A PERSONALIZED MOBILE APPLICATION TO GENERATE MUSIC THERAPY USING A LARGE LANGUAGE MODEL AND STORING THE USER'S DATA ON FIREBASE

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ABSTRACT

Mental health support is out of reach to many people, particularly, neurodivergent people, such as those with ASD or ADHD. Conventional music therapy is expensive and needs clinical supervision, although it is effective. In an attempt to fill this gap, I came up with an AI-based music therapy app that provides patient tailored music and therapy suggestions bearing off survey-based information. It takes no wearables, no therapist. The tool is developed using Flutter and the API offered by OpenAI and consists of both an intuitive interface and a smart understanding of the user's feelings. The most important problems were the control of API expenses and the formulation of survey questions; it was overcome with timely optimization and orderly input schemes. The quality and speed of AI answers was tested and it was revealed that the average user gave responses based on the usefulness with 7.35/10 and an average response time of less than 5 seconds. In contrast to the current solutions, my app is free, available, and designed to be used on a daily basis. This project is scalable with real-time support to the users who need flexible and affordable mental health care as it can reduce the cost and increase access to care.

KEYWORDS

AI Music Therapy, Neurodivergent Support, Affordable Mental Health, Flutter

1. INTRODUCTION

Stress-related disorders, anxiety, and neurodevelopmental illnesses (including autism and ADHD) affect millions of citizens across the globe, and many of them do not have the persistent support of mental health services [11]. Conventional music therapy was proven to be very effective in assuaging stress, normalizing emotions, and enhancement of concentration particularly among people with autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) [12]. Nevertheless, music therapy is too expensive due to limited availability: one session costs between 50-130 dollars, therefore, making it impossible to carry long term therapy by most of these families [4].

This struggle is very personal. My brother has autism and music therapy is one of the things that he often uses to help him relax and manage his emotions. Nevertheless, my family has not always had professional support, which both stays the same and is not so expensive. It is not an isolated case as other families in different parts of the world experience the same obstacle to healthcare.

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The CDC shows that 1 of every 31 children in the U.S. is identified to be autistic, and 7 million children have ADHD [5,6]. Most of these people need the instruments of emotional control not every two days or not every three hours, only in the scheduled sessions [10]. The challenge that this project will address is the need to substitute or complement the expensive human-based music therapy with a more available and accessible option based on AI and capable of offering on demand emotional support. This app makes music therapy possible anywhere at any time and thus a worthy technology to be used by such individuals, as my brother, who needs it the most, since it is calming, constant, and responsive to needs and emotions.

Methodology A is Intelligence in Music Therapy, it involves biometrics such as heart rate to produce music that is customized according to clinical demands particularly in case of ASD/ADHD. It produces good results but is reliant on costly wearables and therapist supervision hence it is not accessible. My project substitutes the biometric tracking system with a free and survey-based system and introduces the tools of self-reflection, to monitor oneself on a series of emotional conditions.

Methodology B, MediMusic is a system of curated playlists calibrated based on the patient/patient demographic data and real-time heart rate to decrease levels of anxiety in the clinical environment. Being effective, it involves proprietary hardware and is not convenient in use at home or by neurodivergent users. My app eliminates the costs and equipment limitations, focuses on the independence of the user, and includes journaling to use the app in the everyday situations of home and every setting outside of an institution.

Methodology C Soundverse uses user prompters to create original music though it is not primarily a therapeutic tool. It is not clinically organized, does not have emotional monitoring, and is inaccessible. My project is a better version of this since it introduces free therapeutic services, mood questionnaires with direct instructions, and journaling capabilities to ASD/ADHD consumers who require long-term emotional support.

The way I intend to address the issue is to design an AI driven music therapy mobile application that could offer individualized emotional support by displaying the recommendations of tranquilizing music, artificial intelligence-enhanced therapy recommendations, and self-insight components resting on the mood, status, and preferences of each user.

After first opening the app, a user is required to fill in a brief survey about their age, existence of any diagnosed mental health challenges (autism, ADHD, etc), their current mood (1 being unhappy and 10 being happy), emotions that they feel stuck processing, their favorite music genre and tempo, and how they use the music when stuck. This questionnaire will enable the AI to create a customized emotional profile using which it bases all subsequent interaction.

On the basis of this data, the AI offers three important features: Artificial intelligence would develop therapy recommendations according to the mood of a user. As an example, a person who is anxious may get instructions on how to breathe and feel grounded or also grounding strategies. The carefully chosen recommendations of music therapy, combining all the desires and requirements of the user, contains low-tempo music to relax, rhythmic to focus, and uplifting to improve the mood. A personal reflection system on which the user can check their mood development, keep emotional notes and save their favorite songs to repeat what already helped them.

This will enable users to understand the pattern of their emotional and music response better, and it will allow them to be more self-sufficient in terms of their mental health. Compared to conventional treatment, where it is expensive and time restricted and other general music related

applications with no therapeutic inclination, the solution provides accessible, adjustable, and low cost emotional support.

This app offers the combination of mental health guidance, music therapy, and personal data tracking on a single platform and this generates a kind sustainable and supportive care to any individual who needs emotional release, which makes therapeutic options more tailored, efficient than ever.

In Section 4, I have performed two experiments in order to assess the performance and usefulness of my AI therapy app. The first experiment was aimed at checking the quality of corresponding therapy advice which were generated by AI and were rated on the 20-points scale. The realistic inputs of surveys were designed, and each output was evaluated on the scale of emotional relevance and clarity. The score was 7.35 overall with good results, and the most popular with devoted user inputs. In the second experiment, the response time of the AI was gauged, regarding the duration it took the algorithm to come up with the advice in 20 runs. The major part of the results was located between 4 and 6 seconds, with an average of 4.9 seconds, which points to a fast, non-complicated performance. The delays were linked to long prompts or complex prompts. These findings demonstrate that the AI will work, provided humans can give it unambiguous information to operate on and behave fast enough to retain interest, and that reasonable layout of the survey and timely communication are correlates of success of the app.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. Learning Flutter: Adapting from Python to Dart

We used the flutter framework to create the mobile application. This involved learning the language Dart and how to structure the code within the flutter's framework [7]. I've been coding using python for 3 years. But as a first time programmer using flutter, implementing the app with Flutter presented significant challenges due to the steep learning curve of Dart. I am switching from python's more free form way of programming to flutter's more structured and forgiving style in terms of syntax. It's also easier to make a particular user interface on flutter compared to python.

2.2. Token Efficiency in Scalable AI Therapy

A challenge in the process of bringing personalized AI therapy is that the costs required to utilize large language models (such as OpenAI GPT 4.1) are difficult to manage. These models are also charged in terms of tokens used-1000000 tokens approximated to 750000 words. As an example, the cost of GPT-4.1 amounts to 0.002 dollars per million input tokens and 0.008 dollars per million output tokens [8]. This price plan implies that long prompts to the user or detailed answers produced by AI may get costly as they scale. Solutions that I can apply to this would be to use token efficient prompting, prevent overly long output, or cache frequent inputs to save money.

2.3. Emotion-Aware Question Design for AI Music Therapy

The greatest difficulty will be to formulate survey questions that can give the AI the details it needs to succeed in coming up with actual personalized music therapy and recommendations. As an example, the question like, What emotions do you struggle with at the moment? should give

the user an opportunity to choose certain patterned answers such as anxiety, sadness, or anger to enable the AI to provide properly customized answers. Otherwise, in the case of too broad question, the AI may miss or get the wrong context of emotional statements. I might also improve the open-ended questions such as: How does music assist you when you are overwhelmed by giving direct answers or multiple choice questions. These questions may be tested with actual users to make sure that the test is clear and emotionally correct.

3. SOLUTION

The first key aspect is Flutter as a framework of mobile apps development and will enable us to create a user-friendly, smooth interface on iOS and Android. The second element is an AI model that analyzes the information supplied by users and determines the individual recommendations of music therapy and mental health advice on the basis of provided survey responses. The third element is the survey system to obtain essential data about the users, including constant mood, music favorites, how they feel about themselves, and other emotional difficulties to direct the AI to create relevant therapy material.

The program is initiated by the steps of the user creating his account where his/her information is safely saved to the Firebase server for later authentication.

Once they are through with registration, they log in, verifying through Firebase's authentication system, to see their personal dashboard [9].

They may move to a specific record, if it already exists in the Firestore Database, this screen shows former sessions of therapy and generated music choices.

Then they are able to take the survey, participants will respond to the questions that concern their mood, mental condition, music preferences, etc.

According to these answers, the ChatGPT API model develops individual therapy recommendations and suggests five particular songs.

From their personal dashboard, the All Songs screen can be used by users to browse the recommended music or favorite songs, and save them to maintain their mental health in the future.

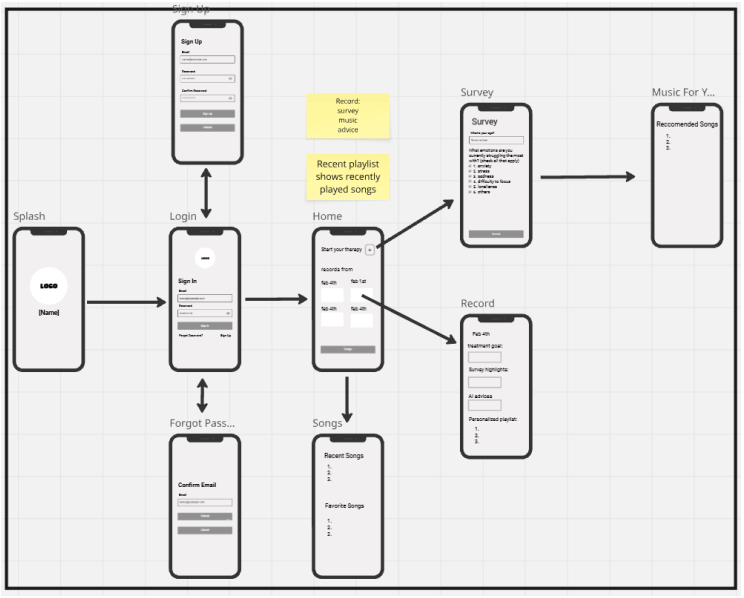

Figure 1. Overview of the solution

The framework we used to make the mobile application was flutter. With the use of Visual Studio code as our workspace we coded and created both the Android and iOS interfaces. In order to use it, I downloaded Flutter using the official site (Flutter.dev) and installed it along with Visual Studio Code and Android Studio.

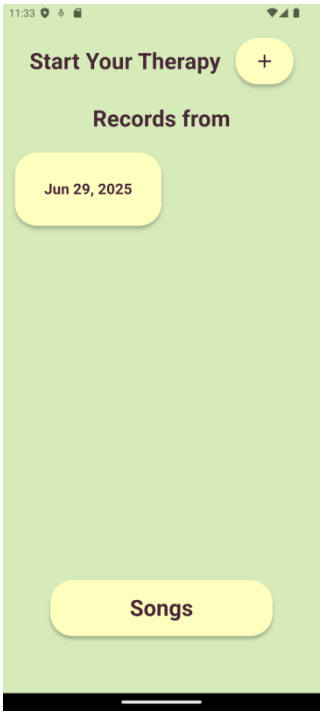

Figure 2. Screenshot of record page

```
import 'package:flutter/material.dart';
import 'package:melodycare/services/services.dart';
void main() async {
 WidgetsFlutterBinding.ensureInitialized();
 await Firebase.initializeApp(options: DefaultFirebaseOptions.currentPlatform);
 runApp(const MyApp());
}
class MyApp extends StatelessWidget {
 const MyApp({super.key});
 // This widget is the root of your application.
 @override
 Widget build(BuildContext context) {
  return MaterialApp(
   theme: ThemeData(
    scaffoldBackgroundColor: const Color.fromARGB(255, 215, 235, 186),
    colorScheme: const ColorScheme(
     brightness: Brightness.light,
     surface: Color.fromARGB(255, 254, 255, 190), //appbar
     onSurface: Color.fromARGB(255, 71, 40, 54),
     primary: Color.fromARGB(255, 71, 40, 54), //text
     onPrimary: Color.fromARGB(255, 235, 212, 148),
     secondary: Color.fromARGB(255, 71, 40, 54),
     onSecondary: Color.fromARGB(255, 235, 212, 148),
     error: Color.fromARGB(255, 71, 40, 54),
     onError: Color.fromARGB(255, 235, 212, 148)
    ),
   ),
   routes: screenRoutes,
   debugShowCheckedModeBanner: false,
  );
 }
}
```

Figure 3. Screenshot of code 1

The screenshot shown above is the home screen of our mobile application, which has been developed using the Flutter framework. The accompanying code sample is from the “main.dart” file, which serves as the entry point for our app and establishes the foundational structure for all subsequent components. At the very beginning of “main.dart”, we import the necessary Flutter libraries, as well as any additional Dart files or third party packages required for functionality such as Firebase connectivity, state management, and custom widgets. Following the imports, we define the “main()” function, which is responsible for initializing connections to external services in this case, linking our application to the Firebase backend for authentication, database access, and cloud functions. Once those connections are established, “main()” invokes “runApp()”, passing an instance of our root widget class, “MyApp”. Inside “MyApp”, we configure global theming defining primary and accent colors, font styles, and widget behavior before constructing a routing map called “screenRoutes”. This map determines which screen or page to display based on named routes, ensuring that users are directed to the appropriate interface as they navigate through the application.

The Chat GPT API was used to take in the information from the answered survey questions and output a reply given a format prompt [14]. This reply consisted of a treatment goal, survey highlight, advice, and a list of five songs. The five songs would not only contain the name of the song, but also the artist.

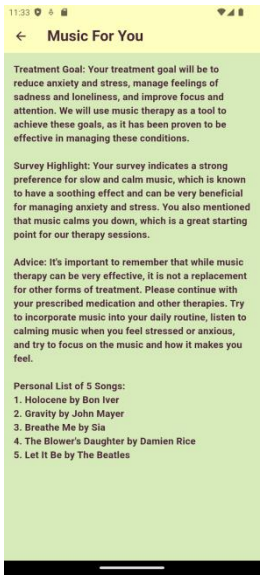

Figure 4. Screenshot of advice

```
Future<void> handleMessage() async {
    print("Asking AI");
    String instructionPrompt =
        "You are a psychological counselor and music therapist";
    String userPrompt =
        "I want you to give me a treatment goal, survey highlight, some advice, and a
personal list of 5 songs based on my survey results."
        "Survey results: ${singleton.surveyResults}"
        "Put it in a format such that the required elements you must give me are labelled
before the actual element."
        "Do not add anymore text after listing off the five songs.";
    final request = ChatCompleteText(
      messages: [
       Messages(role: Role.system, content: instructionPrompt).toJson(),
       Messages(role: Role.user, content: userPrompt).toJson(),
      ],
      maxToken: 1500,
      model: Gpt4ChatModel(),
     );
print("Getting AI response");
ChatCTResponse? response = await openAI.onChatCompletion(request: request);
setState(() {
  suggestions = response!.choices.first.message!.content.trim().replaceAll(
    "",
    '',
  );
  isLoading = false;
});
parseAIText(suggestions);
}
```

Figure 5. Screenshot of code 2

This snippet is primarily designed to interact with the ChatGPT API. The async function "handleMessage()" begins by printing "Asking AI." Next, it defines two prompt variables: a system-level "instructionPrompt" that casts the AI as a psychological counselor and music therapist, and a user-level "userPrompt" that requests a treatment goal, survey highlights, advice, and a personalized list of five songs based on the survey results injected via "singleton.surveyResults."

The code then constructs a "ChatCompleteText" request object. It populates the "messages" list with JSON-converted entries for system and user roles, sets "maxToken" to 1500 to cap the response length, and selects the GPT-4 model through "Gpt4ChatModel()." After printing "Getting AI response," it calls "openAI.onChatCompletion" and awaits the asynchronous reply. Once the response arrives, the first choice's content is trimmed of extraneous quotation marks, assigned to the "suggestions" variable, and the loading flag is set to false. Finally, "parseAIText(suggestions)" is invoked to process and render the AI's formatted output in the user interface.

The survey collects user data to guide the AI's personalized music therapy. Built using Flutter, it uses input mapping to structure responses for AI processing. This component connects users' emotional and musical preferences directly to the AI, enabling accurate therapy advice based on specific, interpretable survey inputs [15].

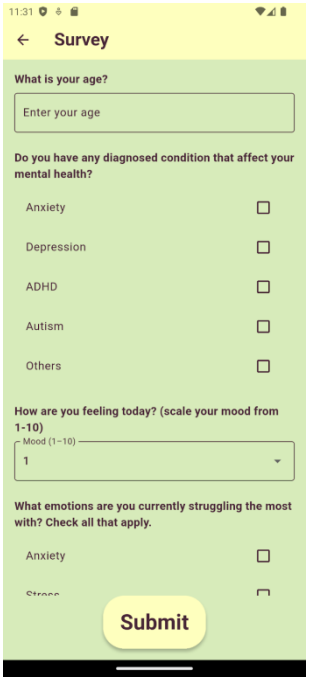

Figure 6. Screenshot of the survey

```
Map<String, List<String>> questions = {
  "What is your age?": [], //type age
  "Do you have any diagnosed condition that affect your mental health?": [
   "Anxiety", //chose all that apply
   "Depression",
   "ADHD",
   "Autism",
   "Others",
  ],
  "How are you feeling today? (scale your mood from 1-10)": [],
  "What emotions are you currently struggling the most with? Check all that apply.":
    [
     "Anxiety",
     "Stress",
     "Sadness",
     "Difficulty to focus",
     "Loneliness",
     "Others",
    ],
  "What music do you prefer?": [
   //check all that apply
   "Classical",
   "Jazz",
   "Pop",
   "Instrumental",
   "Electronic",
  ],
  "How does music help you when you feel overwhelmed?": [
   //check all
   "Calms me down",
   "Motivates me",
   "Depends",
  ],
  "Do you have a preference in tempo?": [
   "Slow/Calm", //chose all
   "Moderate/Balanced",
   "Strong Beats",
  ],
 "Do you prefer music with lyrics or instrument only?": //only one
   ["Lyric", "Instrument", "I don't care"],
 "How long would you like your music therapy session to be?": [
  //chose one
  "10-15 minutes",
  "30 minutes",
  "1 hour",
 ],
};
```

Figure 7. Screenshot of code 3

This code defines a survey's questions and answer options using a Dart Map<String, List<String>>, where each key is the question text and the associated list holds the selectable responses. First and foremost, this structure is intended "for the survey questions," ensuring that all prompts and choices are centralized in one place. The variable "questions" maps question strings (e.g., "What is your age?") to lists of responses. Empty lists (e.g., for age or mood scale) indicate free form or numeric input fields. Pre-populated lists denote multiple-choice options. For example, "Do you have any diagnosed condition that affects your mental health?" offers items like "Anxiety," "Depression," and "ADHD". Questions tagged "check all that apply" allow multiple selections, while those with single-entry comments (e.g., "only one") enforce a single choice. This approach promotes consistency and easy iteration when dynamically generating UI widgets for each survey item, simplifying future updates or localization efforts.

4. EXPERIMENT

4.1. Experiment 1

The effectiveness and usefulness of the AI therapy advice is one of the blind spots. Users trust the effectiveness of therapy depending on the high quality of advice. So it's necessary to test and make sure the AI advice are useful as a mental support for users.

To evaluate the effectiveness of the AI-generated advice, I did an experiment of 20 individual interactions with the AI with different user information at varying levels as it was obtained through the survey. At the end of every session, I gave a score of the AI advice starting at 1 and going up to 10 about its clarity, emotionality, and personalization [17]. The arrangement models a variety of user experiences without real patient usage. There were no external control groups and all the ratings were done manually to be uniform. The idea was to gauge the extent to which the AI will adapt to different needs by trying different and various survey inputs and emotional/musical preferences.

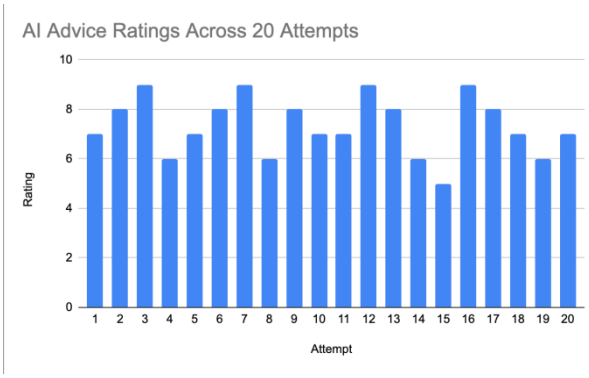

Figure 8. Figure of experiment 1

The average of the AI advice was 7.35 with median 7.0, indicating a fairly steady performance. The rating ranged between 5.0 and 9.0 which was the highest. I was partially surprised by the narrow range: there were no highs and lows; so, this model can be characterized by the desire to remain in the moderate high effectiveness field. The number 5 rating meant either the non specific or generalized response, probably because of the ambiguous survey entry. The optimal scores (9.0) were achieved in accordance with detailed, emotionally specific reactions. This indicates that the user input determines the dominant impact on advice. Any personalization is best when an AI has sufficient context at its disposal. There were cases of ratings of 6 when the

answers were too short or had no emotional keywords, which lowered the capacity of the AI to personalize responses. In subsequent evaluations, it might be desirable to encourage the users to provide more detailed answers, which will contribute to raising the average ratings as well as enhancing the overall success of the therapy guidance.

4.2. Experiment 2

The other potential blind spot is the responsiveness of AI, which corresponds to the amount of time it takes AI to generate therapy advice. Because the users might refuse to use the app in such stressful situations, as they might want a time-limited answer, a long wait would interfere with the efficacy and usability of the app [16].

To measure the average responding time by AI, I timed the time taken by the model to come up with a music therapy recommendation upon the completion of the survey submission. I did 20 times with a very small variation on each case. A stopwatch was used to measure times from the point of submission till the moment when a complete AI generated message was visible. Such an approach captures an experience of a user. The intention was to note whether the AI model prompted through OpenAI API is reliable in delivering results based on a reasonable waiting time of less than 6 seconds to hold a user.

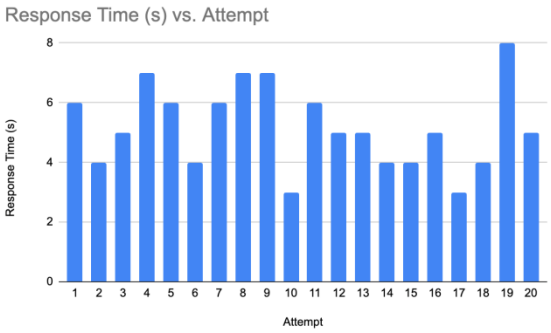

Figure 9. Figure of experiment 2

The average reaction time was 4.9 seconds and median 4.5 seconds on 20 trials so there was pretty quick and consistent speed in terms of output. The overall response time was 3 seconds to the fastest to the slowest which was 8 seconds. Most of the responses were between 4-6 seconds. I did feel that there would be some variation due to API load or prompt complexity but the amount of consistency of results was a surprise. Only a single response took more than 6 seconds, probably because this was a longer or more complicated response to the survey question. In general, the AI was fast enough not to impede the smooth experience of a user. The largest independent variable that affected delays was the length of prompt. The more emotional the user fills in the survey, the longer explanation it requires. Response time may further be trimmed down in future development allowing less prompts and even preloading of common queries. Nevertheless, it can be stated that current performance is well grasped in an acceptable range of real-time delivery of emotional support.

5. RELATED WORK

The article "Intelligence in Music Therapy" describes scalable solutions that involve individualized therapy based on the use of biometrics (e.g. heart rate) and generative music, which is also the target of my app to provide scalable emotional support [1]. Although effective

during clinical trials (i.e.better outcomes in ASD/ADHD cases), its mechanism of action is based on using costly wearable devices and supervision by a therapist, which restricts it to reach underserved populations. The following gaps are addressed by my project directly: it applies the survey-based personalization (there are no money costs) and adds the element of self-reflection journals to enable the longitudinal tracking, which is not offered in the article. More importantly, my app can serve as a self-contained method of treatment and is available to anyone in a hurry, with little cost and free of barrier to access to clinicians, thereby democratizing the access of neurodivergent people with unreliable access to care.

The research published by the British Dental Journal (2021) to investigate the role of MediMusic in defining AI curated playlists to reduce anxiety by 22 per cent in the clinical environment (e.g. dementia/ dentistry) employing both demographic data and real-time heart rate monitoring [2]. Although it works, it has a set of limitations, such as reliance on wearable devices (heart rate monitor), unique hardware (MediBeat device), and clinical application, disregarding the availability to at-home user groups (neurodivergent populations). My project is better at enhancing accessibility because it: 1) does not involve any cost in hardware (will only need a phone), 2) is highly focused on user autonomy (it does not require a clinician), and 3) implements therapeutic self-reflection measures not included in MediMusic. More importantly, my solution can be used as a low-entry, customized option to chronic users who cannot be helped with an institutionalized approach such as ASD/ADHD people requiring daily assistance.

Soundverse is based on the generative AI to produce original therapeutics music based on textual prompts and dedicated technologies (SAAR, Stem Separation), which are consistent with my project objective of personalized music therapy [3, 13]. However, in addition to being effective in mood regulation, its subscription-based business model and focus on music creation do not address important gaps in access and therapeutics: no clinical guidelines are embedded to support neurodivergent individuals, and it does not support tracking emotional management longitudinally. My app goes further by putting more emphasis on zero-cost accessibility to underserved communities, Incorporating therapeutic tools and introducing mood diaries to put music and its effects into perspective: a service that is specifically tailored to the chronic needs of ASD/ADHD patients.

6. CONCLUSIONS

A major shortcoming is the app does not create original music or provide embedded playback. Although AI performs recommendations to be personal through the survey, it simply consumes ready made tracks from Spotify/Apple Music. This entails the user to locate and play recommended songs manually which interrupts therapeutic flow. Furthermore, the AI is unable to create tailor made songs that better suit the exact requirement of the user.

This could be solved in the future by firstly, having a flutter package that enables playing audio on app, Secondly, creating generative AI functionality using generative models to create original and customizable snippets of music, thirdly, some form of anatomical monitoring on the user's body, so the app can change the delivering dosage of therapeutic material. Such as Heart rate monitoring. This would turn the app to a closed loop therapy system.

The project will be the first to create an easily accessible and AI-powered music therapy available to neurodivergent people and individuals needing mental health support. The app can provide free emotional support in real-time. The combination of generative AI and embedded playback in the future will be even more empowering to the user, making personalized healing an on demand process to communities that need it.

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