Novel Solution to Improve Mental Health by Integrating Music and IoT with Neural Feedback

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Novel Solution to Improve Mental Health by Integrating Music and IoT with Neural Feedback

B. Murali Krishna*
Dept. of E.E.E, School of Engineering, C.U.K, Karnataka, India.
V Ch. Jhansi
Asst. Professor, E.E.E Dept., SSN Engineering College, Ongole, Andhra Pradesh, India.
P.S. Shama
Ph.D Scholar, Computer Science Engineering, Belgaum, Karnataka, India.
A. Boya Leelambika
M. Tech, KL University, Vaddeswaram, Guntur, India.
Chiranjeevi Prakash
M. Tech, KL University, Vaddeswaram, Guntur, India.
B.V.V.N. Manikanta
M. Tech, KL University, Vaddeswaram, Guntur, India.
**Corresponding author E-mail: muralikrishna.cuk@gmail.com*

Abstract

Health care is one of the services that is given for highest importance. With advances in medicine and technology, physical health is well maintained. Whereas mental health is one of the major concerns that is being addressed by most of the people. Due to busy schedules, mental health is being neglected and due to which most are suffering from mental illness such as anxiety disorders. In this work, we propose a novel approach to improve mental health by using IoT with neural feedback.

Index Terms: Brain Waves, Neural Feedback, Internet of Things (IoT), Mental Health.

1. Introduction

IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and can transfer data over a network without requiring "human to human" or "human to computer interaction". The vision of IoT is to reduce the human efforts and make devices smarter to share information with each other. The smart devices capture every bit of information of daily life via sensors to process and interact with human or other devices to complete a task. Thus, thing in IoT is an object in physical world which is integrated with communication network. It bridges the gap between physical world and the digital world [1] – [8]. IoT cuts across many domains like agriculture, health, defence sector, construction, etc… [3], [4].

Over view of this paper is organized as follows. IoT in health care, significance of mental health, introduction to brain waves, introduction to EEG and methods to capture EEG, proposed neural feedback based IoT system to improve mental health, results and conclusion.

2. IoT in Health Care

While technology can't stop the population from ageing or eradicate chronic diseases at once, it can at least make healthcare easier on a pocket and in term of accessibility. A new paradigm, known as the Internet of Things (IoT), has an extensive applicability in numerous areas, including healthcare.

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The full application of this paradigm in healthcare area is a mutual hope because it allows medical centers to function more competently and patients to obtain better treatment. With the use of this technology-based healthcare method, there are unparalleled benefits which could improve the quality and efficiency of treatments and accordingly improve the health of the patients.

The main components that involve in IoT applications for healthcare are device (sensors), interconnected gateway, cloud, monitoring devices.

Sensors detect patient's body condition and sends data to monitoring device using interconnected gateway. The monitoring device analyses this data with data available in the cloud and sends notification to physician.

IoT helps in diagnosis, monitoring and treatment of diseases. Some of the applications of IoT in health care are as follows[3], [5] – [7].

Artificial Pancreas System: This device detects the glucose level in patient and correspondingly regulates insulin level for diabetic patients [8].

Activity Tracker for Cancer Treatment*:* It is used to gather information about the patient to treat multiple malignant tumors.

The tracker will gather day to day data about the activity level and fatigue, also collects data about the appetite which is stored in the apps on their smart phones. Using this gathered data, patient's treatment will be determined and improved.

In case of cancer especially, the use of activity trackers plays an important role to track reaction of patients to a particular therapy.

Ingestible Sensors*:* Ingestible sensors are an example of digital medicines. The medicine dissolves in the stomach and radiate signals which are caught by sensors of the wearable's worn by patient and transmits the data to the app on the smart phone

3. Mental Health

Mental health refers to cognitive, behavioral, and emotional wellbeing. The Mental health effect physical health also and it can affect the daily life, relationships, and even physical health. Mental health also includes a person's ability to enjoy life to attain a balance between life activities and efforts to achieve psychological resilience.

With hectic and busy lifestyle mental health is often neglected by most. But this in turn effects their physical health indeed.

There are lot of symptoms that indicate physical illness. Whereas symptoms of mental illness are often neglected and not known to most. This increases risk of mental fatigue which becomes a factor for stress disorders, depression, sleep disorders, etc.

The major treatment for mental disorders includes Psychotherapy, usage of medication such as anti-depressants, anti-anxiety medication, stimulants, mood stabilizers, etc. But usage of medication has their side effects such as drowsiness, nausea, vomiting etc.

4. Brain Waves &EEG

At the root of all our thoughts, emotions and behaviors is the communication between neurons within our brains. Brainwaves are produced by synchronized electrical pulses from masses of neurons communicating with each other. These brain waves are mainly classified as Infra-Low waves, Delta waves, Theta waves, Alpha waves, Beta waves and Gamma waves. A glimpse of these waves is shown in Fig. 1.

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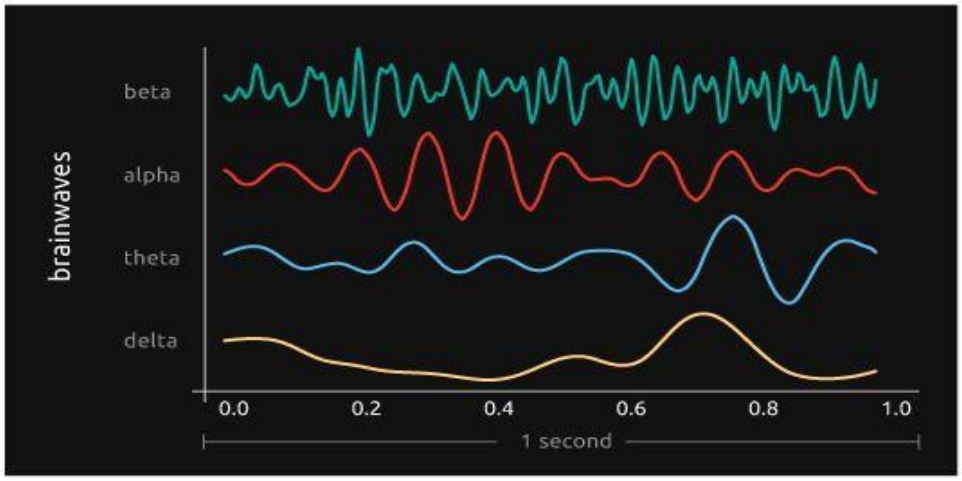

Fig. 1: Brainwaves

Infra low waves have frequencies that are less than 0.5 Hz. They play major role in brain timing and neural network function. Delta waves, that have frequencies between 0.5 Hz to 3 Hz are generated during deep meditation and dreamless sleep. They suspend external awareness and are the source of empathy, healing and regeneration. Theta waves with frequencies 3 Hz to 8 Hz are generated during dreamy sleep. Alpha waves have frequency range of 8 Hz to 12 Hz. Alpha state is the resting state of brain. Alpha waves aid overall mental coordination, calmness, alertness, mind/body integration and learning. Brain waves with frequency range 12 Hz to 38 Hz are known as Beta waves. Beta waves denote waking state of consciousness. Brain waves with frequencies between 38 Hz and 42 Hz are called Gamma waves. These Gamma waves are generated when engaged in multiple tasks (thoughts).

5. Brain Sensing Headband

The reading or graph of brain waves taken is called EEG (ELECTROENCEPHALOGRAM). These EEG signals are very weak and very hard to capture. To sense and capture those brain waves, electrodes are placed around head on scalp at specific points. With advances in electronics, the whole bulky brain computer interface has been compacted to a stylish headband as shown in Fig. 2. An EEG headband can be used to sense brain's EEG signals. This headband can be connected to a computer or a mobile to analyze brain waves [10] – [15].

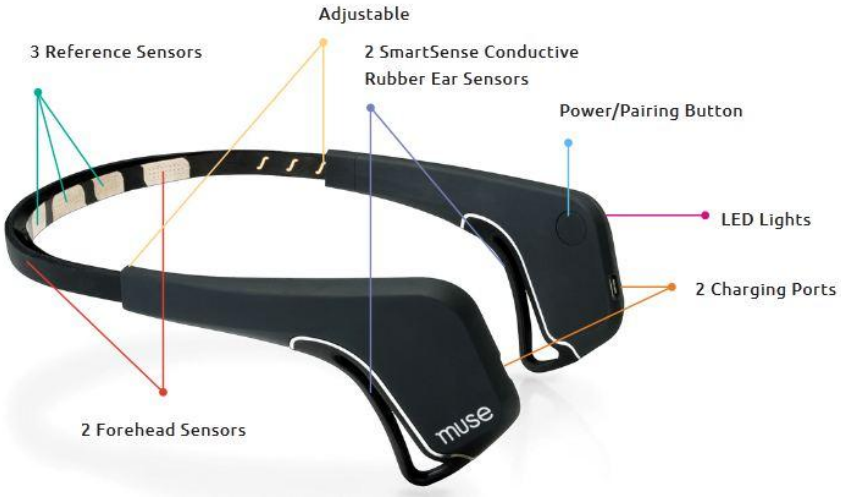

Fig. 2: Brain Sensing Headband

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6. Working of Proposed Method and Expected Benefits

As we know that the sound can affect and alter state of brain. The music with different frequencies has different effects on brain. The music such as binaural beats is proved method to alter state of brain. There are lot of music based mobile apps available that can alter state of brain to meditative state. But these applications (Apps) are not so effective as they are pre-recorded music that play from start to end without any details on present state of brain. To overcome this issue, neural feedback has been used [16] – [17]. This neural feedback can be taken from headband. The architecture of such neural feedback-based system is shown in Fig. 3. Such kind of neural feedback based IoT system can be used to improve mental health. The main components of the proposed system are brain sensing headband, mobile with internet connection.

Fig. 3: Architecture of the proposed system

The working block diagram of the proposed system is shown in Fig. 4. The brain sensing head band connected with a mobile App will show the current state of brain. The App will play music and records EEG pattern, analyses the data available in cloud and determines state of brain. This works as neural feedback and the App tunes the music such that brain will work in Delta state, where deep relaxation and healing takes place. By continuous usage of this therapy will not only improve the mental health but also gives energy boost to brain and body due to deep relaxation. For most of the people, listening the music is a common way of relaxation and hence it doesn't have any side effects also.

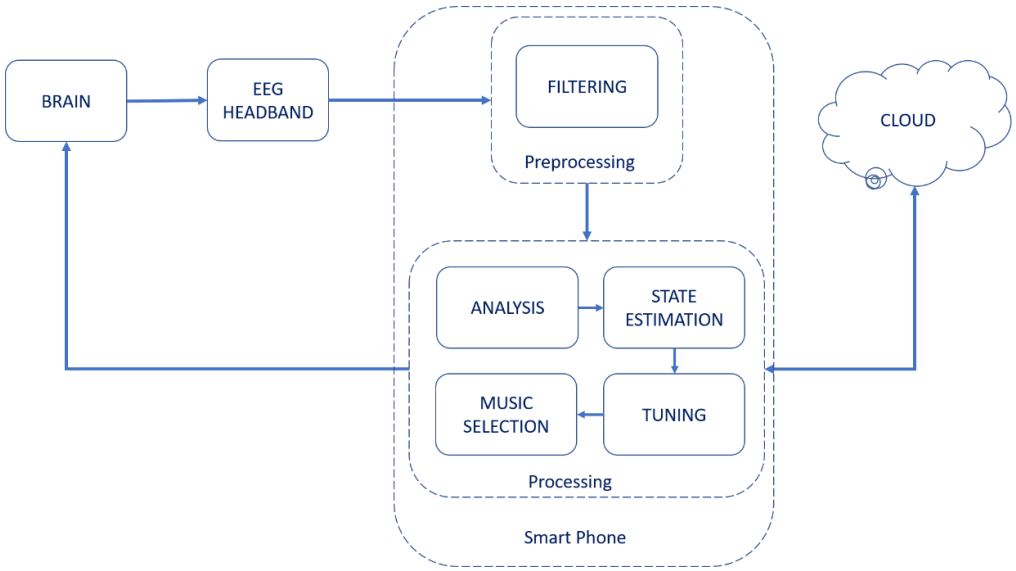

Fig. 4: Working block diagram of proposed IoT based Mental health system with Neural Feedback

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The proposed method can be applied for random mental conditions. The expected results of proposed method are shown in Fig. 5. Various advantages of this method include: Low cost, Easy to implement, cures mental illness effectively, enhances concentration, Improves cognitive abilities, No side effects.

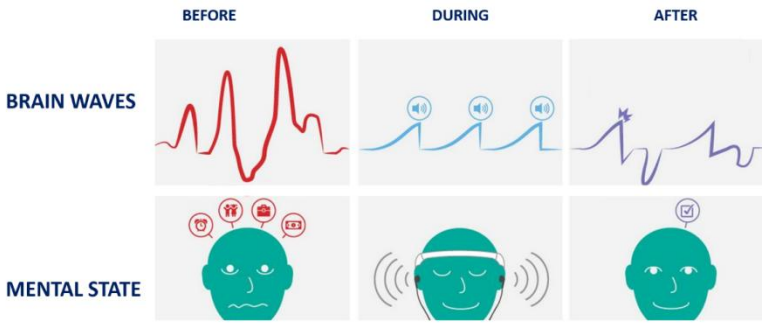

Fig. 5: Results of Proposed Method

7. Conclusion

An App aided with Neural feedback through EEG headband can tune brain to a relaxed state and can heal mental illness with no side effects effectively.

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