A report submitted in partial fulfilment of the requirements for the degree of Bachelor of Science (BSc) in

COMPUTER SCIENCE

UNIVERSITY OF THE WEST OF ENGLAND

FACIAL EMOTION RECOGNITION FOR MUSIC RECOMMENDATION SYSTEM

By

YIE NIAN CHU

Supervisor: Craig Duffy

School of Computing
and Creative Technologies

UNIVERSITY OF THE WEST OF ENGLAND

Date of submission: March 30, 2024
Word count: WORD COUNT

DECLARATION

I, Yie Nian Chu confirm that the work presented in this report is my own. Where information has been derived from other sources, I confirm that this has been indicated in the report.

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Yie Nian Chu

ABSTRACT

ACKNOWLEDGEMENTS

ACRONYMS

AI Artificial Intelligence

AMTA American Music Therapy Association

FER Facial Emotion Recognition

ML Machine Learning

NAMT National Association for Music Therapy

PTSD Post-traumatic Stress Disorder

TBI Traumatic Brain Injury

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1. INTRODUCTION

1.1. BACKGROUND

2. LITERATURE REVIEW

2.1. INTRODUCTION

As the field of therapeutic interventions has developed, music therapy has become a potent tool for treating a variety of psychological and emotional illnesses. (Association, 2005) It is acknowledged as a clinical and evidence-based practice. Without demanding musical proficiency from participants, it strives to improve mental, emotional, physical, and cognitive abilities in a variety of contexts, including schools, mental health centers, hospitals, and nursing homes. (Clinic, 2020) Scientific research suggest that novel activities such as vibroacoustic treatment, improvisation, singing popular songs, and composing can support personal growth and healing. (Craig, 2019) As a result, music therapy is a very flexible and successful therapeutic approach. Its effectiveness stems from its ability to recognize and address each individual's emotional condition. This idea aligns with the potential of face expression recognition technologies.

Facial Emotion Recognition (FER) technology bridges the gap between emotional understanding and technological innovation. It is a sophisticated version of facial recognition that uses Artificial Intelligence (AI) and Machine Learning (ML) to identify human emotions through facial expressions. Based on feature analysis, FER could identify emotions like happiness, sadness, anger and neutral. (Huang et al., 2023) The ability to sense and react to individual emotional states makes it valuable in the healthcare sector, where it has the potential to transform patient care through monitoring emotional health, diagnosing illnesses and enabling more personalized treatment plans. Particularly in therapy, it provides a non-invasive way to gauge patient's emotional states which allows therapists to more precisely customize their approaches. (Zharovskikh, 2020)

Building upon these foundational technologies, music recommendation systems

represent another pivotal element in personalizing therapy sessions. These systems make music recommendations based on a number of variables, including user preferences, behavior, psychographic traits, and demographics. Additionally, it will categorise listeners into several groups such as savants, enthusiasts, causals and in differents, for more efficient tailoring in order to improve listening experiences. (Song et al., 2012) Since music has a enormous effect on emotional and psychological health, these systems' accuracy becomes especially important in therapy. (Schedl et al., 2021) Innovatively, AI-driven models have pushed the boundaries further by detecting patient's real-time emotions, and offering recommendations that not only match but also influence mood and psychological states. (Babu et al., 2023) Technology plays a vital role in augmenting music's therapeutic potential, as evidenced by the introduction of AI into music recommendation systems, which bring in a new era of tailored therapy encounters.

2.2. MUSIC THERAPY

The history and theoretical foundations of music therapy track back thousands of years, but the field's practical development really took off in the 1940s. Following World War II, the US War Department published Technical Bulletin 187 in 1954 that detailed a program for rehabilitating service members through music. (Else, 2014) With its emphasis on the use of music in a range of therapeutic settings, this curriculum established a standard for the official acknowledgement and advancement of music therapy as a profession. The National Association for Music Therapy (NAMT) was founded in 1950, which further cemented the path for the formal recognition and advancement of music therapy as a profession. (Else, 2014) During this crucial time, the field of music therapy had substantial growth and advocacy, which resulted in the development of standards for training and application. The field then united to establish the American Music Therapy Association (AMTA) in 1998. (Else, 2014)

The theoretical foundations of music therapy are as varied and deep as its history, encompassing a wide range of psychological theories and studies such as developmental psychology, psychoanalysis, and John Bowlby's attached theory. (Ackerman, 2018) These theories shows how music might be used therapeutically to promote safe attachments, improve social and emotional growth, and assist dynamic,

patient-centered therapy. The improvisational methods developed by Kenneth Bruscia place an additional emphasis on creativity and spontaneity, which facilitate the use of music to convey feelings and build interpersonal bonds.(Bruscia and Archive, 1987)

Furthermore, empirical studies and neuroscientific discoveries that demonstate the effects of music on emotional regulation, stress response, and neuroplasticity reinforce the foundation of music therapy. (Hillecke, 2005) According to this research, music therapy can benefit a wide range of people, including trauma survivors and infants. It also highlights the benefits of music therapy for mental health and cognitive development.

Music therapy's adaptability and relevance are highlighted by the inclusion of early educational programs and advocacy in addition to focused interventions for military groups. (Else, 2014) According to Gooding and Langston (2019), music therapy has proven to have a deep ability to adapt to changing healthcare needs and societal demands as evidenced by its supportive role in post-war recovery from conditions such as Post-traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) , and its acceptance as a clinical profession. (Garrison, 2021) With a strong foundation in evidence-based treatment and a profound comprehension of music's therapeutic potential, music therapy has come a long way from mystical conceptions to a scientifically validated practice.

2.3. FACIAL EMOTION RECOGNITION

2.4. MUSIC RECOMMENDATION SYSTEM

3. REQUIREMENTS

3.1. FUNCTIONAL REQUIREMENTS AND NON-FUNCTIONAL REQUIREMENTS

3.1.1. Functional Requirements

Req. No.	Categories	Requirements	Priority
FR1	User Registration and Account Management	The system must allow user to register by providing a unique username, user's actual name, date of birth, email, and password.	High
FR2		The system must verify user accounts through an email verification process.	High
FR3		Users must be able to login with their email or username and password. A "Remember Me" option should allow users to stay logged in for 7 days.	High
FR4		Users can access a settings page to update their name, date of birth, email, password, and profile picture. Usernames cannot be changed.	Medium
FR5		Users must be able to reset their passwords through a password reset feature on the login page.	Medium

Req. No.	Categories	Requirements	Priority
FR6	Facial Emotion Recognition	The application integrates a machine learning model to recognize user's facial emotions via their device's camera.	High
FR7	Spotify Web Playback Integration	The system integrates with Spotify Web Playback SDK to play music within the web application.	High
FR8		The application must allow users to connect their Spotify account before accessing music playback services. This integration should facilitate authentication and authorization seamlessly within the web application.	High
FR9	Music Recommendation System	The application must generate playlists based on the user's recognized emotion using an algorithm.	High
FR10	User Interface and Experience	The web application supports a toggle between light and dark themes, automatically detecting and applying the user's device theme upon first use.	Medium
FR11		The application supports multiple languages: English, Japanese, Chinese, Korean, and Malay.	Low

3.1.2. Non-Functional Requirements

Req. No.	Categories	Requirements	Priority
NFR1	Performance and Scalability	The application shall load within 3 seconds for 95% of its users under standard network conditions.	High
NFR2		The system must be scalable to support up to 100 concurrent users without significant degradation in performance.	High
NFR3	Compliance and Security	All user data, including passwords and personal information, must be encrypted.	High
NFR4		The application must implement secure authentication mechanisms to prevent unauthorized access.	High
NFR5		User data must be stored in a secure database with access strictly limited ot the backend server. The database shall not be directly accessible from any public network (0.0.0.0/0).	High
NFR6		User passwords must be encrypted using a secure hashing algorithm (e.g., bcrypt) to ensure their safety even in the event of a data breach.	High
NFR7		All forms of data transmission involved in user authentication and registration must be over HTTPS, and sensitive information shall not appear in URLs or any part of the HTTP request visible to the client side.	High

Req. No.	Categories	Requirements	Priority
NFR8		The application must comply with relevant data protection and privacy regulations, including GDPR where applicable, ensuring user's rights to privacy and data security are upheld.	High
NFR9	Usability	The application shall be designed with a user-friendly interface, ensuring ease of navigation and accessibility.	Medium
NFR10		User input fields should provide immediate feedback to correct errors or invalid data.	Medium
NFR11	Compatibility and Interoperability	The web application must be compatible with the latest versions of Chrome, Firefox, Safari and Edge browsers.	High
NFR12		The system must ensure seamless integration with the Spotify API and maintain compatibility with Spotify's update.	High
NFR13	Localization and Internationalization	The application must support multi-language interfaces, allowing users to switch languages easily.	Medium
NFR14		Date and time formats should adapt to the user's selected language and region preferences.	Low
NFR15	Maintenance and Support	The system should be designed to allow easy updates and maintenance without significant downtime.	Medium

Req. No.	Categories	Requirements	Priority
NFR16		Documentation must be provided for end-users and developers, detailing usage, integration features, and troubleshooting steps.	Medium
NFR17	Application Performance	The facial emotion recognition feature must provide a response within 5 seconds from the time of user's request under standard network conditions.	High
NFR18		The system should ensure a Spotify playback start time of less than 3 seconds after user selection or playlist generation.	High
NFR19		The web application's overall time to interactive (TTI) should not exceed 5 seconds for 90% of its users under standard network conditions.	High
NFR20	User Interface Design	The application must adhere to WCAG 2.1 AA standards for color contrast, navigability, and text size to ensure accessibility for users with disabilities.	High
NFR21		All user interface components (buttons, links, form elements) must be navigable using a keyboard in a logical order to support users with mobility or visual impairments.	High

Req. No.	Categories	Requirements	Priority
NFR22	Data Handling and Authentication	Implement OAuth 2.0 for secure authentication with Spotify, ensuring that user credentials are handled safety and in line with best security practices.	High
NFR23		Apply secure session management practices, including the generation of unique session tokens for users during login and their secure storage on the client side.	High

3.2. REQUIREMENTS SPECIFICATION

3.2.1. Use Cases and UML Diagrams

4. METHODOLOGY

4.1.

5. DESIGN

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8.1. CONCLUSION

8.2. FUTURE OUTLOOK

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APPENDIX

APPENDIX A

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APPENDIX B

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