EMOTION RECOGNITION AND SENTIMENT ANALYSIS FOR

RELATIONSHIP IMPROVEMENT.

TMP-2023-24-133

Project Proposal Report

Nanayakkara Kuruppu Arachchi Shakila Dilshan

B.Sc. (Hons) Degree in Information Technology Specialized in Information Technology.

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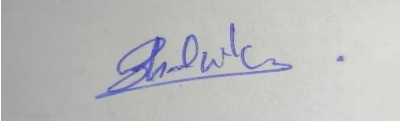**Department of Information Technology and Faculty of Computing.**

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DECLARATION

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Group Member Name	Student ID	Signature
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Signature of the Supervisor: **Date:** 2023/08/18

Signature of the Co-Supervisor   **Date:** 2023/08/18

ABSTRACT

In a relationship, emotions and sentiments are very important. A relationship is how two or more people interact with one another or are related to one another. There are several reasons why some people feel hurt or harmed in those relationships. Due to these painful incidents, some people's mental health is changing, some of them are committing suicide, and some of them are experiencing mental health problems including sadness and anxiety. This study deals with this issue. Our goal in developing the "AI AND VR-ENHANCED EMOTION RECOGNITION AND SENTIMENT ANALYSIS APP FOR RELATIONSHIP IMPROVEMENT" was to assist those who were having relationship problems. To do that, we must first determine the user's level of mental health. In order to achieve this, we use image processing and audio recognition technologies, analyze the resulting data, and then give the advice to the user on what to do in order to return to a normal state of mental health state.

To analyzing the data that coming from image processing and auditory recognition systems, need to be create a model to compare that data and make a decision. That is the main purpose of this component. And also get the user mental state this component will provide a small game that have few stages to measure the focus level and mental stability. To solve these problems using deep learning techniques and convolutional neural network. Also, we use some technologies and tools python, video analysis by open cv, emotion recognition and build learning models by tensor flow , Deep Neural Networks (DNNs), cloud computing and pre trained models are used for data and calculations. After all of these the app will provide to the user, what he/she need to do to the solve the problem.

Keywords: Image Processing, Deep learning, Convolutional neural network, Deep Neural Networks (DNNs), Open CV, Tensor flow.

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LIST OF ABBREVIATIONS

Abbreviation	Description
CNN	Convolutional Neural Network
VGG	Visual Geometry Group
FER	Facial Expression Recognition
CK+	Cohn-Kanade
SDLC	Software Development Life Cycle
AI	Artificial Intelligence
WBS	Work Breakdown Structure
FC	Fully Connected

1. INTRODUCTION

1.1 Background & Literature survey.

In the digital age, the way people talk and specific feelings has multiplied to include various bureaucracy which includes textual content messages, social media posts, and audio recordings. This digital expression presents a completely unique possibility to leverage era for understanding emotional states and offering applicable assist. Relationships, whether or not romantic, familial, or social, play a sizable role in a person's emotional well-being [4]. Challenges inside relationships can result in stress, anxiety, and other mental health concerns.

Figure 1. 1: People mental health problems

Emotion recognition technology, often powered by artificial intelligence and machine learning, has gained momentum in accurately deciphering human emotions from image and audio inputs [2]. Sentiment analysis, a subset of emotion recognition, involves determining the emotional tone of a given image or audio content. Speech processing technology could aid mental health assessments [1].This technology has applications ranging from users sentiment analysis for businesses to mental health support for individuals.

Digital interventions for mental health have gained traction due to their accessibility and potential to reach a wider audience. Mobile apps and platforms are being developed to offer

users insights, advice, and resources to navigate emotional challenges [1]. In the context of relationship issues, these platforms can offer tailored guidance that acknowledges the complexities of human emotions within relationships [2].
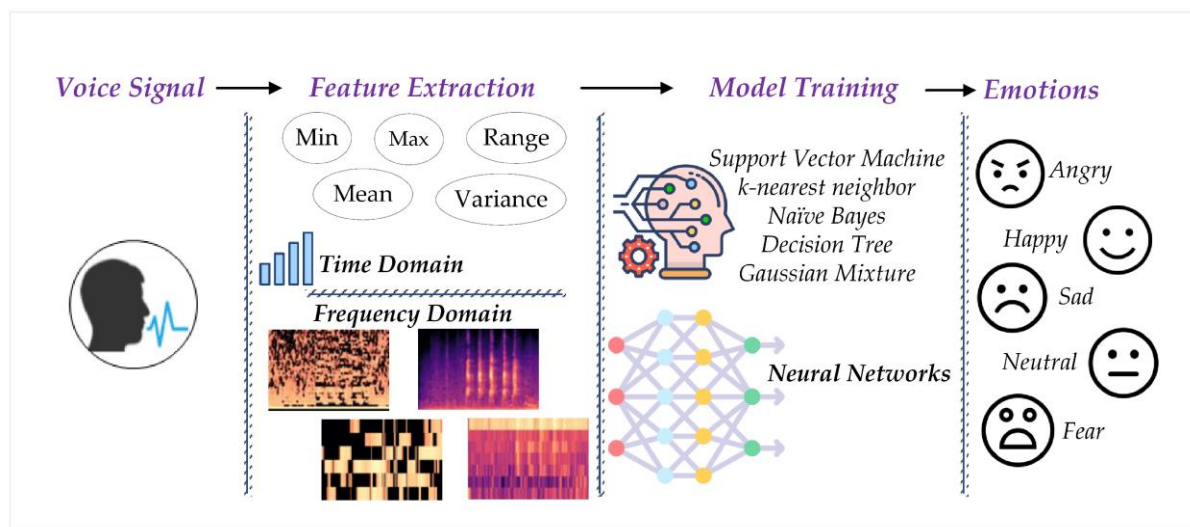
Figure 1. 2: Audio recognition

As with any technology involving personal data and emotions, ethical considerations are paramount. User privacy, informed consent, data security, and cultural sensitivity must be carefully addressed to ensure the responsible use of emotion recognition and sentiment analysis technologies. Sentiment analysis is a process of automatically identifying whether a user-generated text expresses positive, negative or neutral opinion about an entity [3].

There are lots of data on web which require analysis in order for them to become useful. Many researchers have focused on making sense of these data. Therefore, sentiment analysis concept is proposed. Sentiment analysis methods try to emerge any opinions, feelings, and subjectivity behind the text. Machine learning algorithms and vocabulary based methods are used to perform sentiment analysis. [8]
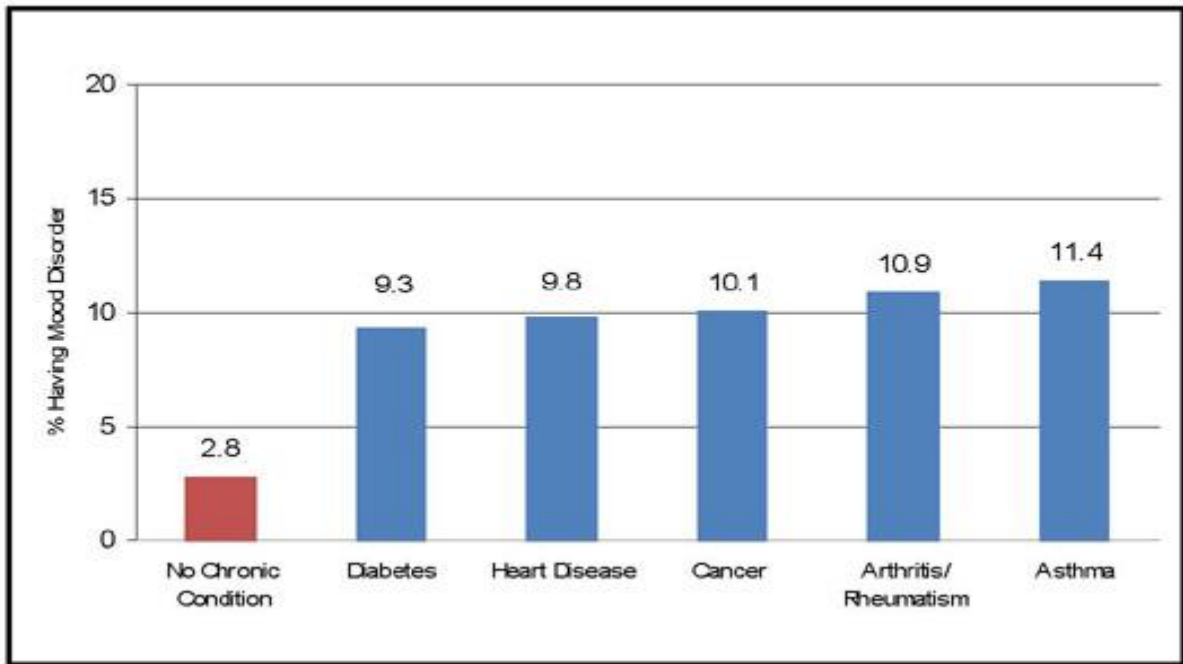
Figure 1. 3: The Relationship between Mental and Chronic Physical Conditions

In conclusion, the research topic of "Emotion Recognition and Sentiment Analysis for Relationship Improvement" marries cutting-edge technology with psychological insights to create a holistic digital solution for enhancing mental health within relationships. By leveraging the capabilities of emotion recognition and sentiment analysis, this research seeks to contribute to the emerging field of digital mental health support, offering individuals meaningful tools for self-awareness, emotional regulation, and relationship enhancement.

1.2 Research Gap

Despite the advancements in technology and the growing awareness of mental health issues, there exists a significant research gap in the area of utilizing AI and VR-enhanced tools for addressing emotional challenges within relationships. While various studies have explored the impact of technology on mental health and relationship dynamics, the specific integration of real-time emotion recognition, sentiment analysis, and virtual reality in a comprehensive app designed to enhance relationships remains largely unexplored. Several key gaps can be identified:

4.1 Lack of Comprehensive AI-VR Solutions:

Existing literature on mental health and relationship dynamics often discusses the role of technology in isolation, without a holistic approach. While AI tools and VR simulations have been utilized separately to address emotional well-being and relationship improvement, there is a lack of comprehensive solutions that integrate both aspects seamlessly. This research seeks to bridge this gap by developing an app that combines AI-driven emotion recognition with VR-enhanced simulations to create a comprehensive tool for relationship improvement [9].

4.2 Limited Application of Deep Learning in Relationship Improvement:

While deep learning techniques have gained prominence in various fields, including image and audio recognition, their application to relationship improvement remains limited. Existing studies typically focus on traditional counseling methods, lacking the integration of cutting-edge technology. This research aims to leverage the power of deep learning, particularly convolutional neural networks, to analyze emotional states and provide personalized advice based on data-driven insights [10].

4.3 Lack of Real-Time Emotional Assessment and Feedback:

Many studies have explored retrospective assessments of emotional well-being within relationships. However, there is a dearth of real-time emotional assessment tools that provide immediate feedback and suggestions for improvement. The proposed app addresses this gap by continuously analyzing emotional states through image and audio recognition, offering users instant insights into their emotional well-being and relationship dynamics [11].

4.4 Limited Integration of VR in Relationship Counseling:

While virtual reality has shown promise in various therapeutic contexts, its application in relationship counseling remains relatively uncharted. Most relationship counseling approaches rely on traditional methods, often lacking the immersive and experiential benefits that VR can provide. This study seeks to pioneer the integration of VR simulations to enhance emotional intelligence and empathy within relationships [12].

4.5 Inadequate Measurement of Mental Stability and Focus:

Assessing mental stability and focus is crucial in understanding an individual's emotional state. However, conventional methods for measuring these aspects lack the engaging and interactive nature that technology can offer. The incorporation of a focus and mental stability game in the proposed app addresses this gap by providing a dynamic and interactive tool for evaluating user mental states [13].

In conclusion, the research gap identified in this study stems from the absence of comprehensive AI and VR-enhanced solutions for addressing emotional challenges within relationships. The integration of real-time emotion recognition, sentiment analysis, and virtual reality simulations presents a novel approach to relationship improvement that combines cutting-edge technology with psychological well-being. This research aims to fill these gaps by developing an innovative app that leverages AI and VR for enhancing emotional intelligence and relationship dynamics.

Table1.1: Comparison between existing system

Feature	Research 01	Research 02	Research 03	Research 04	Proposed Solution
Gaming evaluation	NO	NO	NO	NO	YES
VR-enhanced solutions	NO	YES	NO	NO	YES
Image Processing and Audio recognition both data analysis	YES	NO	NO	YES	YES

1.3 Research Problem

Developing a mobile app that integrates sentiment analysis as a mental health support how can sentiment analysis be effective harnessed to decipher user's emotional states and provide advice for enhancing their mental wellbeing, specifically within the context of relationship challenges?

Figure 1.4: Symptoms of Mental Illness

 The research problem addressed in this study revolves around the seamless and effective integration of sentiment analysis and an interactive focusing game within a mobile app, aiming to empower users with a comprehensive approach to understanding their emotional well-being

and enhancing their mental health. The challenge lies in developing a sophisticated system that not only accurately interprets users' emotional sentiments from image and audio inputs but also incorporates insights derived from the interactive focusing game to offer tailored advice for mental health support.
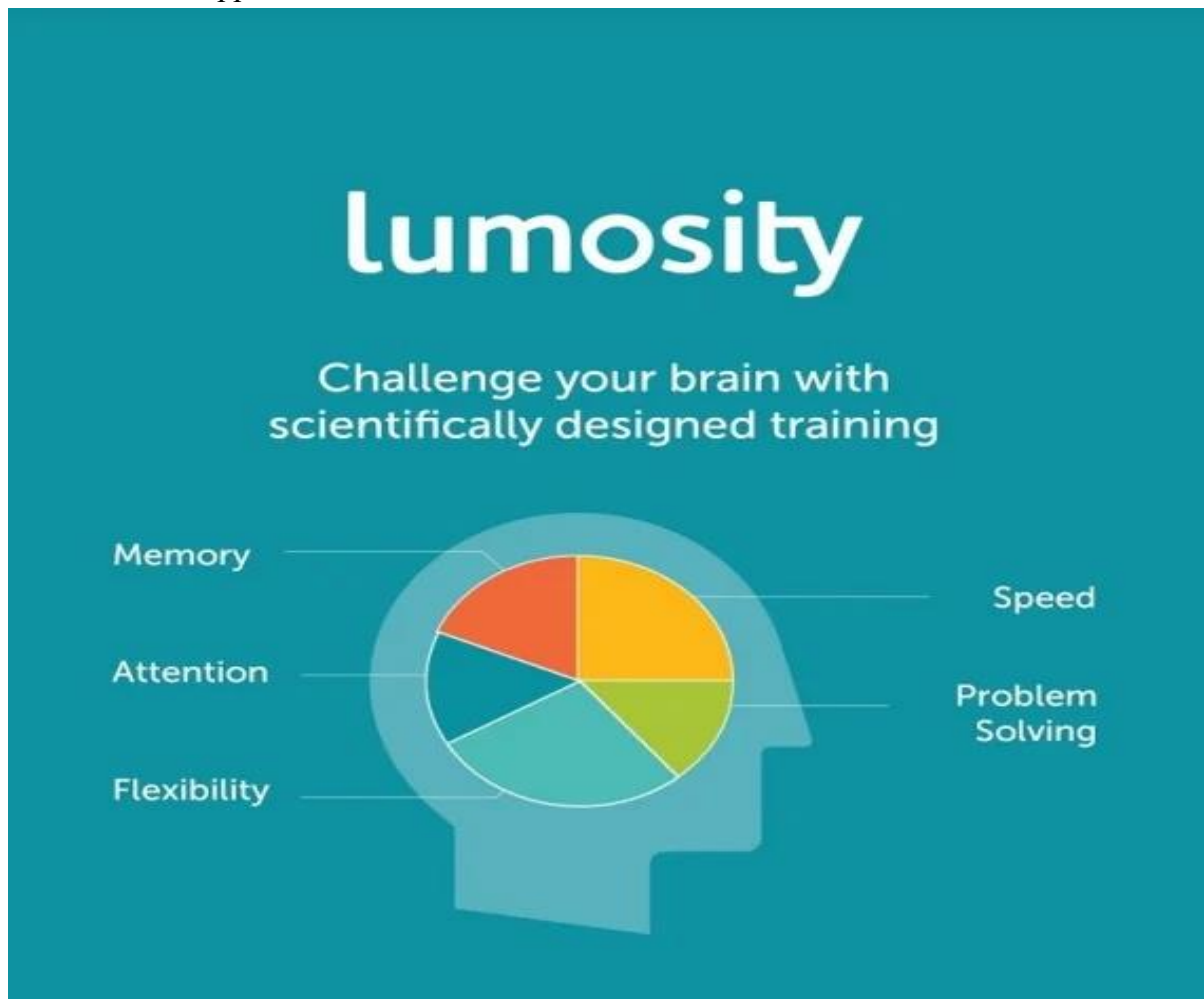
Figure 1.5: Already existing mobile game for empowering brain capacity

The research problem is further extended by the inclusion of an interactive focusing game, designed to assess users' cognitive engagement and attention levels. This introduces a novel dimension to the research, as the integration of focusing game insights with sentiment analysis findings presents a complex challenge in data fusion and interpretation. The objective is to synergize the data from both components to provide a more holistic understanding of users' mental states, encompassing emotional and cognitive aspects.

2. OBJECTIVES

2.1 Main Objectives

main objective is this component is to develop a model to mobile app for accurate and real time image processing and audio recognition data analyses and give the advice for user to what he/she needs to be done to recover from their mental illness. And also giving to the game to play to the user and getting data about users focusing state is the another objective of this component.

2.2 Specific Objectives

To accomplish the goal outlined above, below specific goals must be completed.

Sentiment Analysis Model Development: Design and implement a sentiment analysis model that processes users' image and audio outputs from audio and image processing systems, classifies emotional sentiments, and provides sentiment scores.

Focusing Game Design: Create an engaging focusing game with multiple stages that challenge users' cognitive abilities, including sustained attention and task switching.

Data Fusion Architecture: Develop a robust architecture for combining sentiment analysis and focusing game data, ensuring seamless integration and meaningful interpretation.

User Engagement Enhancement: Design the mobile app's interface to ensure a user-friendly experience that encourages active participation in both the sentiment analysis and focusing game components.

Advice Generation Algorithm: Formulate an algorithm that synthesizes insights from both components to generate personalized advice and recommendations for mental health improvement.

Usability Testing: Conduct usability testing with target users to assess the app's effectiveness in capturing emotional states, measuring cognitive engagement, and delivering relevant advice.

Performance Evaluation: Evaluate the accuracy of the sentiment analysis model and the effectiveness of the focusing game in measuring cognitive engagement, utilizing appropriate metrics.

3. METHODOLOGY

This section outlines the methodology followed to acquire the research objectives of developing a mobile application that combines emotion recognition, sentiment analysis, interactive assessment, and personalized advice for mental health development.

3.1 System Architecture
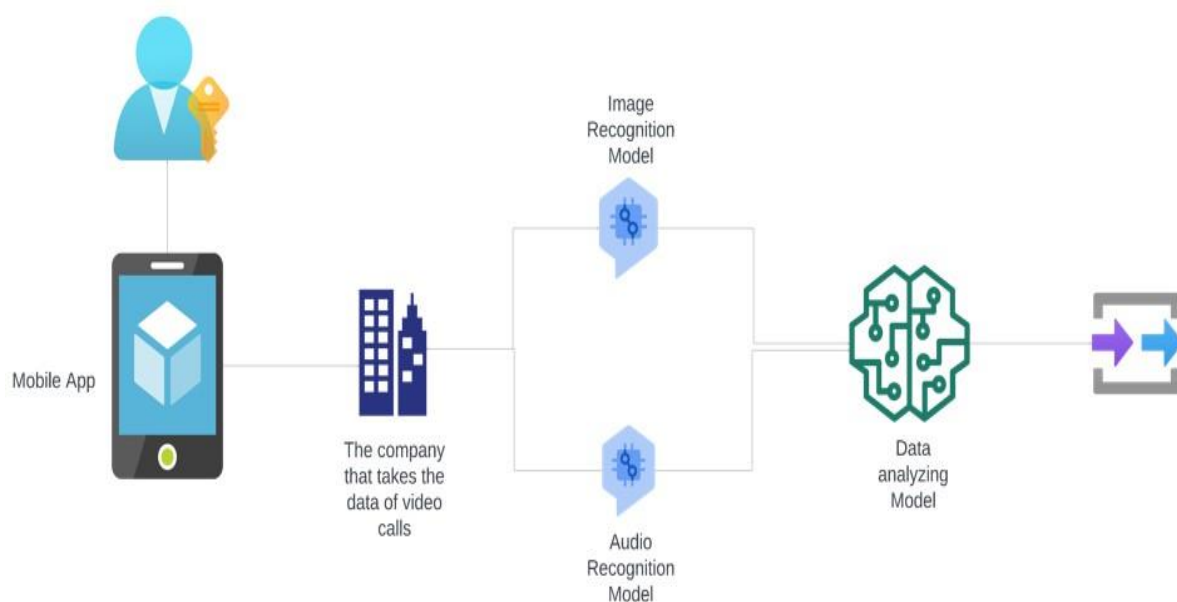
Figure 3.1: Analyze the data that coming from image processing and audio recognitions systems

The facts collection system involves integrating an image processing system inside the mobile application. Users are prompted to add pictures that reflect their emotional expressions. These pics encompass a number of feelings and serve as input for subsequent emotion recognition and sentiment analysis stages. For image data, convolutional neural networks (CNNs) are employed to perform emotion recognition. These networks are skilled on diverse datasets to correctly classify emotional expressions depicted within the images. Feature maps are extracted to perceive facial features and patterns indicative of various emotions.

The mobile application features an audio recognition system that allows to get the audio from calls that user make. These audio samples capture spoken language and emotional nuances in user's voices, contributing to a comprehensive understanding of their mental states. Textual data extracted from audio transcriptions and user provide captions are subjected to sentiment

analysis. Natural language processing (NLP) strategies, together with recurrent neural networks (RNNs), are applied to identify the emotional sentiment conveyed through the spoken words.

As an additional element, a game designed to evaluate users focusing levels is integrated within the application. This game evaluate the user's cognitive engagement and attention. The game includes a few of stages that progressively challenge users focusing competencies, thereby imparting insights into their focusing ability.

The outcomes of the emotion recognition, sentiment analysis and focusing level assessment steps are mixed to derive insights into user's mental states. Patterns and relationships between emotional expressions, sentiment and focusing ability are diagnosed, facilitating a nuanced understanding of user's wellbeing. Based on the insights acquired, a rule-based system generates personalized advice and recommendations for users. The recommendation is tailored to deal with the emotional states and focusing level diagnosed through the analysis, with a particular attention on users relationship-associated demanding situations.

The emotion recognition, sentiment analysis, and advice generation components are seamlessly integrated inside the mobile application's interface. Users can access to their analysis outcomes, focusing level assessment and personalized recommendation through the app.

Figure 3.2: Recognize an emotion using image processing system architecture

The research follows ethical guidelines regarding consumer consent, data privacy and confidentiality. Users are pre-informed about the data collection process, the purpose of

analysis and integration of interactive assessments. Data is anonym zed and saved securely to protect user privacy.

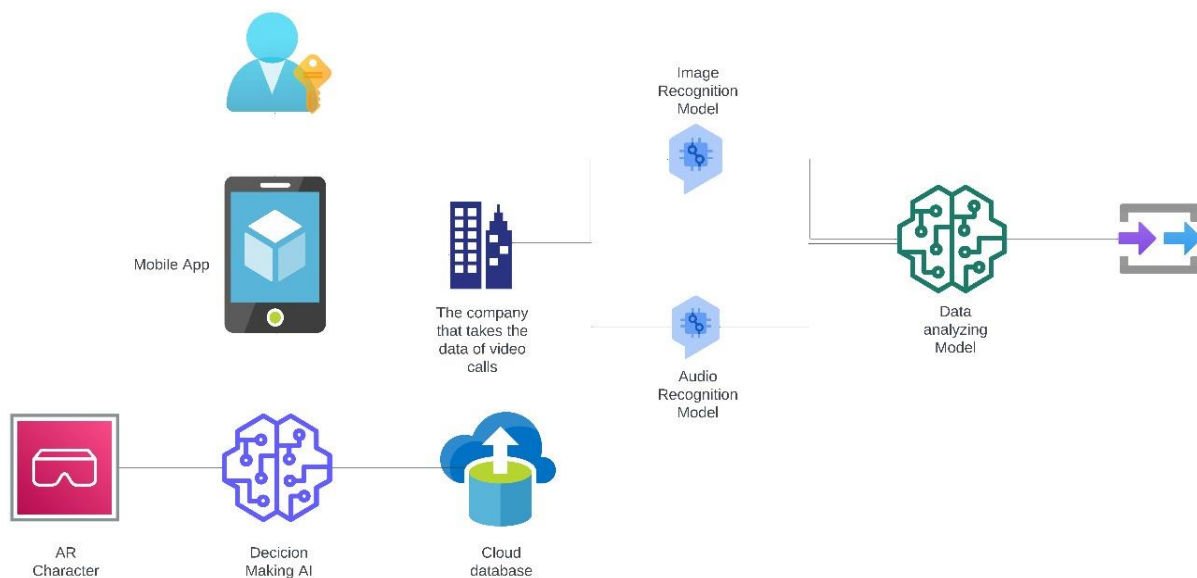In conclusion, developing a mobile application that merges emotion recognition, sentiment analysis, interactive assessment, and personalized recommendation. By seamlessly integrating those components, the methodology allows for a holistic information of users' mental states and their relationship challenges. The inclusion of an engaging focusing level assessment game enhances the accuracy of information collection and contributes to a deeper comprehension of user's cognitive engagement. The synergy of image processing, audio recognition, sentiment analysis, and focusing stage evaluation forms the foundation for generating personalized recommendation aimed toward enhancing user's mental wellbeing.

Technologies	React Native, Expo, Keras, OpenCV, Flask, Node.js, ML libraries
Techniques	Deep Learning, Real-time Processing, CrowdSourcing
Architectures	Robust
Algorithms	CNN, Machine learning algorithms, Advice Generation Algorithm

Table 3.1: Technologies, techniques, architectures, and algorithms used.

3.1.1 Software Solution

The Software Development Life Cycle (SDLC) serves as a methodical framework for developing software with precision and coherence. In conventional SDLC, developer's encounter limitations in revisiting earlier stages when requirements shift, necessitating adherence to a fixed sequence of steps. Yet, in an agile approach, such constraints are eased, as agility emphasizes flexibility and adaptability. Among various agile frameworks, Scrum stands out as a particularly potent one. Functioning as an agile project management methodology, Scrum offers a lightweight yet robust solution for managing intricate and evolving challenges. The Illustration in Figure 3.3 vividly portrays the core six processes that constitute the foundation of agile methodology, embodying its fluid and responsive nature.
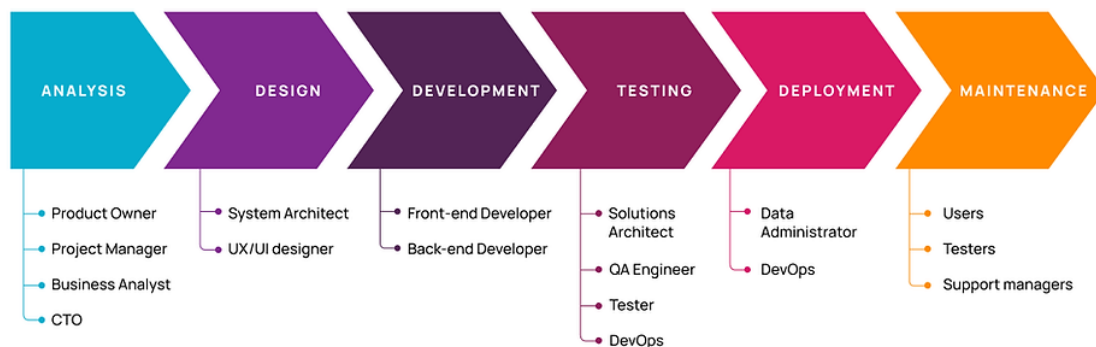

Figure 3.3: Agile methodology (SDLC)

1. Requirement Gathering

This phase involves getting the data that coming from the image processing and audio recognition systems.

2. Feasibility Study (Planning):

The feasibility study evaluates the project's viability. Economic feasibility assesses the cost-effectiveness of the solution, including data storage and processing expenses. Schedule feasibility determines the project's timeline, considering the available resources and development time. The study ensures that the chosen technologies align with project goals and constraints.

3. Design:

System and software design documents are created in this phase. The system design outlines the architecture, components, and data flow of the automated system.

4. Implementation (Development):

The implementation phase involves coding and integrating the machine learning and real-time processing technologies. The integration of these technologies enables the system to analysis data that gather from Requirement Gathering.

5. Testing:

Testing is vital to validate the system's functionality and performance. Tracking and monitoring tools are implemented to assess accuracy, reliability, and real-time processing capabilities and refined to enhance the system's accuracy and user experience.

3.1.2 Commercialization

Target Audience & Market Space

Target Audience

- Couples and romantic partners
- Families
- Individuals seeking relationship improvement
- Therapists and counselors.

Market Space

- There is no limit in age for users.
- No need to advanced knowledge in technology.

Future Scope

Future scope includes AI advancements for deeper emotion understanding, virtual reality integration, and applications in mental health and education.

4. PROJECT REQUIREMENTS

4.1 Functional Requirements

1. Getting data: Getting data from image processing and audio recognition system to the analysis model.

2. Sentiment Analysis Algorithm: Develop a sentiment analysis model that categorized data as relevant emotional states and algorithm should be trained to understand of emotional expression within the context of mental health and relationship challenges

3. Real-Time Analysis: Provide users with near real time sentiment analysis result.

4. Emotional Categorization: implement a system that assigns emotional labels to sentiment analysis result for a good understanding.

5. Advice Integration: Integrate sentiment analysis result into the advice generation algorithm to give personalized guidance and those advices should be relevant to the emotional states identified through sentiment analysis.

6. Integration with Focusing Game: Develop a game that can effectively get the data of users focusing ability.

4.2 User Requirements

- Ease of Use:

  User should find it easy to use.

- Accuracy of Analysis:

  Users expect the sentimental analysis result to accurately reflect their emotional states

- Personalized Advice:
  Users expect the sentiment analysis results to be translated into personalized advice that resonates with their emotional states. The advice provide should be relevant to their specific context such as relationship challenges.

4.3 System Requirements

Software requirements delineate the functionalities and resources necessary for a software system to meet user needs effectively. They bridge user expectations and technical implementation, guiding development by defining features, performance, and interactions. By minimizing misunderstandings and aligning stakeholders, requirements ensure the creation of user-centered, reliable software solutions that fulfill business objectives.

- Emotion Analysis: Deep Neural Networks (DNNs) for analyzing and identifying emotions

- Deep Learning Framework: Keras, for a high-level deep learning framework, for training and deploying emotion analysis models.

- Cross-Platform App Development: Develop a user-friendly application using React Native and Expo, ensuring compatibility with both Android and iOS.

- Backend Server: Use Flask to host and manage the deployed deep learning models for real-time emotion Analysis.

- Integration: Establish a Node Server to connect the mobile and web applications with the Flask Server, facilitating real-time communication.

- Crowdsourcing: Implement a mechanism to engage users and gather feedback on the accuracy of emotion recognition results.

4.4 Non-Functional Requirements

1. User Privacy and Data Security: The system must ensure that all collected user data is securely stored, encrypted, and accessible only to authorized personnel, complying with privacy regulations.

2. Performance - The system is expected to demonstrate efficient performance, delivering rapid and precise results to users.

3. Availability - The application's accessibility should extend to users worldwide, accommodating various languages and ensuring uninterrupted availability as required.

4. Scalability and Concurrent Usage: The solution should be able to handle a growing number of simultaneous users without degradation in performance, ensuring a smooth user experience during peak usage times.

4.5 Use case Diagram
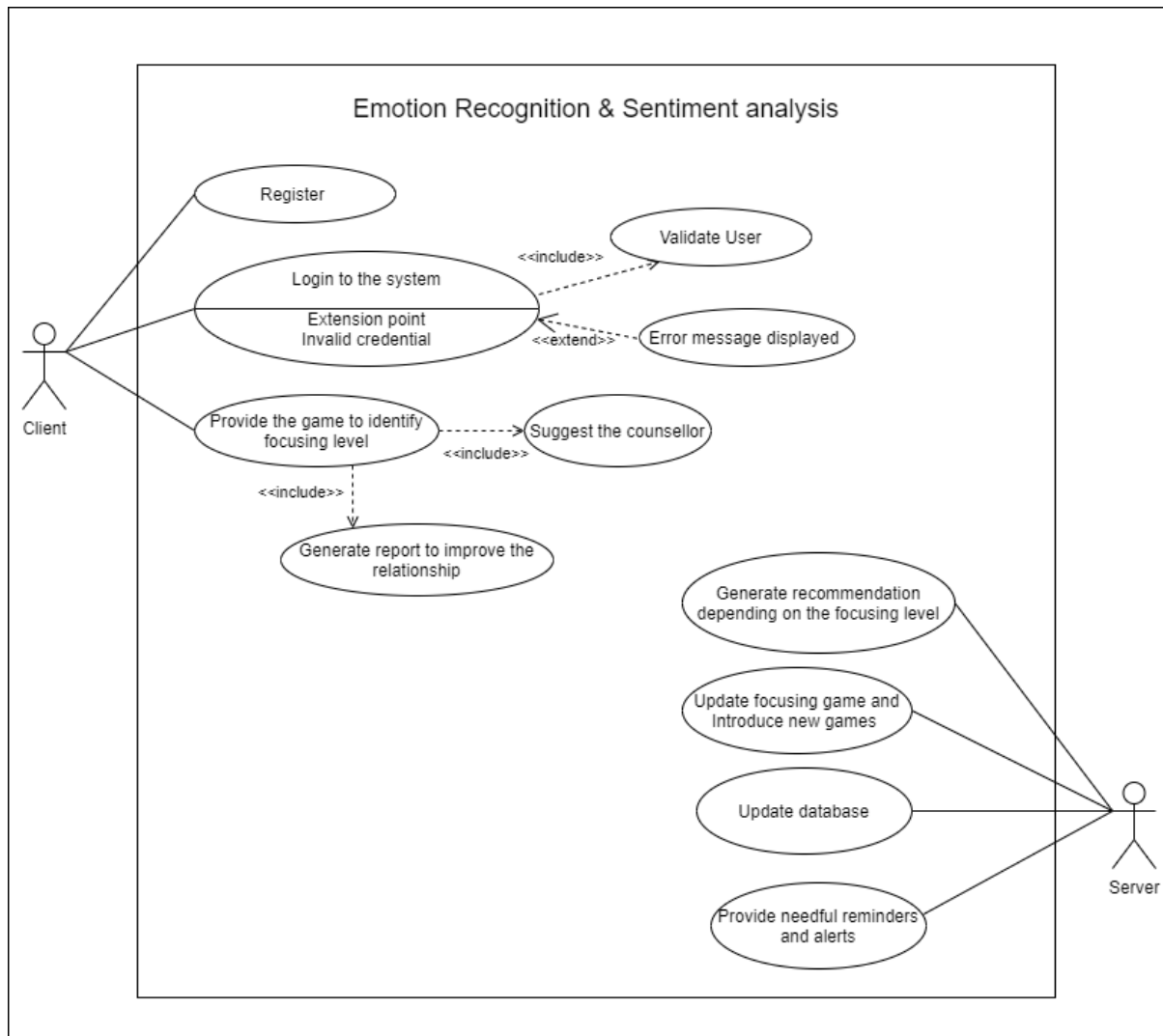
Figure 4.1: Use case diagram

5. BUDGET AND BUDGET JUSTFICATION

Requirement	Cost(Rs.)
Mobile app hosting charge – Play store	5 000.00
Cloud service	6 000.00/month
Internet Charges	5 000.00
Total Cost	**16 000.00**

Table 6. 1: Budget for the proposed system

6. GANTT CHART

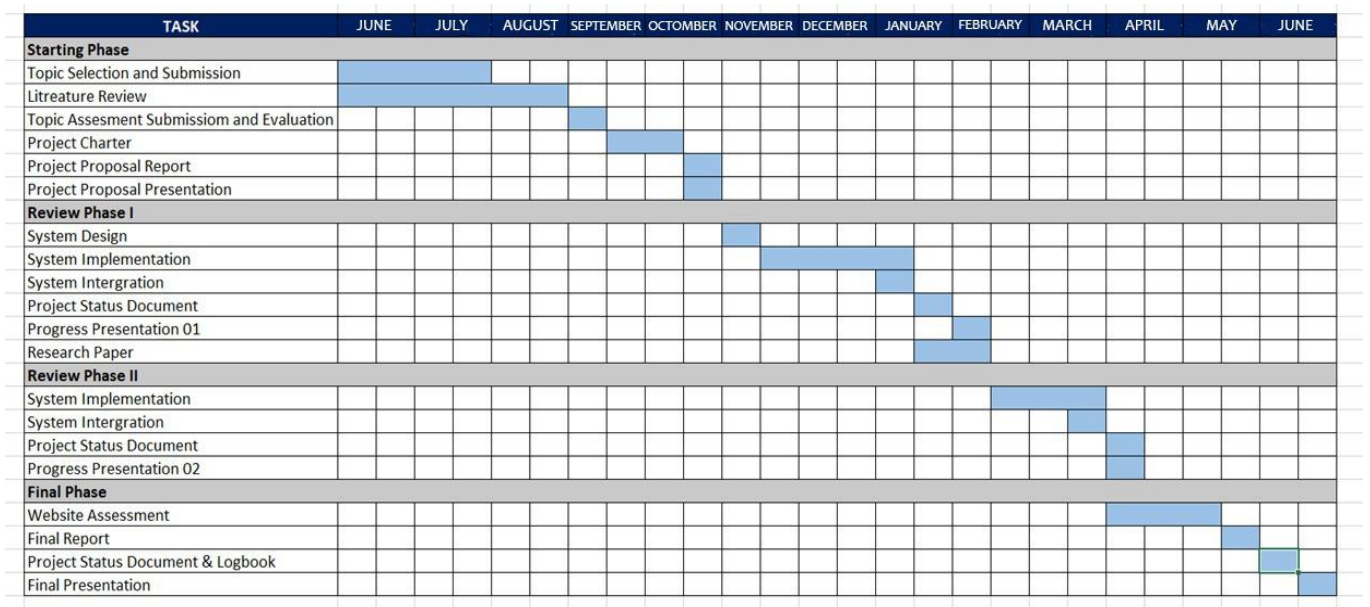| TASK	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Starting Phase													
Topic Selection and Submission	██	█											
Litreature Review	██	██											
Topic Assesment Submissiom and Evaluation			█										
Project Charter				█									
Project Proposal Report					█								
Project Proposal Presentation					█								
Review Phase I													
System Design						█							
System Implementation						██							
System Intergration							█						
Project Status Document							█						
Progress Presentation 01								█					
Research Paper							██						
Review Phase II													
System Implementation										██			
System Intergration										█			
Project Status Document											█		
Progress Presentation 02											█		
Final Phase													
Website Assessment											██		
Final Report												█	
Project Status Document & Logbook												█	
Final Presentation													█

Figure 6.1: Gantt chart
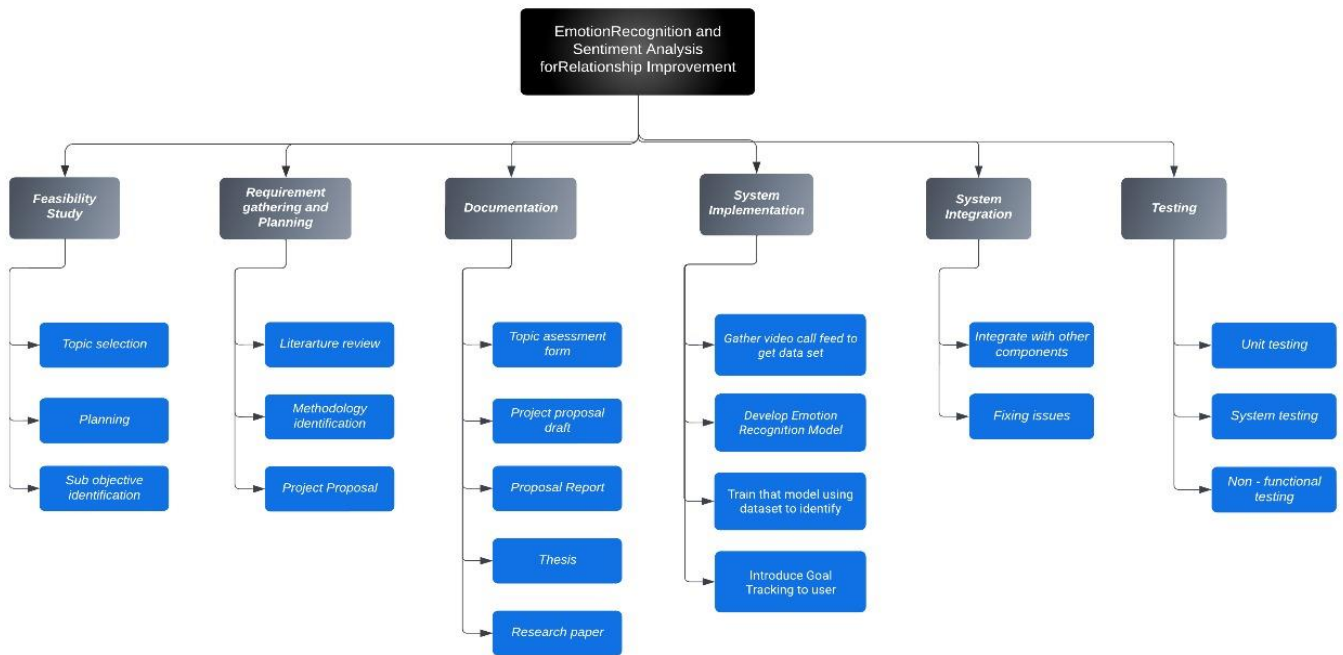
6.1 WORK BREAKDOWN STRUCTURE (WBS)

Figure 6.2: Work breakdown chart of Recognize an emotion using image processing component

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