International Journal
of Discoveries and Innovations in Applied Sciences
Vol. 4 Issue 2 **| pp.** 1-15 **| e-ISSN:** 2792-3983
Available online @ https://openaccessjournals.eu/index.php/ijdias
OPEN ACCESS JOURNALS

Emotionally-Related Song Playing System for Users that Makes Use of Force Sensor

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Abstract: A user's mood is just as important as their past tastes or the type of music they listen to when deciding what to play. In order to discover a user's emotional state from signals collected by wearable physiological sensors, this research suggests a framework for music recommendations based on emotions. Specifically, a wearable computer that incorporates a Force sensor may identify the user's emotional state. Any recommendation engine that relies on collaboration or content can use this emotional data as supplemental information. You can use this data to make the recommendation engines that are already out there even better. In our suggested system, we want to detect the user's emotions and play music automatically based on those feelings. The sensors we've supplied act as the user's biological mental signal, which it then converts into an equivalent electrical signal. The music player then plays the songs based on this electrical signal. In the future, wearable gear can be used to improve this system even further. The bracelet has a built-in force sensor that can detect an emotional signal and provide music recommendations based on that reading.

Keywords: software requirement specification, robust transactional property graph database, Cypher, graph query language, class-based, object-oriented, computer programming language. graphical user interface eclipse.

Citation: Rajest, S.S., Regin, R., Shynu T., Steffi R. Emotionally-Related Song Playing System for Users that Makes Use of Force Sensor. *International Journal of Discoveries and Innovations in Applied Sciences* **2024**, 4*(1)*, 1–15. https://doi.org/10.17605/cajssh.v5i1.1062

Received: 23 December 2023
Revised: 12 January 2024
Accepted: 28 January 2024
Published: 22 February 2024

1. Introduction

To alleviate data overload in novel learning contexts and provide students with appropriate student assets, an attribute-based recommendation system provides a tailored recommendation-enabling mechanism [8]. The recommendation is made using a combination of content-based sifting, community-oriented separation, and a few hybrid approaches [9]. Using the most up-to-date and relevant data, property-based technique caters to each student's individual learning style [10]. In comparison to music class, three attributes types, author, and year better illustrate the essential variables of musical preference [11]. By combining the client's qualities with the proposed content-based proposal, we were able to outperform the classification-based advice [12]. These features are sufficient for music preference estimate, as shown by the results. Next time we have a client with a comparable property, we'll share their music with them [13]. What matters is that this concept comes together at a point when it is integrated with a power sensor and the framework that plays music. When that happens, music might be played as an expression of emotion [14,15,16,17].

Using multi-channel physiological inputs to predict arousal and valence is the emotion recognition issue. Our system will play music automatically based on the user's current mood [18,19,20,21]. An integrated galvanic skin response (GSR) and photo plethysmography (PPG) physiological sensor (OR) and a wearable computer can determine the user's emotional state [22,23,24,25]. Any recommendation engine that relies on collaboration or content can use this emotional data as supplemental information [26]. Arousal and valence prediction from multi-channel physiological inputs is our proposed approach to the emotion recognition challenge. Our system will play music automatically based on the user's current mood [27,28,29,30,31].

1.1. Literature survey

According to Petrantonakis and Hadjileontiadis [1], the goal of the emerging field of EEG-based emotion recognition in the realm of human-computer interaction is to develop and apply novel algorithms that can detect and classify emotions based on electroencephalogram (EEG) data. In this paper, a new approach is introduced for this purpose. It makes use of an optimised hybrid filter that combines empirical mode decomposition (EMD) and genetic algorithms (GA) to identify the intrinsic mode functions (IMFs) that correspond to the multiple energy contents of the initial signal that needs to be classified. After the chosen IMFs produce the filtered signal, it is analysed using higher-order crossings (HOC) to extract features. Happiness, anger, fear, disgust, sorrow, and surprise are the six emotion classes that the final feature vector is classified into using quadratic discriminant analysis. The suggested EEG-based emotion recognition method is efficient, as shown by the high classification performance (84.72 percent maximum mean classification rate).

Discovering the connections between emotional states and brain activity can be done by recording ongoing brain activity using an electroencephalograph (EEG). Subjects' self-reported emotional states while listening to music were used to classify EEG dynamics in this study using machine-learning techniques. In order to improve EEG-based emotion recognition, a framework was suggested that would 1) systematically look for EEG features that are distinctive to emotions and 2) investigate how well the classifiers work. Using a support vector machine, 26 participants were able to achieve an average classification accuracy of 82.29% ± 3.06% in identifying four different emotional states: joy, anger, sadness, and pleasure. Also, the study looked at the possibility of utilising fewer electrodes to describe the EEG dynamics while listening to music and found 30 elements that were independent of the participants that were most influential in emotional processing. Electrodes positioned close to the parietal and frontal lobes provided the bulk of the discovered features, which is in line with many previous findings in the literature. Potentially useful in clinical or everyday settings, this research might pave the way for a non-invasive method of gauging emotional states [2].

For studies on emotion recognition and implicit tagging, researchers have used MAHNOB-HCI, a multimodal database that records responses to emotional stimuli. We put up a multimodal setup to record synchronised films of faces, audio signals, data from eye gazing, and physiological signals from the peripheral and central nervous systems. In a total of two studies, twenty-seven people of various sexes and ethnicities took part. Participants in the first study rated their own emotional state after viewing 20 films based on arousal, valence, dominance, predictability, and other emotional keywords. In the second trial, participants saw brief video clips and still images twice: once untagged and again with the appropriate or wrong tags. Participants were asked to rate how much they agreed or disagreed with the tags that were shown. We split the recorded films and physiological reactions and put them in a database. The academic community has access to the database through a web-based interface. Results from trials with emotion recognition and implicit tagging, as well as those with single modality and modality fusion, were published after data analysis. Both the recorded modalities' possible applications and the importance of the emotion elicitation methodology are highlighted by these findings [3].

2. Method

Here we offer a multimodal dataset for studying human emotions. While watching forty one-minute clips of music videos, 32 individuals had their electroencephalograms (EEGs) and other physiological data monitored. On a scale from arousal to valence to like/dislike to dominance to familiarity, participants ranked each video. Additionally, 22 out of the 32 subjects had their front faces videotaped. We provide a new approach to stimulus selection that combines an online evaluation tool, video highlight detection, and retrieval by emotional tags from the last.fm website. The ratings that the participants gave throughout the experiment are examined in detail. It seeks to discover correlations between the frequencies of the participants' EEG signals and their ratings. Here we share our methods and findings for classifying arousal, valence, and like/dislike ratings utilising EEG, peripheral physiological data, and multimedia content analysis in a single trial. Lastly, the classification findings from several modalities are combined to make a choice. Since the dataset is open to the public, we hope that other researchers may utilise it to evaluate different approaches to estimating emotional states [4].

3. Results and Discussion

The DECAF dataset, which can decode users' physiological reactions to emotionally charged audiovisual content, is introduced in this study. In contrast to datasets like DEAP [15] and MAHNOB-HCI [31], DECAF contains (1) brain signals recorded using the Magneto encephalogram (MEG) sensor, which makes it possible to capture naturalistic affective responses with minimal physical contact with the user's scalp, and (2) the explicit and implicit emotional reactions of 30 participants to 40 one-minute music video segments used in [15] and 36 movie clips, allowing comparisons of the EEG vs. MEG modalities and movie vs. music stimuli for affect recognition. Along with MEG data, DECAF includes simultaneously recorded videos of the face using near-infrared (NIR) technology, as well as peripheral physiological responses from electrocardiograms, electrooculograms, and trapezius electromyograms (tEMG). To prove that DECAF is useful, we show I how participants' physiological responses correlated with their self-assessments and (ii) how DECAF classified valence, arousal, and dominance in a single trial, with performance compared to available datasets. To show how DECAF can do dynamic emotion prediction, we employ its time-continuous emotion annotations on movie clips from seven different users [5].

In order to build EEG-based emotion detection models for positive, neutral, and negative emotions, this paper proposes deep belief networks (DBNs) to examine crucial frequency bands and channels. With the help of fifteen volunteers, we were able to compile an EEG dataset. Over the course of a few days, each participant completes the tests twice. Differential entropy characteristics are retrieved from multi-channel EEG data and used to train DBNs. We look at the trained DBNs' weights and the important channels and frequency ranges. There are four different profiles to choose from: 4, 6, 9, and 12 channels. Compared to the original 62 channels, the recognition accuracies of these four profiles are much more constant, reaching a maximum of 86.65%. Based on the weights of trained DBNs, we may identify crucial frequency bands and channels that match the observations. Furthermore, our experimental results demonstrate the existence of neuronal signatures linked to various emotions, which are consistent both within and between individuals and sessions. We evaluate deep models and shallow models side by side. Among the four algorithms, DBN has the highest average accuracy at 86.08%, followed by SVM at 83.99%, LR at 82.70%, and KNN at 72.60% [6].

One common method for measuring brain activity without causing any harm is the electroencephalogram, or EEG. Present EEG investigations can only use subjects who are either completely still or who engage in very limited motions, like treadmill walking, because of how easily motion artefacts can be introduced into the data. In this study, we offer a novel multimodal sensing method for evaluating EEG data acquired during realistic free-motion activities. The EEG is selectively processed during the brief intervals when the subject's eyes are focused on desired stimuli and there is a natural stop in their movement. This is achieved by combining data from the subject's gyroscope with the data from their wearable eye-fixation device. We showcase the method via a practical exercise where participants navigate a clothing store. This demonstrates that, regardless of the task's requirement for free mobility, localised EEG could be examined over 65% of the time. Also, you may use it to show how colour priming works when you go clothing shopping. When people look at merchandise that fit the store's colour scheme, their left frontal EEG activity goes up [7].

More and more, researchers and media professionals are looking for objective engagement metrics to deduce why consumers watch videos [32]. The psychological level has mostly operationalized participation through markers of attentional and emotional processes, often ignoring motivational elements, despite the complexity of this construct. We argue that, in addition to attentional and affective processes, motivation, which is defined as an individual's inherent interest in ingesting a particular piece of content, must be considered when people are consuming news [33,34,35,36,37,38,39]. Using electroencephalographic (EEG) recording of users' brain activity while they read pre-classified news sets according to their possible interest, this work offers an objective measure for motivation [40,41,42,43,44,45]. Here, we zero in on a measure the so-called frontal alpha asymmetry that shows how much an object or event makes one want to approach or flee (FAA). In addition to the standard method for EEG signal analysis, we present a new method that uses signal entropy estimation [46]. While the results show that FAA is a good proxy for objectively monitoring interest in media contents, entropy analysis is sensitive to interest manipulation and provides results that supplement traditional power spectrum analysis; however, its interpretation in information processing needs further investigation [47,48,49,50,51].

One of the leading diseases in the last ten years is depression, which endangers the lives of millions. But for now, doctors rely heavily on their own experience and a lot of manual labour when making a diagnosis of depression using questionnaire-based interviews [52,53,54,55,56,57,58,59,60,61]. Consequently, pragmatic and impartial approaches are required. A case-based reasoning approach for depression identification is presented in this research. After acquiring EEG data from a portable three-electrode device, the data was processed to eliminate artefacts and extract characteristics. Several classifiers were used. In order to build the case base, the most effective features were chosen using the best-performing k-nearest Neighbor (KNN) evaluation algorithm [62,63,64,65,66,67,68,69,70,71]. To get the best rate of depression recognition, we used the weight set of standard deviations to compute similarity using normalised Euclidean distance. The ideal similarity identification of depressed patients achieved an accuracy of 91.25 percent, which was higher than the KNN classifier's 81.44% accuracy or other classifiers that had been reported earlier [72]. In this way, we present a new, widely used, and efficient way to identify depression automatically (Figure 1).

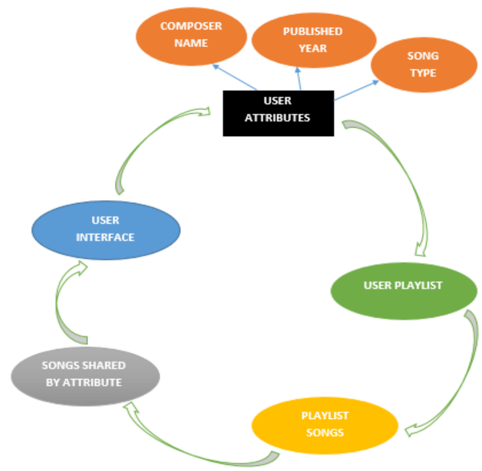

Figure 1. Architecture diagram

The user is able to interact with the application by means of an interface that is developed between them. There is a connection between the system that detects applied force and the force monitoring equipment. You can add songs to a playlist by creating one first. Music recommendations and automatic playback are based on attributes as force is applied [73,74,75,76,77,78,79].

FSRs are sensors that can detect real applied power through crushing and weight application. They are not only easy to use, but also to bear. Two halves separated by a divider make up the force-sensing resistor [80]. With increasing power, the semiconducting component will join with more Dynamic Component dabs, lowering the protection. In most cases, the resistance value of a force detecting resistor will fluctuate at random in response to the applied force. Though they aren't always precise and can vary by as much as 11% from one sensor to the next, power sensors are inexpensive, simple to set up, and work. Therefore, the range of findings should be investigated upon deployment of a force-sensing resistor [81,82,83,84,85,86,87]. They are able to identify electricity, but they are off by one when they assume there is a whole number load on it [88].

This module takes in quantities from the sensor and sends them into an Arduino UNO microcontroller, which then converts the analogue values into digital values on an HTML web page. The Arduino platform consists of an integrated development environment (IDE) and a programmable circuit board (PCB). Its primary function is to populate the microcontroller board with values from the computer system. The USB connection sends the board additional code. The first pin is a source of force [89,90,91,92,93,94,95]. The Simple In has 6 pins. The pins can read the sign using a basic sensor. This value is transformed into an electronic value. Pin 7 is the Digital Output. You can use these pins for increased yield and computerised input. The power-led indication is located on pin 11. When the Arduino is connected to a power source, this LED will light up. While sending and receiving signals, the Transmit and Receive pins light up. As a means of determining the IC type prior to programme loading, Pin 13 serves as the central processing unit (CPU) of the Arduino [96,97,98,99,100,101].

During this module, you will connect various equipment parts to the Arduino board. This includes sensors, power supply, engine, and bell. Then, you will start the process of connecting the Arduino board to the server. Once the server is up and running, the system will receive all the information from the microcontroller-based Arduino board [102,103,104,105,106,107,108,109].

The system file is crucial in this module as it retrieves the pressure values from the database using JDBC connectivity. Access to the server's database is made possible using JDBC connectivity, which is typically described as an API for application programming. With the help of the necessary power source, the measured sensor data are first transmitted to the computer via a UART cable. Thanks to it, we can use the RxTx jar file to save the received sensor pressure data in a database. As soon as it gets the sensor values, this operation will begin running automatically [110,111,112,113,114,115].

Analyzing the stored data is the focus of this module. When the Arduino board sends the sensor value, it will be treated as real-time data [116,117,118,119,120,121]. After that, we use MySQL and the NetBeans IDE 8.1 software application to research the saved database in order to track the sensor values according to human emotions. The Apache Tomcat component of the NetBeans IDE 8.1 application uses MySQL to store and retrieve historical data, which it then uses to make predictions. In an automated fashion, the songs are suggested depending on a person's mood after the sensor analyses their emotions [122,123,124,125,126,127,128,129]. The user is able to interact with the application via the interface that is developed between them. There is a connection between the system that detects applied force and the force monitoring equipment. You can add songs to a playlist by creating one first. As pressure is exerted, the songs are automatically played based on the qualities. It stands on its own as a platform. James Gosling and others at Sun Microsystems created the object-oriented programming language known as Java. Despite having a feature set more similar to Objective C, the language was originally named Oak (after the oak trees outside Gosling's office) and was meant to replace C++ [130,131,132,133,134,135,136,137,138,139].

A class is a relatively new idea for people who are just starting out with object-oriented programming. Classes, in their most basic form, define sections of code that can include both data (in the form of attributes) and functions (methods) [140]. For those who are familiar with C programming, the interpreter searches for a specific method called main when it executes a class. An array of strings, similar to C's *argv[]* parameter, is declared static and supplied as an argument to the main method. Any time it is deemed essential, the code can implement changes. In order to accomplish the goals stated previously, the following criteria are necessary: Java stands out due to its unique feature of co-implementation and interpretation for each programme. Compilers are useful tools for transforming Java programmes into Java byte codes, an intermediate language that the Java interpreter may use [141,142,143,144,145,146,147,148]. Each instruction in the Java byte code is processed and executed by the computer using an interpreter. Every time the programme is run, interpretation takes place, but compilation only happens once [149]. You can see it in action in the Figure 2 below.

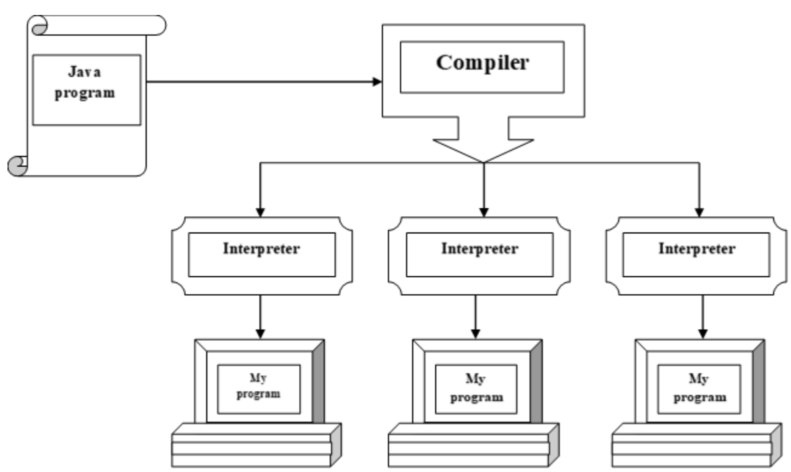

Figure 2. Working of JVM

Program development, documentation, and data structure design are the first steps in the software testing process. In order to fix bugs, software testing is necessary. A programme or project is not considered finished until all requirements have been met. As the last check of specification design and code, software testing is an essential part of software quality assurance. Executing the software in order to locate the error is known as testing. There is a chance of discovering an unknown error with a well-designed set of test cases [150,151,152,153,154,155,156,157].

Glass box testing is another name for this type of testing. By understanding the product's intended uses, this type of testing may verify that the product can carry out all of its intended purposes without a hitch while simultaneously checking for bugs in each one [158,159,160,161,162,163,164].

By understanding how a product works on the inside, this type of testing may verify that "all gears mesh," that the product's internal operation meets specs, and that all internal components have been thoroughly stressed. The primary emphasis is on the software's functional needs [165,166,167,168,169].

In order to find bugs related to interfaces, integration testing is a methodical approach to building the program's structure while running tests. That is, to put it simply, integration testing entails thoroughly verifying the product's component parts. Using unproven modules, construct a programme structure is the goal. Important modules should be located by the tester. It is important to test critical components early on. One strategy is to wait for each unit to pass testing individually before combining and testing them. Starting with the unstructured testing of smaller applications, this method has grown. Making smaller batches of tested units and adding them to the final product is another option. After integrating and testing a small group of modules, another module is added and tested. Continuing in this manner. The main benefit of this method is that interface dispenses are easy to locate and fix.

4. Conclusion

The linking process was the most significant blunder that occurred throughout the project. Whenever all of the modules are brought together, the link is not established correctly with all of the support files. Then, we investigated the interconnections and the links that were available. Any errors that occur are specific to the new module and the intercommunications that it has. It is possible to stage the development of the product, and modules can be incorporated into the product as they finish unit testing. The testing process is considered finished once the final module has been merged and tested. This project provides an explanation of a music recommendation system that is based on the opinion of the user. Previously, we have indicated that the sensors that we have provided are the biological mind signal of the user. These sensors transform the biological mind signal into an equivalent electrical signal, and the music player then plays the songs based on the electrical signal. The use of wearable technology in the future may allow for more improvements to be made to this system. The force sensor is incorporated into the wristband, and it enables the user to read the force signal that corresponds to the emotion and make recommendations for music.

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