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Music Recommendation Based On Face Emotion Recognition

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Abstract: *Music therapy is an excellent method for slowing the course of dementia. Because it activates the brain regions responsible for remembering by eliciting emotions. When therapists give enough and personalized stimuli for each patient, treatment is most effective. However, this might be difficult at all times. Artificial Intelligence (AI) approaches will aid in this problem. This paper provides a detailed review of emotional computing. This paper will look into AI approaches for automatic emotion recognition in Human-Machine Musical Interfaces (HMMI).*

Keywords *- Affective computing, Auditory Stimulation, Emotion Recognition, Recommendation system Music therapy.*

I. Introduction

Several nations have seen significant changes as a result of ageing populations in recent decades. As the aged population has risen, so has the prevalence of age-related disorders including osteoporosis, hypertension, and dementia. The two most common causes of dementia in the world are cerebrovascular ischemia and Alzheimer's disease.

Through musical stimulation and music instruction, music therapy has been demonstrated to slow the progression of dementia. Emotional connections with music enhance memory-related brain regions. In order for music therapy to be effective, it is necessary to detect and rectify the patient's emotions. It can be difficult to recognize emotions, especially for individuals with little experience.

As a result, this publication presents a comprehensive overview of the literature in the subject of Computational Intelligence applied to emotion identification in elelctro encephalograph, speech data, and facial expressions. The goal of this review is to find AI algorithms for autonomous emotion identification in human-machine musical interactions.

Aging, cognitive decline, affective computing, and music therapy are the topics covered in the next section. The systematic search technique is described in the Methodology section. Following that, the findings are presented and debated. The paper's findings and limitations are highlighted in the last part.

II. Literature Survey

The primary theoretical references that constitute the basis for performing and comprehending this research are presented in this topic. This section focuses on Alzheimer's disease and the idea of cognitive impairments. The notion of emotions is then introduced. It highlights the subject of research of Affective Computing by considering the forms and stimuli for emotion recognition. It wraps off with a quick rundown of treatments and interventions. It also explains how technology may help them and how musical methods can help them improve their capabilities. [1]

Some characteristics of cognitive impairments and dementia must be addressed as an introduction to the topic. Cognition is the process through which the brain learns, perceives, remembers, and assimilates information from several senses. As a result, cognitive impairments are frequently identified. As impediments to growth, especially in terms of learning and intellectual talents.

This paper discusses Memory loss, focus issues, and trouble reasoning rationally are all symptoms of cognitive deficiency, also known as moderate cognitive impairment. Although these symptoms are not dementia, it is typical for the elderly to confuse them with natural ageing. These are now warning indications that both persons and their families should be aware of, since they may indicate the onset of Alzheimer's disease in rare situations (AD) [2]

Despite their similarities, distinguishing between cognitive decline and Alzheimer's disease is critical in order to avoid misunderstanding. Alzheimer's disease is one of the most prevalent kind of memory loss, which is also a blanket term encompassing disorders in which the brain fails to function correctly. Alzheimer's disease is a kind of dementia that is chronic, degenerative, and progressive.[4].

This paper discusses Memory problems are a hallmark of Alzheimer's disease, although they are rarely the most visible sign, according to the study. Cognitive issues may arise as an early indication as the disease advances. Even if there is no cure, several sorts of intervention can enhance the quality of life of Alzheimer's

sufferers. It is vital to mix pharmaceutical and non-pharmacological techniques to treat the individual holistically, include psycho-corporal and biological treatments, as well as music therapy, as examples of these interventions. Despite this, various different methods to emotional computing and computational intelligence have evolved.[5]

Emotions are experienced in everyday life events, despite the fact that they are employed in a variety of contexts. Emotions have a crucial part in the social development of every individual. [6]

A number of studies confirm that emotional expressions are made up of variables that are directly proportional to cognitive aspects. Therefore, emotions can be in different ways in each individual, including facial expressions, sensations and body movements. As a result, emotions are among the most essential experiences since they impact, among other things, choices, motives, and decisions. They are also necessary for both verbal and nonverbal communication.[7]

There are at least two different categories of emotions in the literature. In the first category, have Joy, sadness, wrath, fear, disgust, surprise, and awe will be universal or fundamental emotions. Second, social emotions like remorse, humiliation, hubris, and amazement exist. Aside from the description of each emotion, there is a distinct method in which it presents itself from one individual to other. When it comes to these emotions, humans are capable of detecting and feeling each other's sensations. People may be able to identify it instinctively, but computers have a hard difficulty doing so.[8]

Affective Computing (AC) is a branch of Artificial Intelligence that focuses on the study of emotions in computers in this context. Rosalind Picard invented the term "affective computing" in 1997 to define a branch of research that is completely transdisciplinary with other domains of knowledge such as Biomedical Engineering, Psychology, and Computer Science. The objective of this branch is to create emotion recognition algorithms that may be used for a variety of applications. AC researches how computers identify, represent, and convey emotions (as well as other psychological features of people) as well as how they react to them. In this circumstance, there are numerous approaches to examine the issue of emotion detection. Data must be employed in order to do this.

Support Vector Machines (SVM), Convolution Neural Networks (CNN), and Generative Adversarial Networks (GANs) appear often in the research on audio recognition. They are often regarded as the most effective models for this sort of categorization. The MFCC has also developed a reputation as one of the most popular characteristics.The MFCC is a parametric representation of the frequency spectrum of a speech signal. It's a frequency scale that's remarkably comparable to the human auditory system and exhibits nonlinear behavior.

Human emotion may also be detected through physiological signs. The Skin Temperature, Galvanic Skin Response (GSR), Electrocardiogram and Respiration Range, are all Peripheral Nervous System signals. The electroencephalogram, or EEG, is the signal that is analyzed in the Central Nervous System. In this sort of approach, a model that analyses several signals performs better. Emotions may have a substantial influence on physiological and cognitive responses.

Multimodal analysis coupled classifiers become quite effective at recognizing these feelings. They can also be used as an alternative to speech and picture recognition.

Another way to recognize emotion is by facial expressions; this approach is clearly easier and faster to determine. Aspects that can be visually identifiable, like as dark hair and light eyes, are usually always included in models based on this optics. Standardization and extraction of these properties, on the other hand, are problematic. New study is increasingly taking into account physiognomy, age, gender, and various demographic groupings.

AI models based on photos and videos have a high processing cost. As a result, they have a lot of data that has to be pre-processed or classified. For day-to-day applications where other approaches would be impractical or impossible, these flaws can be compensated for by improved performance and accuracy.

Emotions are a transient psychophysiological phenomenon, last but not least. As a result, gathering information on emotions voluntarily is still difficult. Occasionally, it's important in study settings to put subjects in pre- planned emotional scenarios. It has been discovered that sensory stimulation such as smells, sights, or sounds may elicit emotions. Images, films, melodies, and emotional scenarios created using virtual reality are just a few examples of the visual and audio inputs.

Games that increase patient engagement and bring fun to treatment sessions should be highlighted when discussing the use of technology in therapy. They achieve this by presenting incentives and different levels of difficulty. These qualities are beneficial because they include people in the rehabilitation process. They also make exercising more motivating at the same time. According to the goals of the rehabilitation process, many game genres can be categorized. Exergames and other similar games are designed to encourage physical exercise in seniors in order to enhance their health and wellbeing. Serious games are also included in this

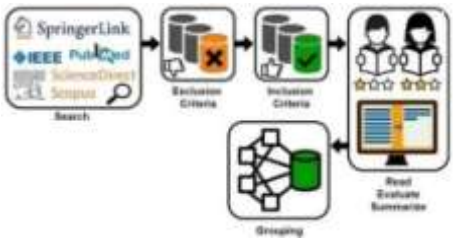
category.

The study suggests that playing serious games can help patients with Parkinson's disease train their skills. Besides treating traumatic brain injury, it can also be used to train patients with dementia.

The studies mentioned in this section confirm that applications and inclusion of games, robotics, VR, for therapeutic purposes - when combined with musical strategies - will be highly effective. In fact, music makes a big difference in the rehabilitation process, and it also influences how users interact with the systems. The search for musical solutions for applications in healthcare continues to grow. In order for these technologies to be truly beneficial, it is critical that properly trained professionals assist in their development.

III. Methodology

Automated database searches utilizing keywords and time periods as criteria were used to carry out the systematic review. The methodological features of recent studies, particularly those that deal with the most extensively researched computational and artificial intelligence techniques, are the main emphasis of this study. The following search phrase was used to look up any articles published between 2016 and 2020 that had the terms defined in it in their metadata, titles, or abstracts. Five stages were involved in the article selection process (Figure 1). Finding the quantity of publications from each scientific database was the initial step. Secondly, determined if it met each of the four exclusion criteria (EC). Research based on intrusive procedures, publications classed as a poster, instructional, editorial, book, annals, or reviews, and studies that don't employ computational tools are all prohibited by EC. The third phase involved choosing papers that satisfied at least one of the following inclusion criteria (IC): IC1).analyses of EEG signals using computer methods; IC2) investigations using speech signals and computational techniques; IC3) investigations using computational methods on physiological data (e.g., electrocardiogram, respiration frequency, heart rate, galvanic skin response); IC4) research using computational techniques for processing images or videos; IC5) Investigations that identify emotions using EEG data; IC6) researches the identification of emotions in voice signals; IC7) researches the identification of emotions in physiological signs; IC8) research that use human-machine musical interfaces; IC9) studies that use picture or video emotion recognition; (HMMI).



This work's multidisciplinary character necessitated searching across numerous bases. The chosen databases, however, comprise works from various fields of study and have distinct focuses. It follows that it is only normal for the search to yield a varied number of publications from each database.

In the last stage of the review, divided the chosen research into the categories depicted in Figure 2. The studies were grouped into six categories: games, virtual reality, affective robotics and therapies (G1), physiological or behavioral responses brought on by acoustic signals (G2), emotion recognition brought on by acoustic stimuli (G3), non-invasive assistive solutions based on human-machine musical interfaces (G4), musical composition, recommendation and customization (G5), and other approaches (G6). Studies that don't fit into any of the previous divisions are included in this last section.

As shown in Fig.2, the minority of the studies (8%) are in the 4th group, regarding to non-invasive assistive solutions based on human-machine musical interfaces. G1 and G3 together concentrate almost half the amount of studies (47%). Thus, it’s possible to see that in the last years many studies are being conducted in the areas of games, virtual reality, affective robotics, therapies, and emotion recognition associated with acoustic stimuli. 19% of the papers are related to physiological and behavioral responses induced by acoustic signals (G2). Finally, both G5 and G6 have 13% of the studies each.

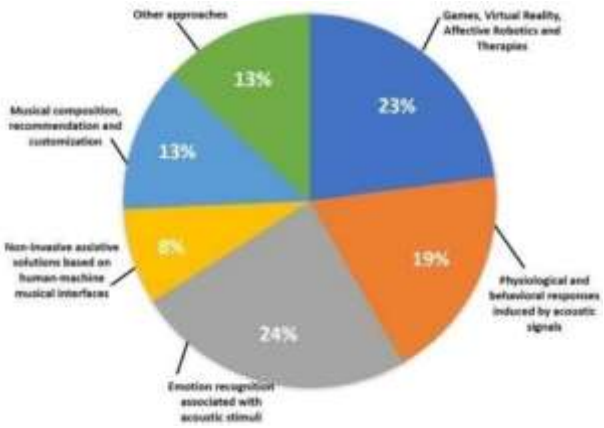


Fig. 2. Group's distribution of the selected studies.

A significant number of studies analyse physiological signals to recognize emotions, which is an approach used by a significant number of studies in this area. Thus, studies using biosignals such as EEG, ECG and skin's electrodermal activity were returned. In addition to bio signals, other

studies have combined more than one parameter to assess emotion. In Ramirez et al. (2020)'s approach, they combined functional magnetic resonance's and EEG's parameters. Nevertheless, used a combination of skin's electro dermal activity and ECG data to identify emotions. The writers often gather their own data for publications that examine bio signals. Although the publications outlined the procedures, it is challenging to duplicate and enhance the tested models due to the absence of available datasets.

Similar to this, a number of studies employed different criteria rather than bio signals to identify emotions. We may single out the organizations that use audio analysis to evaluate emotion. Textual elements can also improve the ability to recognize emotions in music. In order to enhance the performance of models in this area of research, various studies investigate the usage of song lyrics as well as how they relate to audio-visual material. Data from open databases like Soundtracks, MTV, and Mediaeval are typically used in research that exclusively examine audio. The database the authors created was made available to the scientific community. Studies that solely employ audio-visual and video content create their own databases. The study's ability to be replicated is impacted by this.

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