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Analysis of Mental Health Treatment with AI Music Creation

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Abstract. AI music creation combined with music treatment. Nowadays, mental health issues have become a crucial problem that influences people's daily lives. AI music creation can better help people create the music they want by using various melodies. Each melody corresponds to a different emotion of the creator, which combined with the Random model to form new music. By using AI machine learning and AI data analysis to train AI to resolve and make music. Improve the convenience of psychological problem treatment and make treatment more convenient and scientific and technological and synchronized with the times. AI can be used through clinical data and the doctor's preliminary test report analyzes their risk, thereby informing and preventing the occurrence of psychological problems, and better giving corresponding individuals treatment recommendations. This paper mainly uses AI music to alleviate and prevent psychological problems, talks about the way how AI analyzes and understands the melodies present, and what kind of emotions the problems will face in a technical way or even in ethics. Also, the current level of this has been reached.

Keywords: AI music, mental health treatment, AI in treatment, music creation, music treatment

1. Introduction

Nowadays, mental health issues have become an assignable problem that has troubled many people, like parents, for a long time. Music psychotherapy is a kind of treatment that uses different kinds of melodies combined with psychological theories and techniques to release pressure through musical activities like listening, playing and creating. Helping people control their emotions and also helping physiologists treat patients in a more efficient way. Using AI music making on the dataset to get from the internet collection to find the correlation to make the personal music treatment for the patients.

By using the data sets to get different kinds of melodies to treat different kinds of mental health issues. AI has self-learning abilities that can get data from the internet to find correlations of each symptom, combined with the psychotherapist's diagnostic results. This paper is about AI music creation combined with music treatment. An AI model is recommended to form a corresponding music therapy plan and generate the required music according to the music therapy plan, so that it can better form corresponding music for treatment. Different melodies and different major keys bring different emotions, which can release psychological pressure and relieve psychological symptoms in many ways. Helpful for doctors' treatment, and AI can be more convenient, creating

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the corresponding melody is the most effective for this patient. Using these data to form a new data model helps AI to analyze the characteristics of various therapeutic music and form corresponding treatment music. If doctors can use AI music creation as a treatment for patients. This will greatly contribute to the effectiveness of psychological treatment.

2. Music treatment's history and development

Nordoff-Robbins used to say that there is a musician who taught students with language barriers, who learned to speak by music [1]. Then he started working with his college in 1959. Then he started their clinical trials through the Exceptional Children's task. By the music clinical task, small achievements and high support from others. The music melodies and influenced children's emotions. This improves children's activity and focused time and self-control ability. By the clinic task, they found that children who have mental health issues (exceptional children) started using the melodies to show their emotions and release the pressure in their minds. Music healed children gradually without their awareness. The start of children starting to sing or create music is divided into three parts. In one part, "from crying to singing". They started to improvise music compositions from continuous or intermittent crying. "Singing a crying voice"— children started to use their crying voices to sing with their awareness of cresting music. "Singing without a crying voice", a cooperative performance had occurred. During the music psychotherapy, the truth people believe and follow is that music is like a kind of instinct; no one is suspicious of the music treatment. And this is a form of music creation that goes beyond the mere music itself. During the period (1959-1976), Paul Nordoff and Clive-Robins cooperated on academic research and the development of new ways of treating children who have mental health issues [1].

Nowadays, there are about 249 million people struggling to get rid of the mental health issues (major depressive disorder MDD) [2]. Music psychotherapy has already had a significant effect on the treatment of psychological issues such as depression and anxiety disorders. Like lowering the PTSD symptoms and improving social ability. America, Australia, etc.—these countries have relatively complete policies of music psychotherapy.

Recent advances in artificial intelligence technology have changed many industries, like the ability to create music with different melodies; some can even infuse emotion into the music. AI (artificial intelligence) combined with music psychotherapy is pushing the improvements in the development of the treatment and its efficiency. Like music psychotherapy's robots, they can change the rhythm of the music according to the emotion people are asked to write about and provide personal treatment plans with the music, which may be created by artificial intelligence.

3. Analysis of datasets (mental health data)

With the development of AI technology, AI has changed from deep learning to autonomous thinking. It made AI capable of self-learning and brain-like decision-making, more like the human way, predicting the data, which is called machine learning. The process of analyzing data is spread into five parts "Define and Collect", "Preprocess", "Model and Train", "Evaluate and Optimize", "Predict and Deploy".

For "Define and Collect", in this part, you first need to input the define part, like "what you need to analyze for", and "what's the subtitle of this data". Following that, you need to know about the main aim of the thing you need to collect. For example, assuming that the aim is to know about if the number of students seeking help for psychological issues has decreased in the past month at the school psychologist's office, to make sure the school's psychology lessons have affected their mental

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health. For this set, a range of this, like a decrease of 5% of students, come for psychological counseling and the range of time is one month. Next, AI will collect the data of who had come to the office from the school system and sum up to make a new table that contains all the information about the psychologist's office. This part needs the integrity of the data, and also needs to protect the privacy of students by making their names meaningless.

"Model and Train" needs a large amount of data, like clinic experiment information and the successful cases, and then uses 8-N-fold to test and train the AI model (Figure 1). A small part for testing, the other for training. More data means more accuracy.

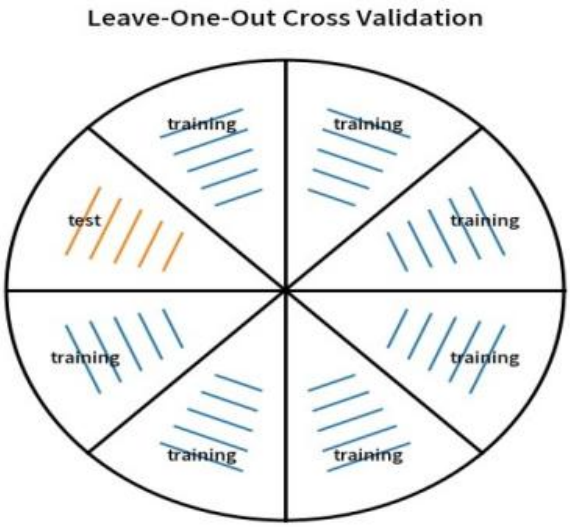


Figure 1. 8-N-fold (database)

Fundamental program uses entropy to determine the priority level of the situation (1) (2). Below are the formulas:

$$Entropy(S) = -P_{+}log_2P_{+} - P_{-}log_2P_{-} \tag{1}$$

$$Entropy(S) = \sum_{i=1}^{n} -p_i log_2 p_i \tag{2}$$

Also, it makes decision trees by using ID3 (Iterative Dichotomiser3) [3]. It is a classical algorithm that can classify tasks automatically. It first used entropy and information gain to calculate (3) the group ability of this decision. Then it will choose the decision that has the biggest information gain (4). Layer by layer, the cells continue to divide until they reach a point where they cannot longer divide. In a simple way ID3 to understand, it is an algorithm that help to produce a decision tree from the database. Formulas:

$$Entropy(S, A) = \sum_{v \in Values(A)} \frac{|S_v|}{|S|} \times Entropy(S_v) \tag{3}$$

$$Gain(S, A) = Entropy(S) - Entropy(S, A) \tag{4}$$

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There are different methods for different types of databases. For example, a balance and an imbalance database. The imbalance database has one more step than balance one—transformed the imbalance database into balance one. The way used to transform this is SMOTE [4]. The main way to synthesize new samples is among the k nearest neighbors of a few samples. It can not only effectively improve the recall rate and F1-score but also avoid AI overlearning on some existing samples of the minority class, thereby increasing the ability to generalize, especially for SVM and tree models. Also, a wide range of uses in medical diagnosis and network security.

Next, based on all databases are balanced program uses Maximum Likelihood Estimation (MLE) [5] to finish model parameter fitting and training. MLE is to find the most possible model value that can produce this kind of sample. The core is to make the joint probability maximum. It first writes the likelihood (5) function, then the logarithmic simplification of differentiation to get the log likelihood (6). By the derivative of the parameters is zero, the value is MLE.

$$L(\theta) = \prod_{i=1}^{n} p(x_i; \theta) \tag{5}$$

$$lnL(\theta) = \sum_{i=1}^{n} lnp(x_i; \theta) \tag{6}$$

After finishing training of the model, use the confusion matrix (Figure 2) to get the accuracy of statistical predictions by the specific thresholds and make a table of base evaluation value. A confusion matrix has evaluation criteria; there are three. Sensitivity (7) is used to check the ability of the model to recognize "True Positive sample", the aim is to ensure the model does not miss when recognizing. The difference between sensitivity and specificity is that specificity checks the accuracy of "True Negative sample" (8), the aim is to make no wrong judgments. Precision is to get the proportion of correct-positive predictions, so this check predicted positive results [6].

$$Sensitivity = Recall = \frac{TP}{P} = \frac{TP}{TP+FN} \tag{7}$$

$$Specificity = \frac{TN}{N} = \frac{TN}{TN+FP} \tag{8}$$

$$Precision = \frac{TP}{P'} = \frac{TP}{TP+FP} \ (Relevance) \tag{9}$$

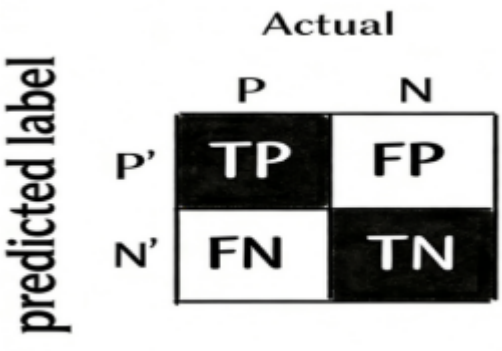


Figure 2. Confusion matrix

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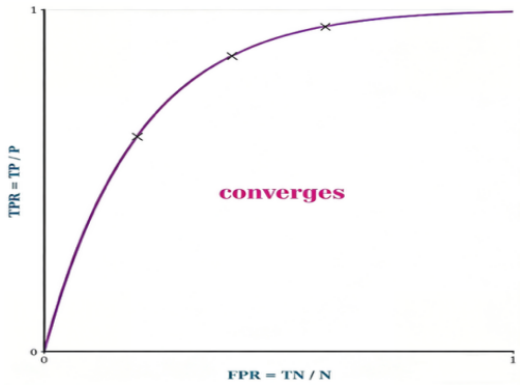


Figure 3. ROC curve

To form the whole trend of data analysis from the database to the specific model. Last part, ROC Curve [7] will be drawn (Figure 3). It is based on the continuous prediction probabilities output by the model all the thresholds are traversed. This crosses the gap of the confusion matrix, which relies on only one threshold. The closer the AUC is to 1, the better the performance it has. Also, it is suitable for data balanced by SMOTE, enabling a more objective evaluation of model robustness in imbalanced situations.

4. The development of AI-generated music

The iterative update of AI is the product that combines art and logic based on a computer. The music produced by AI seems correct, but the product lacks feelings and makes the wrong combination of emotions with the words. An AI model cannot understand and correctly use the depth of emotions and the true feelings of writers. These songs are obviously robotic, even no comparison between the songs written by artists and AI ones, people can easily recognize which one is human-written or not. These queer songs cannot be used in the actual treatment. This is the main and complex technical problem that needs to be solved. However, with the development of deep learning, the accompanying technological breakthroughs in this field. There are lots of tools that are used to create songs automatically, mostly using transformers. The model of GAN is one example of this; it is similar to other self-learning models. AI learns from the huge database, which may contain billions of music for it to learn, search and use. The song is from the melodies contained in the database combined with the analysis results by AI. During the analysis, AI uses its self-learning ability to enter a deeper analysis of the logic between melodies and emotions. Then make its own model. For example, Jukebox in OpenAI can produce various kinds of music, such as jazz and hip-hop, and simulate different singers' vocal timbres.

The more crucial one is that AI is changing from the copy of the music type to the one that can add emotion to music. Project Magenta in Google has been analyzed and transformed into the generation of emotion-matching music from brainwave signals; this provided the pre-preparation of mental health treatment. For example, for the people who have anxiety disorder, the AI system can produce the type of music that uses stable rhythm and is dominated by low frequency. By the rhythm of approximately 50 beats per minute, which can guide the listener to deep breathing and relaxation. In addition, for MDD sufferers, the music may have a higher frequency and a strong sense of rhythm; this can guide them to memorize the happy times. Some frontier research even tries to use Heart Rate Variability (HRV) or use real-time input via brainwaves to let AI know the feel of the

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listener. Let AI self-recreate the next music melodies by these signals. With the aim of personalized treatment of AI music.

5. The difficulties in combining AI-generated music with therapeutic purposes

The AI music used in therapeutic ways not only meets the loss of technical challenges but also meets ethical principles and clinical practice problems. First is the emotion part, sometime AI can make the right analysis of the feelings in music, but the accuracy still needs to be improved, because for the mental health patients, no mistakes of any kind in emotion guiding will be tolerated and nowadays, AI model's emotion depends on the data test training and cannot catch the emotions like the hopefulness in the sadness, or the emotion seems relaxed but is still anxious. All these kinds of complex emotions AI cannot analyze, so this may lead to the treatment for the wrong aim. For example, for people who have PTSD, using the low-frequency music may cause secondary trauma.

In addition, one problem is how to spear personalized and equalized. The treatment of the mental health problem emphasizes one person, one treatment. However, AI-created music uses the melodies in the database engineered and written in it, the database related to the AI music, so the music easily has a high similarity with other music. For instance, if we use an AI model that is created by the Western music library to provide the treatment music for Eastern literary background patients, the efficiency of the therapeutic effect will decrease. Nevertheless, over-chasing the treatment for personal will highly increase the complex level of clinical tests and make it difficult to give out scalable treatment methods. Otherwise, patients with different ages, genders and cultural backgrounds have varying degrees of perception of music; how to make AI models learn these emotions' regulations is still a technical bottleneck.

The absence of ethics and the lack of clinical experiments also influence the development of this. Right now, most AI music treatment is at the part of the small sample size exploratory stage, and the lack of large samples to compare still needs more long-term therapy information. Meanwhile, with AI music ownership of copyright, the degree of algorithm openness is not clear out. During the treatment, this causes other problems for patients, there is no clear zoning of responsibility. Some people may repel the music created by AI because they may think this is fake and has no humanistic warmth, this needs the explanation and guidance given by the therapist.

6. Conclusion

AI enhances humans' daily lives in many ways. Music creation increases the effectiveness of mental health treatment and gives personal treatment music, which is based on each person's symphony. But it seems like a simple way to use it in treatment; there are already a lot of apps for AI music creation. The basic logic of the Random model. Random proof of the word, based on a random model, combines these melodies in a random way. Most music made by AI is without the emotion of the music that people write. This is a science and technology problem that has troubled everyone for the longest time. AI can only turn random combinations into new melodies. But it can be known by analyzing the identity of music to define what kind of emotion can be shown through what combinations of melodies. This is the deficiency of AI it still needs people to overcome these technical issues.

The intelligence of AI is the most crucial and difficult problem to solve, but in the future, one day it may come true. With the development of time, life has become more technologically. AI music creation is to help treat patients with psychological issues in a novel way. But nowadays, people haven't really explored the whole potential of AI. This way of treating people who have mental

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health issues is not yet mature. Doctors can try more to use AI to create music to help general treating the patients with personal treatment. And it also can predict the mental health risk by listening to AI music to release their pressure and make the patients healthier. But this way, creating treatment music needs to be checked by the doctor to make sure it is a good one for patients to listen to. But if people can improve this, it will not only be used in the treatment of mental health issues, but it will also be better for providing creative inspiration for singers. Because the combination of psychotherapy and AI music creation can be more effective and improve individual treatment, plans, and make treatment more effective.

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