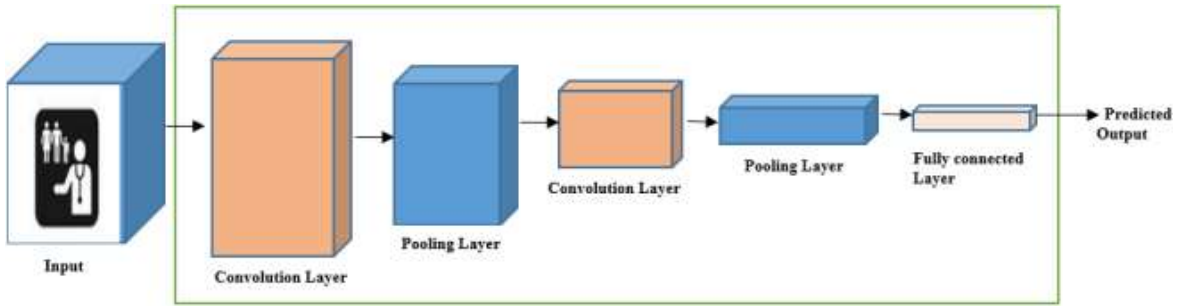


Fig 1: Deep Learning Model

Rapid Technological advancement has sparked a wave in the healthcare sector through the amalgamation and integration of neuroscience and artificial intelligence. In understanding and enhancing human physiology, transformative development and implications of neuromuscular devices and Al works. Significant leaps have been represented by neuromuscular devices in neuro-interface technology, that help to identify and capture the

complex signals in the human body after interpreting them (Ferretti & Lenca, 2018). These implanted neuromuscular devices gather data in the human body from fluctuating hormones. After processing the data with deep learning algorithms, this collected data turns into actionable insights (Kim & Kim, 2017).

Particularly in the health care center the synergy of neuromuscular devices and AI plays a crucial role. Insights from human emotions and behavior could be figured out by leveraging the data neural signals to provide valuable insights (Kumar & Saxena, 2016). Some diverse sources of collecting the data include devices like muscle stimuli recording, acceleromyograph, glucose monitoring, etc. to understand the human body functions (Ding & Sohn, 2019).
Muscle recording devices, considered the cornerstone of neurophysiology, consist of electromyography sensors. These devices help observe the muscles' activities during their contraction and relaxation (Li & Zhang, 2017). To understand the different functions of the muscles i.e. Diagnosis of any disorder of neuro muscles or to optimize performance. The amalgamation of EMG sensors and AI holds a significant leap to revolutionize health care. This paper aims to tailor individual needs by exploring the convergence and its impact on health care along with the creation of personalized AI.

Fig 2. Diagram Representing EMG Sensors

Theoretical Framework:

Neuroscience:

To understand the mechanism of human physiology, by understanding how the neurotransmitter and neural signal interact. Exploration of neuroscience theory helps in getting valuable insights into how these devices interface with the human body and can help interpret physiological data (Adams & Albin 2020)

Artificial intelligence:

In this technological world, Al particularly deep learning methods are one of the major tools that help in transforming the raw physiological data from the neuro devices into personalized insights. Based on the data collected deep learning methods are helping in handling the complex and large data to adapt it accordingly to cater the needs of individuals. Deep diving into theories like reinforcement as well as learning can help understand how AI specifically deep learning methods can learn the data and adapt it according to the individual's needs based on the data collected. (Banino & Barry, 2018)

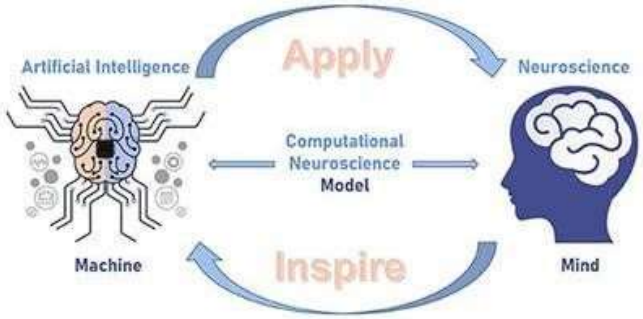


Fig 3. Diagram Explaining The Application OF proposed Tech & Algorithm

These two theories are the theoretical foundation for this research on enhancing human physiology into personalized AI with the help of neuromuscular devices.

2. Proposed Methodology

The methodology entails the analysis of the integration of the sensors into neurotransmitters. These sensors enable the detection and help in the transmission analysis and structuring of the data ultimately resulting in the deep learning ability of logarithm that results in gaining the transmission data to distinguish the signals (Meriem, 2019).To store the data in the cloud neuromuscular devices are developed made up of the following sensors. Gyroscope, Magnetometer, Temperature Sensor, Electromyography (EMG) Sensor, Accelerometer,

Heart Rate Monitor (Park & Kim, 2016).

Data Collection:
Data has been collected by strategically placing the sensors within the muscles in a strategic way. To get the data on diverse aspects the arrangement of the sensors was done strategically and sophisticatedly. To observe the muscular patterns, their impact on hormonal functions, and their ultimate impact on the emotional states.

Data Processing:
To observe meaningful insights rigorous data processing has been done on collected data. To extract information like, patterns of muscle activation, heart rate, and other movement patterns deep learning algorithms were implemented.

Data Transmission:
After processing the data and extracting the essential information, data is transferred from the device to the cloud through wireless devices. Ie. Wifi and Bluetooth.

Cloud Storage:
Within the cloud, the transmitted data has been stored and structured. Most reliable storage solutions are provided by cloud platforms like Google Cloud and Amazon web services. These scalable solutions of storage grant easy access to analyze the data to authorized users.
Population of the Study: Data has been collected through males and females of age above 25 years.

Sample and Sampling Technique:
The sample size of the study was 98. Emotional states of 98 individuals have been observed by implanting neuro-muscular devices in them. As the population was unknown, a non-probability sampling technique was used and due to limited access to individuals, we opted the convenience sampling which means the data was collected from individuals who were easy to approach.

Data Analysis:
After implanting the neuromuscular devices in the 98 individuals their neurotransmitter level and emotional states of the individuals have been observed. To analyze the complex patterns in data, deep learning methods were utilized, this helps to get an ample understanding of the interplay between physiological parameters and emotional states.

Muscle Movement:
The movements of the muscles indicate a wide range of physical activity levels ranging between 0.63 and 0.95. Higher values for muscle movement ranging between 0.7 to 0.9 suggest an increase in physical activity. Variability in muscle movement shows the changes in posture and physical engagement that could be influenced by emotional arousal.

Heartbeat (BPM)
Heartbeat per minute(BPM ranges from 65 to 110 beats and most of them fall between the range of 75 and 85 BPM which shows that the fluctuations in the heartbeat lie within a normal and reasonable range. A high BPM indicates an increase in physiological arousal, whereas a low BPM may indicate a state of relaxation.

Fig 4. Image Representing The Heartbeat Fluctuations

Blood Pressure:
The range of diastolic blood pressure is between 55 to 95 mmHG whereas the range of systolic blood pressure. Data shows that the blood pressure lies within the normal range i.e. 80/120 mmHg. Factors like stress and physical activity or changes in posture may affect blood pressure.

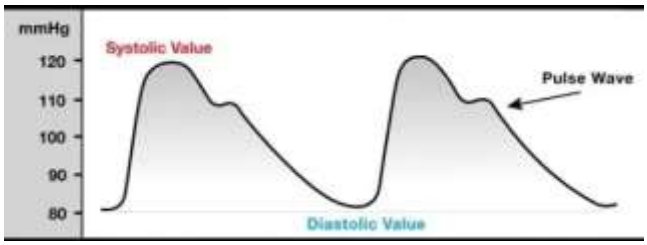


Fig 5. Image Representing The Blood Pressure Range Recorded Using Sensors

Adrenaline.

In body fights and flight, adrenaline plays a key role, in response to the perceived threats adrenaline helps to mobilize energy. Data shows that adrenaline fluctuation ranges between 0.2 to 0.9shows the varying degrees of stress.

Neuron Impulse:

Neuron impulse could be affected by the efficiency of synaptic, levels of neurotransmitters, and other neural dynamics. There is no clear pattern observed in the data and a lot of variability in neural processing and communication and neuro impulse ranges between 25m/s and 58 m/s.

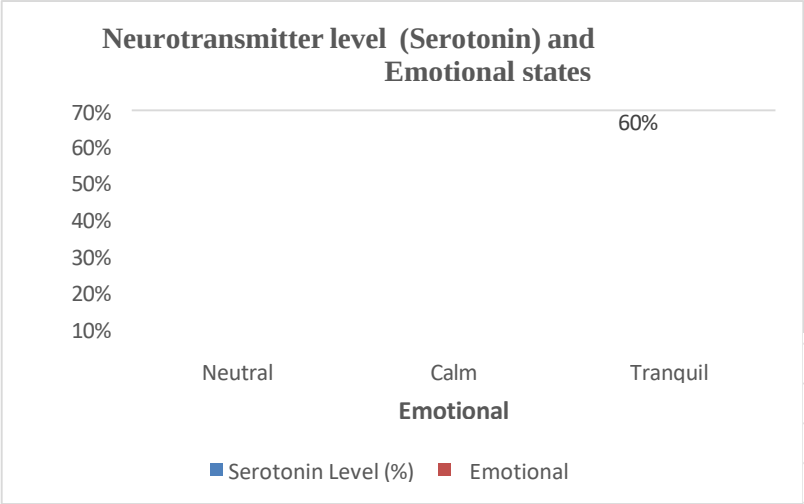
Neurotransmitters i.e. Serotonin, Dopamine, Noradrenaline:

Variability in the neurotransmitter levels and some correlation exist with emotional states. -25% to 58% is serotonin level, 30% to 46% is dopamine level, and 30% to 59%.level is noradrenaline. A high level of serotonin is somehow associated with the feeling of contentment while high levels of Dopamine and noradrenaline indicate excitement.

Emotional States i..e: Happy, Sad, Angry, Excited, Calm:

There is no clear temporal pattern observed in the data and the emotional states are fluctuating constantly. However, neurotransmitter levels can correlate with emotions. The higher the level of serotonin more the feeling of calmness contrary, the higher the levels of dopamine higher the level of excitement and arousal. Dynamic interplay has been observed in the data between the physiological parameters and emotional states, which indicates the complexity of human behaviors.

Neurotransmitter level and Emotional states



Serotonin Level (%)	Emotional State
40%	Neutral
50%	Calm
60%	Tranquil

Serotonin: Higher serotonin level i.e. above 40% represents a higher level of calmness and contentment and less feelings of anger. So, serotonin plays a vital role in controlling feelings of sadness and contentment.

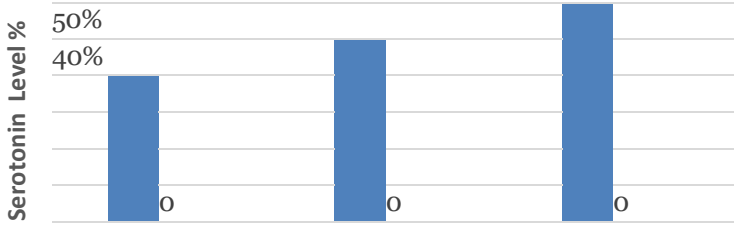


Fig 6. Graph Representing The Hormonal Changes And The Emotional Trackdown Using Algorithms And Sensors

Dopamine:

Dopamine plays a key role in regulating some intrinsic factors i.e. motivation and influencing experiences. A lower level of dopamine results in feelings of sadness and anger while elevated levels of dopamine i.e. above 20% correlate with a high level of happiness that ultimately turns into excitement with an increase in the dopamine level above 30%.

Table 1. Graph Representing How Change In Dopamine Bring Change In Emotional State

Dopmaine Level (%)	Emotional State
20% above	Excitement
30% above	Excitement
40% above	Happiness

Noradrenaline:

Noradrenaline correlates with arousal and stress, which accordingly results in impacting the emotional state. Higher noradrenaline level i.e. above 45% correlated with a higher level of excitement as well as a higher level of anger accordingly.

Adrenaline and Physiological Responses:

In response to body fights and flights, adrenaline plays a vital role that ultimately affects the heartbeat rate, blood pressure, and movement of the muscles. Adrenaline has no specific correlations to emotional state and appears to fluctuate randomly. Moving to the peak levels results in a higher level of arousal and stress.

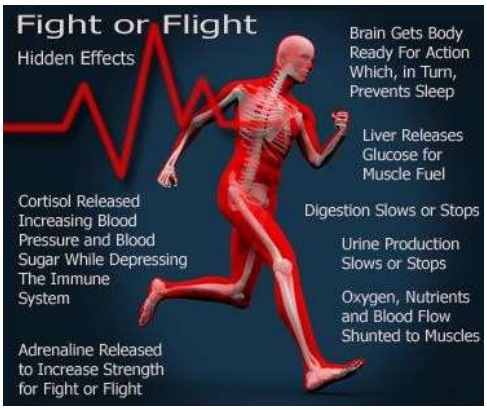


Figure 8: Image Representing The Human Response concerning Different Hormone Secretions Heartbeat and Blood Pressure:

Emotional states have no direct correlation with the heartbeat and blood pressure according to the data set but responses like stress and arousal could be triggered. In general, studies revealed that high blood pressure and heartbeat lead to excitement and anger, while low heartbeat and blood pressure lead to calmness.

Muscle Movement and Emotional States:

Collected data shows that there is no direct correlation between muscle movement and emotional state. However, heightened muscle activity could cause emotional expression ie. Arousal or anger.

Table 2. Table Representing The Human Response Concerning Muscle Movement Patterns

Muscle Movement	Emotional State
Low	Calm
Moderate	Neutral
High	Excited

3. Result Analysis

Performance Evaluation of the Proposed Device

A series of tests were performed on 98 individuals to evaluate the performance of the proposed neuromuscular device. Different factors blood pressure, heartbeat rate neuron impulse etc. were measured. Significant improvements were shown in the detection and parameters through this neuromuscular device that ultimately leads to accurate insights about the emotional states. Here we can find an improvement in the results after using the devices from below Table.

Table 3. Table Showcasing the Tracking Down of Data Using Device Data

Parameter	Baseline	After Using Device
Muscle Movement	0.63	0.95
Heartbeat (BPM)	65	110
Blood Pressure	55 mmHG	95 mmHG
Adrenaline	0.2	0.9
Neuron Impulse	25	58
Serotonin Level	25	58
Dopamine Level	30	46
Noradrenaline Level	30	59

Comparison with Existing Devices

From comparison, it was specified that the proposed neuromuscular device offers better results than the existing one. The proposed device along with measuring the physiological paraments, interprets and provides insights about an emotional state. The significant difference can be seen from the below Table.

Table 4. Table Showcasing The Comparison Between Proposed Model And Existing Models

Parameter	Proposed Neuromuscular Device	Existing Devices
Data Processing Capabilities	High	Moderate
Sensor Accuracy	Excellent	Good
Integration with AI	Advanced	Limited
User Interface	Intuitive	Complex

Findings of the research paper:

- Neuromuscular devices play a significant role in offering valuable insights based on the dynamic relationship between the physiological parameters of humans and their emotional state.
- A complete understanding of the neurotransmitter level can help find insights related to the emotional well-being of a person.
- A complex integration of physiological responses and other environmental factors can influence emotional states.

4. Conclusions and Future work

Conducting the longitudinal studies to track changes in emotional states based on the physiological parameters in a deeper way. To tailor the individual needs future research can be focused on developing more deep learning algorithms to analyze the neuromuscular device more accurately. Integration of neuromuscular devices with Telemedicine platforms so that remote monitoring of physiological and emotional states could be observed.

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