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Philadelphia University

Faculty of Information Technology
Computer Science Department

Research Project 1

(PEDS)

Patients emotion detection System for psychiatry professionals

Mobile Application

Final Documentation

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Chapter 0: First Things First :-

1. Goals and Objectives:

• Accurate Identification:

- This already includes the primary aim of being able to precisely remember one's face under challenging conditions such as lighting, angle, expression, and anything else, to guarantee the trustworthiness of identification or authentication purposes.

• Emotion Detection:

- The people's facial expression in situations of emotional expressions and its appraisal. This includes and is not limited to the reading of basic emotions such as happiness, sadness, anger, surprise, fear, disgust, and at times more complex ones, confusion or frustration.

• Enhanced Security:

- The objective of facial recognition is to enhance identification in security and surveillance to control access to secure places, devices, or systems, to prevent unauthorized entry.

• Real Time Processing:

- The real-time detection is invaluable in the use of applications such as surveillance, live streaming, or interactive systems. The aim is to bring about minimal delay between face and emotion capture and systems that have the capability of response.

• Human Computer Interaction:

- Recognition of face and emotions can be used in the improvement of user experience within the applications, in this case users will not be responding identically as their emotions or identities would be sought for in applications such as gaming, customer care services or virtual assistants.

• Automation of Tasks:

- Automating processes such as watching over large crowds for security threats, making predictions, recording the customers' responses, or developing advertising campaigns filled with emotions lie at the heart of the business domain.

• Data Privacy and Ethics:

- Ensuring responsible use of Face and Emotion Recognition, with a focus on user consent, privacy, and minimization of bias in building trust and assuring legality for sensitive areas.
Scalability:
- Designing systems that can scale efficiently to identify thousands or millions of faces or analyze emotions in a consistent manner across large datasets.
- Cross-Cultural Accuracy:
- Emotion recognition systems try to recognize true emotions from diverse populations by considering cultural variability in expressions and facial cues.

2. Brief Description of the Project:

As part of our team project, we are working on a mobile application that specializes in recognition of face and emotions. This application will automatically recognize and detect human faces in images and video images and streams, while also recognizing and interpreting emotions by facial expressions.

Using advanced machine learning and computer vision technologies, we expect to ensure the fast and seamless navigation of users on mobile. Our app will allow users to see the emotions on their insightful faces in real time, which will promote social interaction and activities in different environments. We look forward to the promising technical challenges ahead and will make every effort to provide simple solutions to real world problems.

3. References:

Adjabi, I., Ouahabi, A., Benzaoui, A., and Taleb-Ahmed, A. (2020). Past, present, and future of face recognition: a review. *Electronics* 9:1188. doi: 10.3390/electronics9081188

Ajili, I., Mallem, M., and Didier, J. Y. (2019). Human motions and emotions recognition inspired by LMA qualities. *Vis. Comput.* 35, 1411–1426. doi: 10.1007/s00371-018-01619-w

Cowie,R.etal.(2001). Emotionrecognition inhumancomputer interaction. In: IEEE Signal Processing Magazine 18.1, pp. 32–80. doi: 10.1109/79.911197.

Crawford, K. et al. (2919). AI Now 2019 Report. Tech. rep. New York: AI Now Institute.

4. Project Requirements (Hardware & Software):

• Hardware Requirements

1. **Phone**:
    - A smartphone with a minimum of 4GB RAM and a capable camera for optimal performance in image and video capture.
2. **Hard Disk**:
    - At least 64GB of free storage space to accommodate the application, including machine learning models and user data.
3. **CPU**:
    - A multi-core processor that can efficiently handle the computational tasks required for face recognition and emotion detection.

• Software Requirements

1. **Face Recognition**:
    - Implementation of libraries such as OpenCV or Dlib for detecting and recognizing faces in real-time.
2. **Emotion Detection**:
    - Utilization of pre-trained models or frameworks, like TensorFlow or PyTorch, specifically designed for emotion recognition based on facial expressions.

3. **User Interface**:
    - Development of a responsive user interface using frameworks such as Flutter or React Native, ensuring a smooth user experience.
4. **Database**:
    - A database solution (e.g., Firebase or SQLite) to securely store user profiles, emotional data, and application settings.

5. Company or Organization (If Applicable):

This project is not specified for a certain organization or a company but it could be used for psychiatric clinics or in hospitals or any other field.

6. Prerequisites:

The main prerequisite in this project will be the coding background in flutter and draft and some app design programming languages and of course the compilers that runs the code and used for the design and implementation such as VS CODE AND ANDROID STUDIO , and for the database there will be a software that we going to specify later on . we are still on the process of gathering information about our idea and we will be done as fast as possible.

7. Project Specialization (Computer Science):

We as a team are majored in computer science and that is our area of specialization
For this project we will try to gain a lot of info about Mobile Applications and databases.

8. Expected Outcomes:

The expected results of our face and emotion recognition mobile application include:

Emotion Detection Tool Accuracy: The application is going to be capable of doing a real-time analysis of facial expressions and correctly interpreting them, leading to better learning and understanding of emotions in different settings, e.g. human interactions or customer feedback.

Better User Experience: Through a more user-friendly design, the user interface will offer better accessibility, which will make the app appeal to a wider scope of users from individuals to businesses.

Analyzing Emotional Trends: This project will produce insights and reports on emotional trends that a user is going through which could be of particular interest to different groups such as research and marketing teams.

Emotion Recognition Technology Development: This program is intended to offer new methods of recognizing emotions and bring in new technologies which will help it lead to more research and application possibilities.

Engaging User: With the provision of immediate emotional reactions, the application can facilitate more meaningful ties in social and professional environments thus, the interpersonal communication and mutual understanding can be greatly improved.
In general, this initiative is purposed to create a real installation that joins the latest technologies with user-orientation, what is both the scientific and real world turn.

Chapter 1: Introduction

1.1. Introduction

our project is an Emotion Recognition System :

An application design that uses machine learning to analyze facial expressions or tone of voice to detect emotions, recognizing insights for mental health professionals or customer service.

1.2. Background

Emotion recognition through facial expressions is a powerful tool in understanding a person's mental and emotional state, and it holds great promise for psychiatric applications. Traditionally, psychiatric evaluations rely heavily on verbal communication and self-reporting, which can often be influenced by factors like mood, anxiety, or communication barriers. This limitation makes diagnosing mental health conditions challenging, particularly for patients who are non-verbal, struggle with emotional expression, or are unable to articulate their feelings. Facial expressions, however, are universal indicators of emotions that can transcend language and cultural barriers, making them an invaluable resource for understanding a patient's emotional state.

This project aims to develop a system that uses facial recognition technology to detect and analyze emotions, assisting psychiatric professionals in making more informed decisions. By employing machine learning algorithms and advanced computer vision techniques, our system will analyze facial expressions in real-time, identifying key emotions such as happiness, sadness, anger, and fear. This system will serve as a supplementary tool for mental health professionals, providing objective, consistent insights into a patient's emotional responses. Additionally, ethical considerations such as patient consent, privacy, and data security will be prioritized to ensure that the technology is applied responsibly in clinical settings.

Emotion recognition systems use machine learning to analyze things like facial expressions or voice tone to understand people's emotions. They're becoming popular in areas like mental health and customer service because they can provide extra insights that help professionals respond in more thoughtful, personalized ways.

1.3. Problem Statement

While these systems hold a lot of promise, many still struggle with accuracy. They can misinterpret emotions due to cultural differences, background noise, or even just slight changes in expressions. Plus, these systems need a lot of data to work well, and gathering enough can be difficult, making them less reliable in real-world use.

1.4. Limitations

Key limitations of emotion recognition systems include:

- Privacy Concerns: Access to personal data, like video or audio, raises privacy issues.
- Classification Challenges: Complex or mixed emotions are harder to identify accurately.

- Data Constraints: Training models requires large, diverse datasets, which can be costly.

1.5. Project Objectives

The project aims to many goals some of them :

- Eemotion Detection:

- The people's facial expression in situations of emotional expressions and its appraisal. This includes and is not limited to the reading of basic emotions such as happiness, sadness, anger, surprise, fear, disgust, and at times more complex ones, confusion or frustration.

- Enhanced Security:

- The objective of facial recognition is to enhance identification in security and surveillance to control access to secure places, devices, or systems, to prevent unauthorized entry.

- Real Time Processing:

- The real-time detection is invaluable in the use of applications such as surveillance, live streaming, or interactive systems. The aim is to bring about minimal delay between face and emotion capture and systems that have the capability of response.

1.6. Project Solution

The solution involves building a machine learning app that detects emotions by analyzing facial expressions and voice tone. Using advanced algorithms like deep neural networks, it will be trained on a large, diverse dataset to accurately pick up on emotional cues, while respecting cultural differences and prioritizing user privacy.

1.7 Scope of the Project (Project Scope Covered - Project Scope Not Covered)

Project Scope Covered

This project aims to develop an advanced facial and emotion recognition system specifically designed for psychiatric applications. By analyzing facial expressions, the system will assess a range of emotions to assist psychiatric professionals in evaluating patients' mental states more accurately. Key areas of focus include:

1. Emotion Detection Accuracy: Our system will identify emotions like happiness, sadness, anger, fear, surprise, and neutrality through subtle facial cues, contributing valuable insights for psychiatric evaluations.

2. Privacy and Ethical Considerations: Given the sensitive nature of psychiatric data, we emphasize strict privacy protocols, data security measures, and patient consent practices to ensure ethical compliance.

3. Clinical Integration: Designed to integrate seamlessly into existing clinical workflows, the system should enhance the psychiatrist's capabilities without disrupting standard practices.

4. Bias Mitigation: To ensure fairness and inclusivity, the model will be evaluated for potential biases across demographics, aiming for an accurate assessment that respects diversity.

Project Scope Not Covered :

To maintain a clear focus, the project excludes:

1. Invasive Data Collection: Our data acquisition will be entirely non-intrusive, relying solely on facial imagery with consent.

2. Substitution for Clinical Judgment: This tool is intended to complement, not replace, the expertise of psychiatric professionals.

1.8 Project Feasibility

The feasibility of this project is high, both from a technical and practical perspective. Given the rapid advancements in machine learning, computer vision, and emotion recognition, we are confident that the technology necessary to develop this system is readily available and well within reach. Below are key points that support the feasibility of this project:

1. Technical Feasibility:
    - Emotion Recognition Algorithms: The core of this project will rely on deep learning techniques, particularly Convolutional Neural Networks (CNNs), which are highly effective for facial emotion recognition. These models can analyze facial landmarks and subtle movements to classify emotions with high accuracy.
    - Data Availability: Several publicly available datasets, such as FER-2013 and AffectNet, contain thousands of labeled images of facial expressions, allowing us to train the system on a diverse set of data. This will ensure that the model can generalize across different demographics and environments.
    - Computational Resources: Training deep learning models requires significant computational power, but modern cloud computing platforms provide scalable GPU resources, ensuring that we can train our models efficiently and within the project's timeline.
2. Clinical Feasibility:
    - Integration with Psychiatric Practice: Psychiatric professionals already use various assessment tools, but integrating emotion recognition technology into clinical workflows presents an opportunity for enhanced diagnostic accuracy. Our system will be designed to work alongside existing tools, providing real-time emotion tracking and generating reports that can assist in patient evaluations.
    - User-Centered Design: The system will be built with the end user in mind, focusing on ease of use and seamless integration into clinical settings. The app interface will be intuitive for psychiatrists, while the website will allow for convenient access to patient data and reports.
3. Ethical Considerations:
    - Patient Consent and Privacy: Privacy and ethical considerations are central to the project. We will ensure that all data is collected with explicit patient consent and that it is anonymized to prevent misuse. Additionally, the system will be designed to comply with data protection regulations, such as HIPAA, to safeguard patient information.

- Bias and Fairness: It's important that emotion recognition technology does not introduce bias into the clinical process. We will rigorously test the system for potential biases across age, gender, and cultural backgrounds, ensuring that it provides accurate assessments for all patients.

4. Timeline and Resource Availability:
    - The project will follow a clear timeline, with specific milestones for documentation, algorithm development, app and website creation, and system testing. The first phase will focus on documentation and research, followed by the development of the core emotion recognition system. Given the availability of necessary tools, datasets, and resources, we anticipate completing the project within the expected timeframe

Chapter 2: Literature review

2.1 Introduction

Emotion recognition technologies have gained significant traction across diverse fields, including healthcare, where they are instrumental in psychiatric practices. These technologies enable professionals to assess patients' emotional states through facial expressions, tone of voice, and textual analysis. The integration of face and speech recognition with emotion analysis has the potential to enhance diagnostic accuracy and therapeutic outcomes. This chapter provides a comprehensive review of existing systems and solutions, focusing on their relevance to psychiatric applications. By identifying the strengths and weaknesses of current approaches, this chapter establishes the foundation for the proposed aapplication.

2.2 Review of Existing Systems

A. System 1: Affectiva's Emotion AI

Affectiva is a leading system in facial emotion recognition. It uses machine learning models trained on large datasets to detect emotions through facial expressions.

- Strengths: High accuracy in identifying basic emotions (happiness, sadness, anger, etc.); real-time processing capabilities; widely validated through academic research.
- Weaknesses: Limited in detecting complex or mixed emotions; struggles with accuracy in diverse populations due to potential biases in training data.
- Relevance: Valuable for facial emotion detection but lacks integration with other modalities like speech or text.

B. System 2: IBM Watson Tone Analyzer

IBM Watson Tone Analyzer focuses on analyzing text and tone in speech to identify emotions and attitudes

- Strengths: Effective in detecting subtle emotional nuances in speech and text; well-suited for textual analysis in conversations.
- Weaknesses: Relies heavily on the quality of speech-to-text conversion; can misinterpret tone in ambiguous contexts.

- Relevance: Suitable for voice emotion analysis but does not incorporate facial recognition.

C. System 3: Cogito Health

Cogito Health offers an integrated solution that combines voice tone analysis with emotional insights for healthcare professionals.

- Strengths: Designed specifically for mental health use; real-time feedback during patient sessions; highly accurate in tone-based emotion detection.
- Weaknesses: Limited focus on facial recognition; more effective for live interactions rather than prerecorded sessions.
- Relevance: A specialized tool for psychiatric professionals but lacks the multi-modal approach your app proposes.

D. System 4: Microsoft Azure Cognitive Services

Microsoft Azure provides APIs for face and speech recognition, including emotion detection.

- Strengths: High adaptability and integration capabilities; supports both facial recognition and speech-to-text analysis.
- Weaknesses: Requires significant customization for psychiatric use; expensive for large-scale applications.
- Relevance: Versatile technology but needs significant development effort to tailor for mental health applications.

2.3 Comparison Between Available Systems

The following table summarizes the features, advantages, and limitations of the reviewed systems:

Feature	Affective	IBM Watson	Cogito Health	Microsoft Azure	PEFAS
Emotion Detection Accuracy	High	Moderate	High	High	Moderate
Multi-Modal Analysis	No	No	Partial	Yes	Yes
Psychiatric Applicability	Moderate	High	High	Moderate	Yes
Cost	High	Moderate	High	High	Moderate
Limitations	Bias in data	Ambiguity in text	No facial analysis	Requires customization	A large dataset needed and Doctors interviews

Insights from the Comparison:

- Strengths Identified: Cogito Health stands out for psychiatric use due to its focus on voice tone, while Affectiva provides reliable facial emotion detection.
- Gaps Addressed: None of the systems fully integrate facial recognition, voice tone, and speech-to-text analysis for prerecorded session summaries.
- Opportunities for Improvement: Combining the strengths of these systems into a single platform could offer psychiatric professionals a comprehensive tool for emotion recognition.

2.4 Conclusion

The reviewed systems demonstrate significant advancements in emotion recognition technology. However, they reveal gaps in multi-modal integration and their application to psychiatric practices. Existing solutions either specialize in facial recognition or voice analysis but rarely combine these modalities into a unified tool. This chapter highlights the need for an innovative system that not only detects emotions from multiple sources but also provides comprehensive summaries for both live and prerecorded sessions. The proposed application aims to fill these gaps by offering a tailored solution for psychiatric professionals.

Chapter 3: Methodology and Work Plan

3.1 Introduction

in the beginning, this chapter introduces the methodology and work plan tailored to our project, which focuses on developing an emotion and facial recognition system to assist psychiatric doctors. The project involves creating an innovative mobile application that uses artificial intelligence to analyze facial expressions and provide insights into patients' emotional states. This chapter outlines the structured approach adopted to ensure the project's successful execution, detailing the processes and tools guiding its development.

3.2 System development methodologies (waterfall) :

The waterfall model is a structured methodology designed to streamline the system development process. It assigns distinct tasks to each development stage and emphasizes the creation of corresponding documentation.

1. **Requirements Gathering** : In this phase, the team will collect all the necessary information to grasp the system’s objectives. For our project, this involves determining:

   1. Which emotions need to be identified

   2. How the system will assist in psychiatric assessments

   3. What tools (such as cameras and software) are required for facial and emotional recognition.

2. **System Design :** After determining the system's objectives, we move on to designing its functionality. This involves:

   1. Selecting appropriate software and algorithms for face detection and emotion recognition (for instance, employing machine learning models)

   2. Crafting a user-friendly interface tailored for doctors and healthcare professionals

3. Establishing a framework for the data that the system will utilize.

3. **Implementation :** In this phase, we start the actual construction of the system:

   1. We develop code to identify faces in images or videos

   2. We either create or incorporate models that can recognize emotions based on facial expressions

   3. We ensure that the system is compatible with the current tools utilized in psychiatric assessments.

4. **Testing :** After constructing the system, we perform tests to confirm that everything operates as intended:

   1. We evaluate each component of the system to verify their proper functionality (unit testing)

   2. We assess whether all components of the system collaborate effectively (integration testing)

   3. We carry out tests with healthcare professionals to determine if the system is practical and precise in real-world scenarios.

5. **Deployment** : After thorough testing and ensuring everything functions properly, the system will be ready for implementation:

   1. The system will be installed in psychiatric clinics or hospitals

   2. Healthcare professionals will receive training on its usage

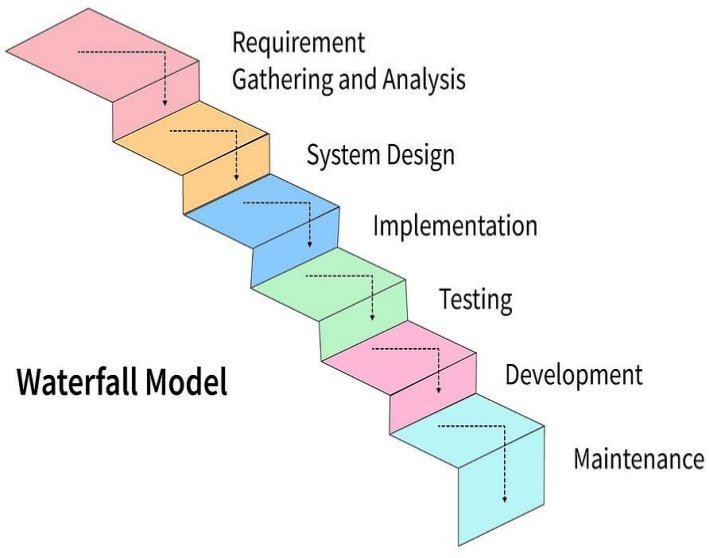
   3. All necessary user guides or manuals will be supplied.

6. **Maintenance** : Once the system is up and running, it will require continuous support:

   1. We'll address any problems that arise during actual use (bug fixes)

   2. We'll enhance the system as necessary to boost performance or introduce new features

   3. We'll assist users and ensure the system remains current.



3.3 Requirement Gathering Technique:

The requirements for this project were gathered using the following techniques:

1. **Interviews**: Conducted discussions with psychiatric doctors to understand their needs and expectations from the emotion recognition system.

Our interview:-

Interview: Requirements Gathering for Emotion and Facial Recognition App

Date: 17/1/2025

Interviewer: Bilal Atwan

Interviewee: Dr. Suhaib Al-Jabari (Psychiatric Professional)

Time: Evening

Duration: Approximately 30 minutes

Bilal: Good evening, Dr. Suhaib. Thank you so much for taking the time to meet with me today. I'm working on a graduation project focused on developing a facial and emotion recognition app tailored to assist psychiatric professionals. Your expertise will help ensure this tool addresses the practical needs of professionals like yourself. Shall we get started?

Dr. Suhaib: Good evening, Bilal. It's a pleasure to contribute. Please, go ahead.

Section 1: Understanding Current Practices

Bilal: To start, could you walk me through your typical interactions with patients during diagnosis or therapy sessions?

Dr. Suhaib: Certainly. Each session begins with observing the patient's behavior, body language, and emotional responses. These observations often provide subtle clues about their mental state, which might not be apparent through verbal communication alone.

Bilal: That's interesting. What challenges do you face in assessing a patient's emotional state during consultations?

Dr. Suhaib: One significant challenge is interpreting emotions in patients who are either reserved or unable to express themselves clearly, such as individuals with certain neurodevelopmental or mood disorders. It often requires relying on subjective judgment, which can vary.

Bilal: Are there any tools or systems you currently use to monitor patients' emotions? If yes, what are their strengths and weaknesses?

Dr. Suhaib: We use self-reporting questionnaires and behavioral observations, but these methods depend heavily on the patient's willingness and ability to communicate. They're helpful but lack objectivity and real-time analysis.

Section 2: Exploring Needs and Expectations

Bilal: If an app could assist you in identifying patients' emotions through facial recognition, what specific features would you find most useful?

Dr. Suhaib: Real-time emotion tracking during sessions would be valuable. Additionally, a feature that provides detailed emotion trends over time for each patient would help identify patterns and triggers.

Bilal: Would you prefer real-time analysis during sessions, or do you think summaries post-session would be more beneficial?

Dr. Suhaib: Real-time analysis would be ideal for immediate intervention, but having post-session summaries would also be useful for more in-depth evaluations and treatment planning.

Bilal: How accurate should the emotion recognition be to gain your trust in using it for clinical purposes?

Dr. Suhaib: The tool must achieve at least 90% accuracy to be dependable. More importantly, it should reliably differentiate between similar emotions like frustration and anxiety.

Bilal: What level of detail do you expect in the analysis? Should it identify basic emotions or delve into nuanced states?

Dr. Suhaib: While basic emotions are a good starting point, nuanced states like ambivalence, guilt, or agitation would be incredibly helpful in psychiatry.

Section 3: Ethical and Practical Considerations

Bilal: What privacy and consent measures should we prioritize to ensure patient comfort and trust?

Dr. Suhaib: Transparency is critical. Patients should be fully informed about how their data will be used, stored, and protected. Consent should be obtained at every stage, with an option to opt out easily.

Bilal: Do you think patients would be open to using such a tool during therapy sessions?

Dr. Suhaib: It depends on how the app is introduced. If positioned as a supportive tool rather than a judgmental or intrusive one, most patients would likely be open to it, especially younger individuals.

Bilal: How should this app integrate into your existing workflow? For instance, should it connect to electronic health records or generate standalone reports?

Dr. Suhaib: Integration with electronic health records would be ideal, but standalone reports could work as long as they're easy to interpret and share with patients or colleagues.

Bilal: What would make the app easy and convenient for you to use during sessions?

Dr. Suhaib: A simple, intuitive interface and minimal setup time. The app should also run seamlessly in the background without disrupting the session.

Section 4: Feedback and Future Vision

Bilal: How frequently would you like updates or improvements to the app based on your feedback?

Dr. Suhaib: Quarterly updates would be reasonable, provided they address genuine needs and don't introduce unnecessary complexity.

Bilal: Would you be open to participating in testing or providing feedback during the development process?

Dr. Suhaib: Absolutely. I'd be happy to help refine the app to ensure it meets the needs of professionals.

Bilal: How do you envision the app evolving to help with other aspects of psychiatric care in the future?

Dr. Suhaib: In the future, it could incorporate voice tone analysis or even integrate wearable devices to track physiological data, creating a more comprehensive picture of the patient's mental state.

Closing

Bilal: Thank you so much, Dr. Suhaib. Your insights have been incredibly valuable and will directly shape how we design this project. Is there anything else you'd like to add or any questions you have for me?

Dr. Suhaib: No additional comments, but I'm excited to see how this project develops. Best of luck, Bilal.

Bilal: Thank you, Dr. Suhaib. I appreciate your time and support.

2. **Surveys**: Distributed questionnaires to potential end users, including doctors and technicians, to gather insights about desired features and usability concerns.
   Our Survey:-
   the results of 15 people for both the **Psychiatric Professionals** and **Patients** surveys. I've summarized the answers for ease of viewing:

1. Survey for Psychiatric Professionals (15 Respondents)

Question	Option	Count (People)
1. How often do you encounter patients who struggle to express their emotions verbally?	Never	0
	Rarely	2
	Sometimes	4
	Often	6
	Always	3
2. How beneficial would real-time emotion detection be during therapy sessions?	Extremely beneficial	12
	Moderately beneficial	2
	Slightly beneficial	1
	Not beneficial at all	0
3. What emotions would you most like to detect using the app?	Happiness	10
	Sadness	12
	Anxiety	13
	Frustration	11
	Anger	9
4. Would you prefer the app to provide a summary of emotional trends over time for each patient?	Yes	13
	No	2
	Maybe	0
5. How important is the app's accuracy in identifying emotions for you to rely on it in clinical practice?	Very important	12
	Moderately important	3
	Slightly important	0

	Not important	0
6. Would you prefer the app to be integrated with electronic health records (EHR)?	Yes	14
	No	1
	I don't have a preference	0
7. What would make the app easy and convenient to use during sessions?	Short setup time	10
	Simple user interface	11
	No interference with the session	13
8. What privacy and consent measures would you expect from the app?	Clear patient consent before use	14
	Full transparency on data usage and storage	12
	Option to opt out at any time	13
9. How comfortable do you think patients would be with using this technology?	Very comfortable	3
	Somewhat comfortable	10
	Not very comfortable	2
	Not comfortable at all	0
10. How often would you be willing to provide feedback for improvements or updates to the app?	Monthly	2
	Quarterly	11
	Annually	1
	As needed	1

2. Survey for Patients (15 Respondents)

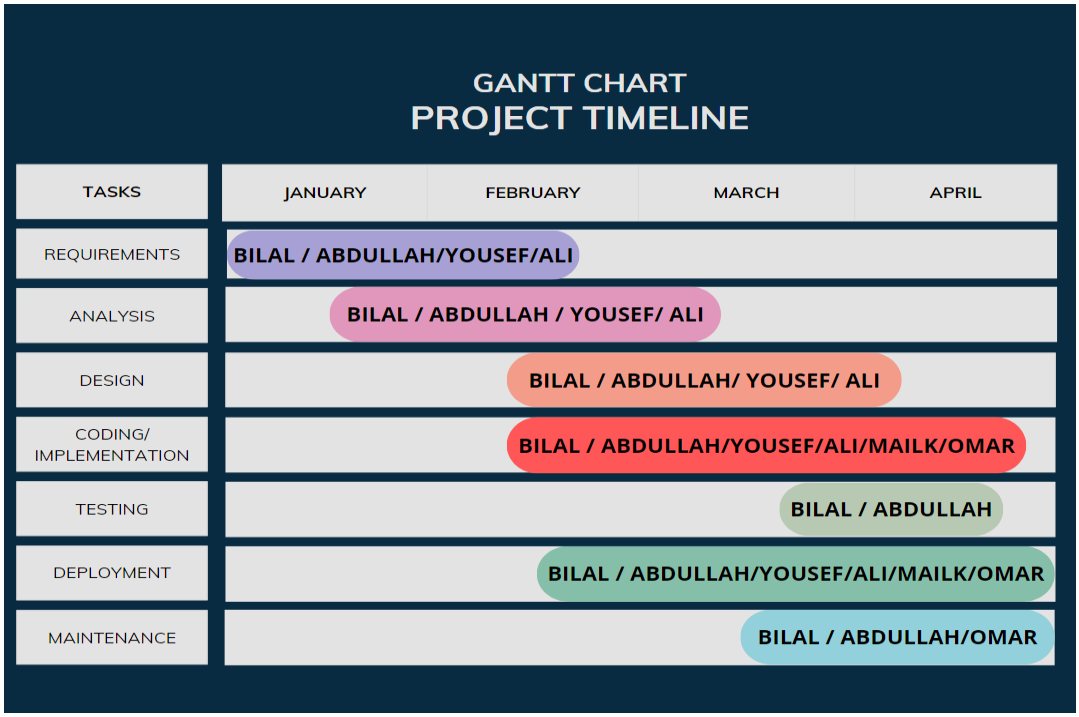
Question	Option	Count (People)
1. How comfortable are you with using technology in your therapy sessions?	Very comfortable	4
	Somewhat comfortable	7
	Neutral	3
	Not very comfortable	1
	Not comfortable at all	0
2. Would you feel comfortable if an app monitored your facial expressions to track emotions during your session?	Yes	6
	No	3
	Maybe	6
3. What emotions would you expect the app to recognize?	Happiness	10
	Sadness	12
	Anxiety	11
	Anger	9
4. How would you feel about having real-time feedback on your emotions during the session?	Very comfortable	2
	Somewhat comfortable	6
	Neutral	5
	Not comfortable at all	2
5. Would you find it helpful if the app showed your emotional trends over time to track your progress?	Yes	13
	No	1
	Maybe	1
6. How important is privacy to you when using an emotion recognition app?	Very important	13
	Moderately important	2
	Slightly important	0
	Not important	0
7. What kind of consent would you like to give before using the app?	Full written consent	9
	Verbal consent	4

	Consent via a quick pop-up before use	2
8. Would you trust the app if it was explained to you clearly how your data would be used and protected?	Yes	13
	No	1
	Maybe	1
9. How would you prefer to provide feedback on the app after using it?	Through the app itself (feedback section)	10
	In follow-up sessions with my therapist	3
	Via email or phone call	2
	Other	0
10. Do you have any concerns or suggestions about using an emotion recognition app in therapy?	Concerns about accuracy and misuse	4
	No concerns	8
	Privacy concerns	2
	Suggestion to include a review feature with the therapist	1

3. **Brainstorming:** Organized team brainstorming sessions to finalize the functional and non-functional requirements of the app and website.
4. **Document Analysis**: Reviewed existing tools and technologies used for emotion and facial recognition to identify best practices and limitations.

3.4 Project plan Gantt chart:

A Gantt chart is a helpful tool in project management. It shows the project schedule, organizes tasks, manages time, and tracks progress. It also helps in solving problems, making decisions, and sharing updates with others, ensuring the project runs smoothly.



3.5 Development Tools:

These Tools helps us to develop, create, design, test, and manage a project. These tools are essential for building, debugging, and maintaining our Application

For Application

1. **Hardware Requirements:**
    - **Computer/Laptop**: Essential for coding, testing, and debugging the application.
    - **Smartphone**: Used to run and test the app in real-world scenarios.
    - **Camera**: Required for capturing facial data, either via a smartphone's built-in camera or an external webcam connected to a computer.
2. **Programming Languages:**
    - **Dart**: The primary language for the app's front-end development, leveraging the Flutter framework to create cross-platform apps.
    - **Python**: Used for backend development and implementing core functionalities like facial recognition and emotion analysis.
3. **Software Requirements:**
    - **Flutter**: A versatile UI toolkit for building natively compiled applications for mobile, web, and desktop. It ensures smooth user interfaces and cross-platform compatibility.
    - **Flask/FastAPI**: Lightweight Python frameworks for building RESTful APIs. FastAPI is particularly suited for its performance and support for asynchronous programming.
    - **Dlib**: A library used for detecting facial landmarks and implementing face recognition.
4. **Optional Frameworks and Libraries:**
    - **TensorFlow/Keras**: Libraries for building, training, and deploying machine learning models used for emotion recognition.
    - **OpenCV**: An open-source library for computer vision, used for preprocessing facial images and performing real-time image operations.
    - **Matplotlib/Seaborn**: Libraries for data visualization, used to generate graphs or charts for emotion analysis results.
    - **Scikit-learn**: A Python library for implementing machine learning algorithms, such as classification and clustering, that enhance emotion analysis.
    - **Pandas**: For data manipulation and analysis, especially useful for managing datasets related to patient records and emotion logs.
    - **NumPy**: Provides support for handling large arrays and matrices, often used in conjunction with other libraries like TensorFlow and OpenCV.
5. **Database:**
    - **Supabase or Firebase**:
        - **Firebase**: A Google-backed platform for real-time database management, offering robust features like authentication and file storage.
        - **Supabase**: An open-source backend alternative with similar functionalities to Firebase, built on PostgreSQL.
6. **Other Tools:**
    - **GitHub**: A collaboration and version control platform that ensures smooth teamwork, tracks progress, and maintains a history of code changes.

Optional Tools:

- **Postman**: For testing and debugging APIs during the development process.
- **Figma**: Used for designing and prototyping the user interface, ensuring a polished and intuitive user experience.
- **Docker**: For containerizing the backend server, ensuring consistent development environments and simplifying deployment.

Chapter 4: Project Design and Specification

4.1 Introduction

This chapter dives into the design and specification of our project. Here, we define exactly what the system is meant to do (functional requirements) and the qualities it needs to have (non-functional requirements). Think of this as the blueprint that guides us through building the system. We'll also break down the structure visually with a class diagram, showing how the different parts of the system connect and interact. This clear, step-by-step approach helps ensure that everything we build aligns with the project's goals.

4.2 System Specification

4.2.1 Functional Requirements:

Authentication and User Management:

- The system shall allow users to register with their email, password, and basic personal information (e.g., name, age, gender).
- The system shall allow users to log in using their registered credentials.
- The system shall allow users to reset their password via email verification.

Facial Recognition and Emotion Analysis:

- The system shall prompt users to capture their facial features through a camera integrated into the application.
- The system shall detect and recognize facial features in real-time.
- The system shall analyze emotions based on facial expressions (e.g., happy, sad, angry, surprised, neutral).
- The system shall provide a confidence score for each detected emotion.

Psychiatric Data Management:

- The system shall allow psychiatrists to view detailed emotion analysis reports for their patients.
- The system shall allow psychiatrists to add diagnostic notes and recommendations based on emotion data.
- The system shall allow psychiatrists to schedule follow-up appointments with patients.

Notifications and Alerts:

- The system shall send real-time notifications to psychiatrists if a patient's emotional state indicates potential distress (e.g., prolonged sadness or anger).
- The system shall notify patients of upcoming appointments, new diagnostic notes, or important updates from their psychiatrist.
- The system shall allow users to customize notification preferences (e.g., email, SMS, in-app notifications).

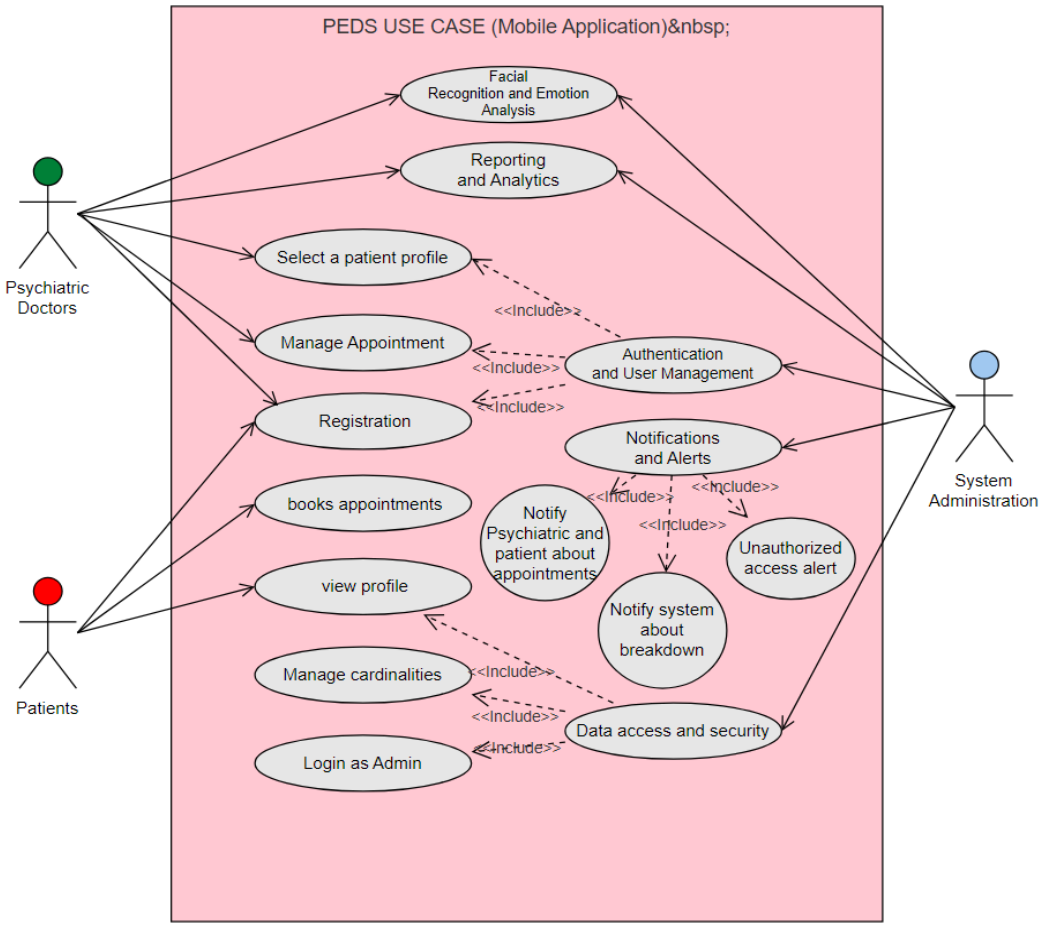
Database Access and Security:

- The system shall allow authorized users (e.g., psychiatrists, admins) to retrieve specific patient information from the database.
- The system shall ensure that only authorized users can access sensitive patient data.

Reporting and Analytics:

- The system shall generate detailed reports for psychiatrists, including emotion trends, diagnostic notes, and patient progress.

- The system shall provide visual analytics (e.g., charts, graphs) to help psychiatrists identify patterns in a patient's emotional state.
- The system shall allow psychiatrists to filter reports by date range, emotion type, or patient.



4.2.2 Non-Functional Requirements:

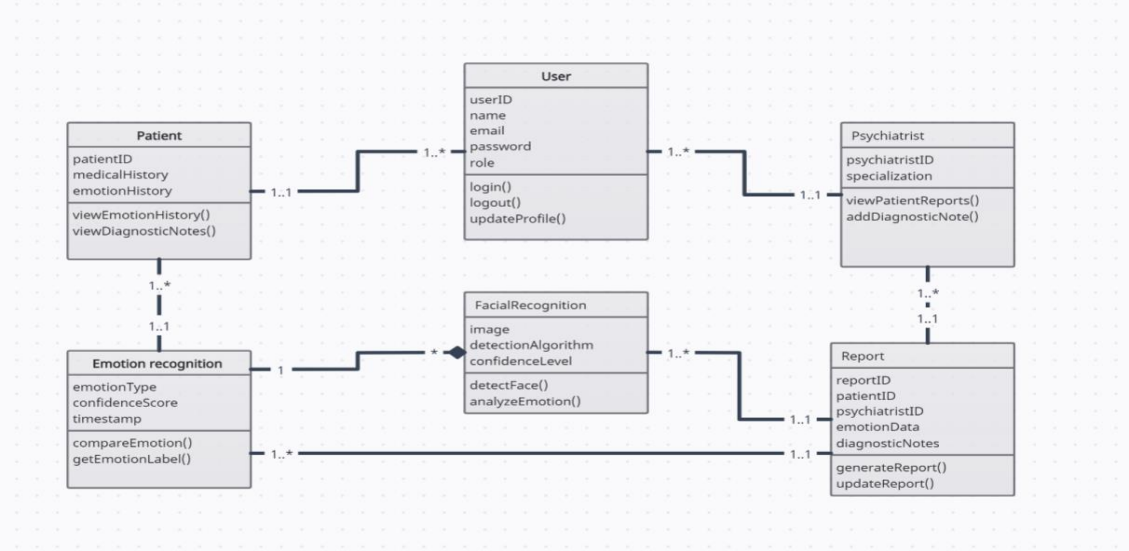
1. **Usability:**
   - **Description:** The system must provide a user-friendly interface that is easy to navigate for both patients and psychiatrists.
   - **Acceptance Criteria:**
     - Users should be able to complete tasks (e.g., capturing facial images, viewing reports) within 3 clicks.
     - The system should provide tooltips and guidance for first-time users.
     - The interface should be accessible to users with disabilities (e.g., support for screen readers).
2. **Reliability:**
   - **Description:** The system must perform consistently and reliably under various conditions.
   - **Acceptance Criteria:**
     - The system should have an uptime of 99.9%.
     - Any critical issues (e.g., facial recognition failure) should be resolved within 24 hours.

Not Primary Under Scope :-

1. **Security:**
   - **Description:** The system must ensure robust data security and protect sensitive user information.
   - **Acceptance Criteria:**
     - All user data must be encrypted both in transit and at rest.
     - The system must comply with data protection regulations (e.g., GDPR, HIPAA).
     - Unauthorized access attempts should be logged and reported to the admin.
2. **Performance:**
   - **Description:** The system must process facial recognition and emotion analysis in real-time with minimal latency.
   - **Acceptance Criteria:**
     - Facial recognition and emotion analysis should be completed within 2 seconds of capturing an image.
     - The system should support up to 10,000 concurrent users without performance degradation.
3. **Scalability:**
   - **Description:** The system must be able to handle an increasing number of users and data without performance degradation.
   - **Acceptance Criteria:**
     - The system should support up to 100,000 users by scaling horizontally (e.g., adding more servers).
     - Database queries should execute within 1 second, even with large datasets.
4. **Compatibility:**
   - **Description:** The system must be compatible with a wide range of devices and browsers.
   - **Acceptance Criteria:**
     - The system should work seamlessly on mobile devices (iOS and Android) and desktop browsers (Chrome, Firefox, Safari).
     - The system should support responsive design for optimal viewing on different screen sizes.
5. **Maintainability:**
   - **Description:** The system must be easy to maintain and update over time.
   - **Acceptance Criteria:**
     - The codebase should follow best practices (e.g., modular design, proper documentation).
     - The system should support automated testing and continuous integration/continuous deployment (CI/CD).
6. **Availability:**
   - **Description:** The system must be available to users at all times, with minimal downtime.
   - **Acceptance Criteria:**
     - The system should have a disaster recovery plan in place to ensure data is not lost in case of failure.
     - Scheduled maintenance should not exceed 1 hour per month.
7. **Data Privacy:**
   - **Description:** The system must ensure the privacy of user data at all times.
   - **Acceptance Criteria:**
     - Users must be able to request the deletion of their data at any time.
     - The system must provide clear privacy policies and obtain user consent for data collection.
8. **Interoperability:**
   - **Description:** The system must be able to integrate with other healthcare systems and third-party applications.
   - **Acceptance Criteria:**
     - The system should support standard data exchange formats (e.g., HL7, FHIR).
     - Integration with wearable devices and external APIs should be smooth

4.3 Class Diagram

To help explain how the system is built, we've created a class diagram.



This diagram helps us visualize how the system works and ensures every part is connected and ready for development.

1. User

- **Purpose:** Acts as the base class for all users in the system.
- **Attributes:**
  - userID: String (Unique identifier for the user).
  - name: String (Full name of the user).
  - email: String (Email address for login and communication).
  - password: String (Encrypted password for authentication).
  - role: String (Role of the user: Patient, Psychiatrist, or Admin).
- **Methods:**
  - login(email, password): Boolean (Authenticates the user).
  - logout(): void (Logs the user out of the system).
  - updateProfile(name, email): void (Updates user profile information).
- **Responsibilities:**
  - Manages user authentication and profile updates.
  - Serves as the parent class for Patient and Psychiatrist.

2. Patient

- **Purpose:** Represents a patient in the system who uses the emotion and facial recognition features.
- **Attributes:**
  - patientID: String (Unique identifier for the patient).
  - medicalHistory: String (Historical medical data of the patient).
  - emotionHistory: List<Emotion> (List of emotion records for the patient).
- **Methods:**
  - viewEmotionHistory(): List<Emotion> (Retrieves the patient's emotion history).
  - viewDiagnosticNotes(): List<DiagnosticNote> (Retrieves diagnostic notes from the psychiatrist).
  - exportData(format): void (Exports emotion history and notes in a specified format, e.g., PDF).
- **Responsibilities:**

- Inherits from the User class.
- Manages patient-specific data, including emotion history and diagnostic notes.
- Allows patients to view and export their data.

3. Psychiatrist
- **Purpose:** Represents a psychiatrist who analyzes patient data and provides diagnostic notes.
- **Attributes:**
  - psychiatristID: String (Unique identifier for the psychiatrist).
  - specialization: String (Area of expertise, e.g., depression, anxiety).
- **Methods:**
  - viewPatientReports(patientID): List<Report> (Retrieves emotion reports for a specific patient).
  - addDiagnosticNote(patientID, note): void (Adds a diagnostic note for a patient).
  - scheduleAppointment(patientID, date): void (Schedules follow-up appointments).
  - generateTrendAnalysis(patientID): void (Generates a trend analysis report for a patient).
- **Responsibilities:**
  - Inherits from the User class.
  - Manages patient reports, diagnostic notes, and appointment scheduling.
  - Provides insights into patient progress through trend analysis.

4. FacialRecognition
- **Purpose:** Handles facial recognition and emotion analysis.
- **Attributes:**
  - image: Image (Captured facial image for analysis).
  - detectionAlgorithm: String (Algorithm used for facial recognition).
  - confidenceLevel: Float (Confidence score for emotion detection).
- **Methods:**
  - detectFace(image): Boolean (Detects facial features in the image).
  - analyzeEmotion(image): Emotion (Analyzes emotions from the facial image).
  - updateFacialData(userID, image): void (Updates facial data for improved recognition).
- **Responsibilities:**
  - Captures and processes facial images.
  - Analyzes emotions and stores results in the Emotion class.
  - Improves recognition accuracy by updating facial data.

5. Emotion
- **Purpose:** Represents the result of emotion analysis.
- **Attributes:**
  - emotionID: String (Unique identifier for the emotion record).
  - emotionType: String (Type of emotion detected: happy, sad, angry, etc.).
  - confidenceScore: Float (Confidence level of the detected emotion).
  - timestamp: Date (Time when the emotion was recorded).

- **Methods:**
  - compareEmotion(otherEmotion): Boolean (Compares two emotion records).
  - getEmotionLabel(): String (Returns the label of the detected emotion).
- **Responsibilities:**
  - Stores emotion data for historical tracking and reporting.
  - Provides methods for comparing and labeling emotions.

6. Report
- **Purpose:** Manages patient reports generated by psychiatrists.
- **Attributes:**
  - reportID: String (Unique identifier for the report).
  - patientID: String (ID of the patient associated with the report).
  - psychiatristID: String (ID of the psychiatrist who generated the report).
  - emotionData: List<Emotion> (List of emotion records included in the report).
  - diagnosticNotes: String (Notes added by the psychiatrist).
- **Methods:**
  - generateReport(patientID, psychiatristID): Report (Generates a report for a patient).
  - updateReport(reportID, notes): void (Updates diagnostic notes in the report).
- **Responsibilities:**
  - Aggregates emotion data and diagnostic notes for a specific patient.
  - Provides a summary of emotional trends for psychiatrists.

7. DiagnosticNote
- **Purpose:** Stores diagnostic notes added by psychiatrists.
- **Attributes:**
  - noteID: String (Unique identifier for the note).
  - patientID: String (ID of the patient associated with the note).
  - psychiatristID: String (ID of the psychiatrist who added the note).
  - noteText: String (Content of the diagnostic note).
  - date: Date (Date when the note was added).
- **Methods:**
  - addNote(patientID, psychiatristID, noteText): void (Adds a new diagnostic note).
  - updateNote(noteID, noteText): void (Updates an existing note).
- **Responsibilities:**
  - Manages diagnostic notes for patients.
  - Provides insights into patient progress and treatment plans.

8. Notification
- **Purpose:** Manages real-time notifications for users.
- **Attributes:**
  - notificationID: String (Unique identifier for the notification).
  - userID: String (ID of the user receiving the notification).
  - message: String (Content of the notification).
  - timestamp: Date (Time when the notification was sent).

- **Methods:**
    - sendNotification(userID, message): void (Sends a notification to the user).
    - viewNotifications(userID): List<Notification> (Retrieves all notifications for a user).
- **Responsibilities:**
    - Sends alerts and reminders to users (e.g., appointment reminders, distress alerts).
    - Tracks and displays notifications for each user.

Relationships Between Classes:

1. **User** is the parent class for **Patient** and **Psychiatrist**.
2. **Patient** has a one-to-many relationship with **Emotion** (a patient can have multiple emotion records).
3. **Psychiatrist** has a one-to-many relationship with **Report** (a psychiatrist can generate multiple reports).
4. **FacialRecognition** is responsible for detecting and analyzing emotions, and it has a composition relationship with **Emotion**.
5. **Report** aggregates **Emotion** and **DiagnosticNote** data for a specific patient.
6. **Notification** is associated with **User** to send alerts and reminders.

Date:18/01/2025

Supervisor Signature: