

Mind Sculptor

An Obsessive-Compulsive
Disorder(OCD) Exposure and Response
Prevention(ERP) Therapy Tool

24-25J-046



Our Team



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Research Problem

- ❖ How can AI and voice analysis improve the identification of OCD presence, subtypes and severity levels?
- ❖ In what ways can biometric data and machine learning algorithms be used to create tailored ERP therapy plans for individual patients?
- ❖ How can AI-supported Interactive Voice Assistant(IVA) increase patient engagement and accessibility to ERP therapy, particularly for those with logistical or psychological barriers?



Research Objectives

Main Objective

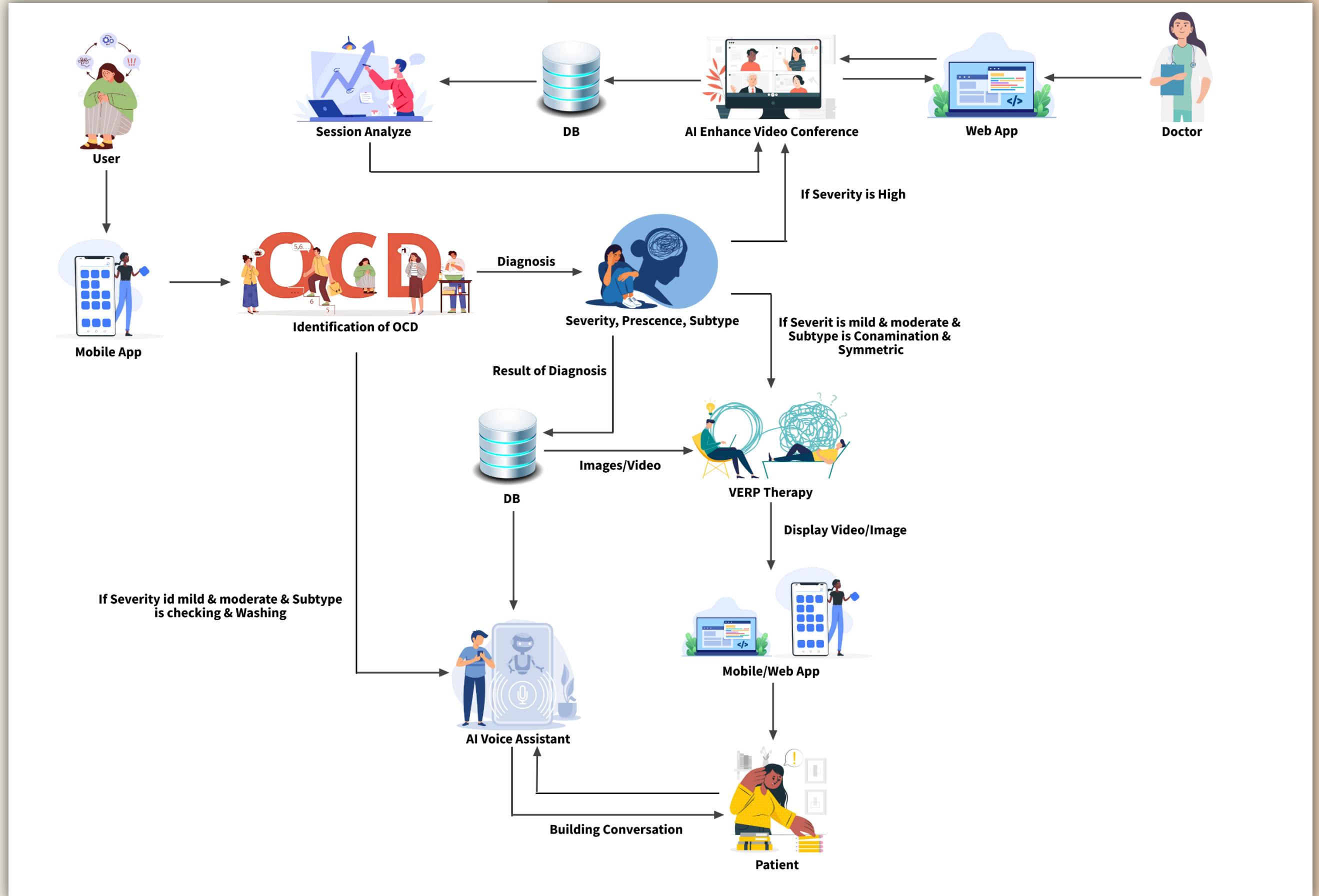
- ❖ Develop an Exposure and Response Prevention(ERP) Therapy tool for patients suffering from OCD.



Sub Objectives

- ❖ To enhance the diagnosis and understanding of OCD subtypes
- ❖ To develop personalized and adaptive ERP therapy plans
- ❖ To create AI-supported Interactive Voice Assistant(IVA)
- ❖ To enable remote and real-time monitoring of therapy sessions

System Diagram



Identify the presence, severity, and sub types of OCD in patients



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Specialization: Software Engineering

Introduction

Background on OCD

- ❖ Obsessive-Compulsive Disorder (OCD) is a mental health condition characterized by unwanted and intrusive thoughts (obsessions) and repetitive behaviors (compulsions).
- ❖ It affects individuals' daily functioning and quality of life.

Importance of the Study

- ❖ Identifying the presence, severity, and sub-types of OCD can lead to better diagnosis, treatment, and understanding of the disorder.
- ❖ Accurate assessment helps in providing tailored interventions and improving patient outcomes.



Research Gap

Feature	Proposed System	GGOC: OCD Relief [1]	nOCD [2]	TalkSpace [3]	OCD Challenge
Dynamic Questionnaires	✓	✗	✓	✗	✓
Explain OCD Episodes as Voice	✓	✗	✗	✗	✗
Keyword Detection in Voice	✓	✗	✗	✗	✗
Voice Pitch Fluctuation Analysis	✓	✗	✗	✗	✗
Accurate Diagnosis	✓	✗	✗	✗	✗
Data Privacy	✓	✓	✓	✓	✓

Research Questions

Primary Questions

- ❖ How can the presence of OCD be accurately identified in patients using modern technological methods?
- ❖ What are the most effective techniques to determine the severity of OCD symptoms?
- ❖ How can different sub-types of OCD be classified and differentiated in patients?

Secondary Questions

- ❖ Can voice recordings and speech analysis provide additional insights into OCD symptoms?
- ❖ What algorithms and techniques are most suitable for these assessments?



Objectives

Main Objective

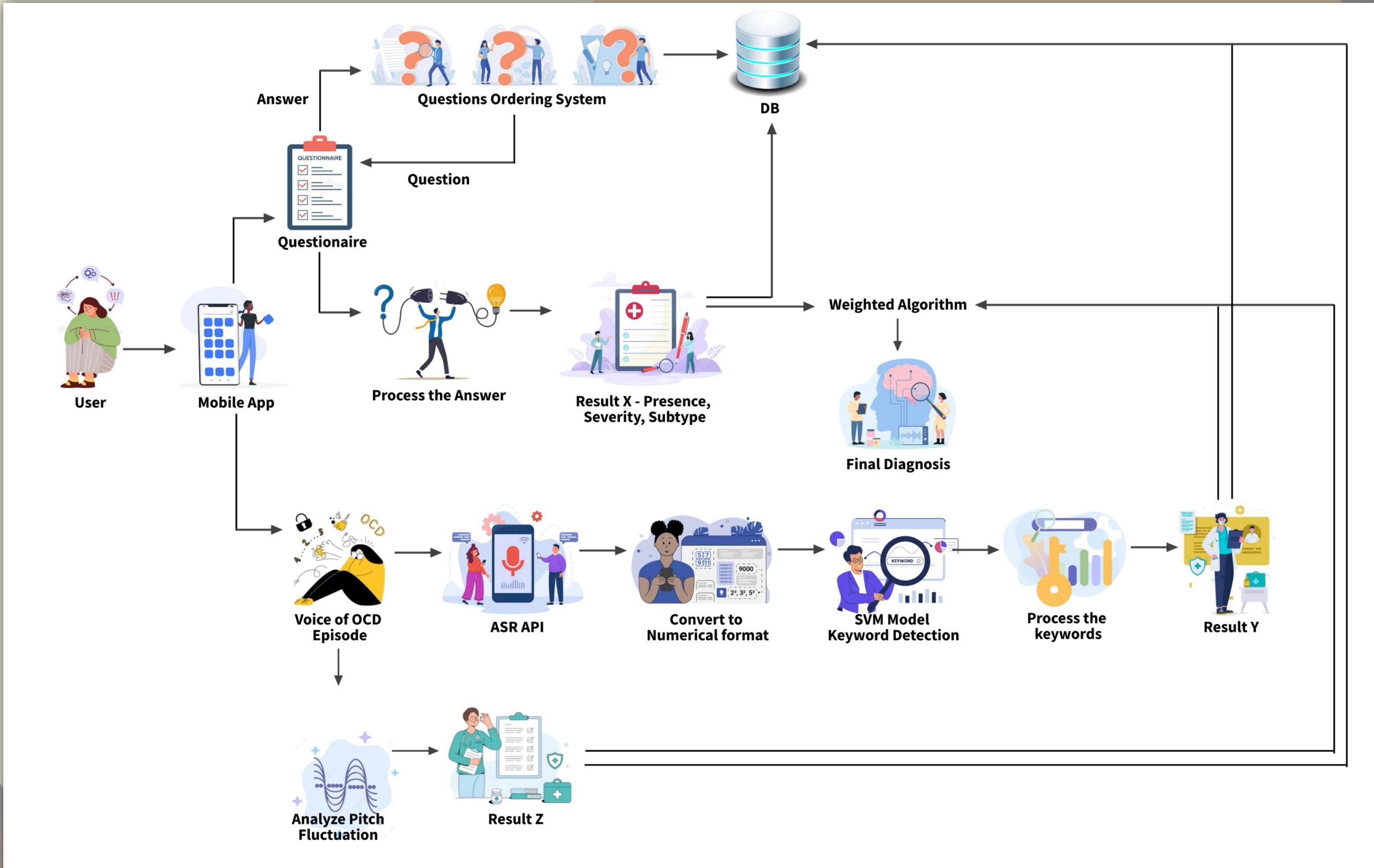
- ❖ Develop a comprehensive assessment method for identifying the presence, severity, and sub-types of OCD in patients.



Sub Objectives

- ❖ **Questionnaire-Based Assessment:** Implement a dynamic questionnaire to provide a preliminary diagnosis based on user responses.
- ❖ **Keyword Detection from Voice Recordings:** Use ASR APIs and algorithms like TF-IDF and SVM to detect keywords from voice recordings for diagnosis.
- ❖ **Voice Pitch Fluctuation Analysis:** Analyze voice pitch fluctuations to assess emotional state and severity of OCD.
- ❖ **Final Diagnosis:** Combine results from all sub-components to produce a comprehensive OCD diagnosis.

Methodology - System Diagram



Novelty Features

❑ Keyword Detection from Voice Recordings

- **Technology Used:** Automatic Speech Recognition (ASR) APIs (e.g., Google Cloud Speech-to-Text).
- **Algorithms Employed:** Term Frequency-Inverse Document Frequency (TF-IDF) and Support Vector Machine (SVM).
- **Purpose:** Detect relevant keywords from patient voice recordings describing OCD episodes.
- **Benefits:**
 - ✓ Provides an additional layer of diagnostic information.
 - ✓ Enhances the results obtained from traditional questionnaires.
 - ✓ Offers a more comprehensive evaluation of OCD symptoms.

❑ Voice Pitch Fluctuation Analysis

- **Technology Used:** Librosa library for audio analysis.
- **Purpose:** Analyze the fluctuations in voice pitch to assess the emotional state of patients when describing OCD episodes.
- **Benefits:**
 - ✓ Provides insights into the patient's emotional and psychological state.
 - ✓ Helps in assessing the severity of OCD more accurately.

Methodology – Technologies, Techniques, Algorithms

Techniques

Technologies

- Expo
- React Native
- Python
- Flask
- MongoDB/Mysql
- Vscode
- Google Colab
- Librosa
- NLTK
- Scikit-learn
- TextBlob

- Speech recognition
- Keyword detection
- Machine learning
- Data augmentation
- TF-IDF

Algorithms

- Support Vector Machine algorithm
- Decision Tree algorithm
- Weighted scoring algorithm

Methodology – System, Personal, and Software Specification Requirement

Functional Requirements

- Develop a dynamic 20-question questionnaire with algorithmic question ordering to assess OCD presence, severity, and subtype.
- Capture and convert patient voice recordings to text using ASR API, and identify keywords using TF-IDF and SVM algorithms to enhance questionnaire results.
- Analyze pitch fluctuations using Librosa to derive insights into the patient's emotional state and behavior.
- Integrate results from questionnaire, keyword detection, and pitch analysis using ensemble learning for a final diagnosis or severity level.

Non-Functional Requirements

- Ensure efficient processing of questionnaire responses and voice data with minimal latency.
- Design an intuitive, user-friendly mobile application interface accessible to users with varying technical expertise.
- Support multiple users and large datasets, scaling to accommodate growth.
- Implement strong encryption for data security, ensuring compliance with GDPR, HIPAA, and other regulations to protect patient confidentiality and handle sensitive information securely.

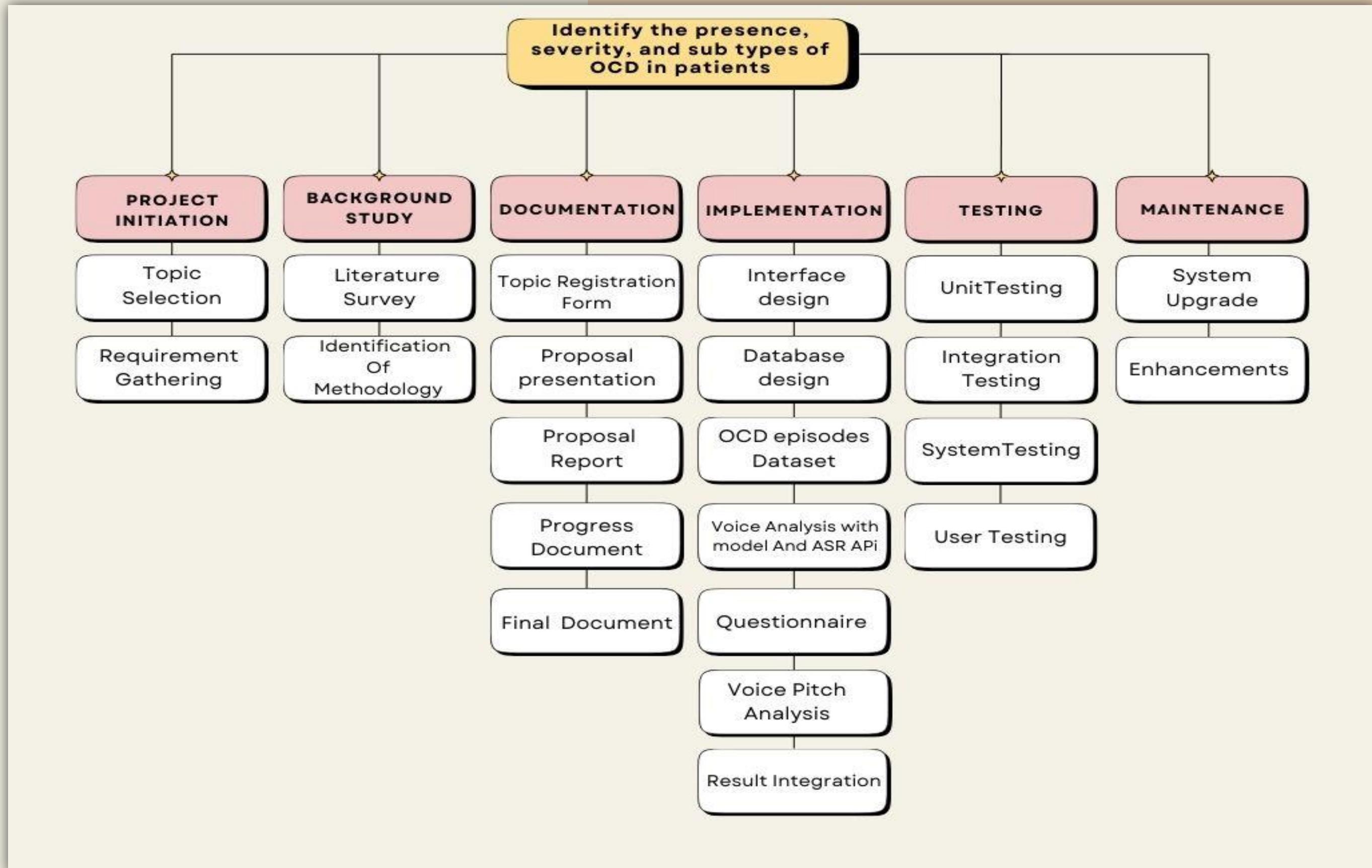
Software requirements

- Python
- Flask
- React Native
- Librosa
- ASR APIs
- Google Colab
- NLTK, scikit-learn, Gensim, TextBlob

Personal requirements

- Dr. Roshan Fernando: Psychiatrist guiding the overall research project, providing insights into OCD diagnosis and treatment methodologies.
- Ms. Sandaru Fernando: Psychologist assisting in the development of the dataset and providing expertise in psychological assessment.

Work Breakdown Structure



Project Timeline Gantt Chart



References

- [1] B. Pascual-Vera, M. Roncero, G. Doron, and A. Belloch, “Assisting relapse prevention in OCD using a novel mobile app–based intervention: A case report,” *Bulletin of the Menninger Clinic*, vol. 82, no. 4, pp. 390–406, Dec. 2018, doi: <https://doi.org/10.1521/bumc.2018.82.4.390>.
- [2] M. Gershkovich et al., “Integrating exposure and response Prevention with a mobile app to treat Obsessive-Compulsive Disorder: Feasibility, Acceptability, and preliminary Effects,” *Behavior Therapy*, vol. 52, no. 2, pp. 394–405, Mar. 2021, doi: [10.1016/j.beth.2020.05.001](https://doi.org/10.1016/j.beth.2020.05.001).
- [3] T. D. Hull and K. Mahan, “A Study of Asynchronous Mobile-Enabled SMS Text Psychotherapy,” *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*, vol. 23, no. 3, pp. 240–247, 2017, doi: <https://doi.org/10.1089/tmj.2016.0114>.
- [4] E. McIngvale, C. Bakos-Block, J. Hart, and P. S. Bordnick, “Technology and Obsessive Compulsive Disorder: An Interactive Self-Help Website for OCD,” *Journal of Technology in Human Services*, vol. 30, no. 2, pp. 128–136, Apr. 2012, doi: <https://doi.org/10.1080/15228835.2012.699368>.

Enhanced Exposure and Response Prevention Therapy



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Introduction

Background

- ❖ Exposure and Response Prevention(ERP) therapy is commonly used treatment by psychiatrists for patients diagnosed with Obsessive-Compulsive Disorder(OCD).
- ❖ Exposure and Response Prevention(ERP) therapy, have proven effective in reducing symptoms and improving outcomes for OCD patients.
- ❖ Enhanced Exposure and Response Prevention(VERP) is an innovative approach to treating OCD patients.
- ❖ VERP uses advanced technology to simulate OCD-inducing scenarios and integrates biometric data to enhance the effectiveness of traditional exposure therapy.
- ❖ VERP can be used to treat patients with symmetric OCD, contamination OCD, sexual orientation OCD.



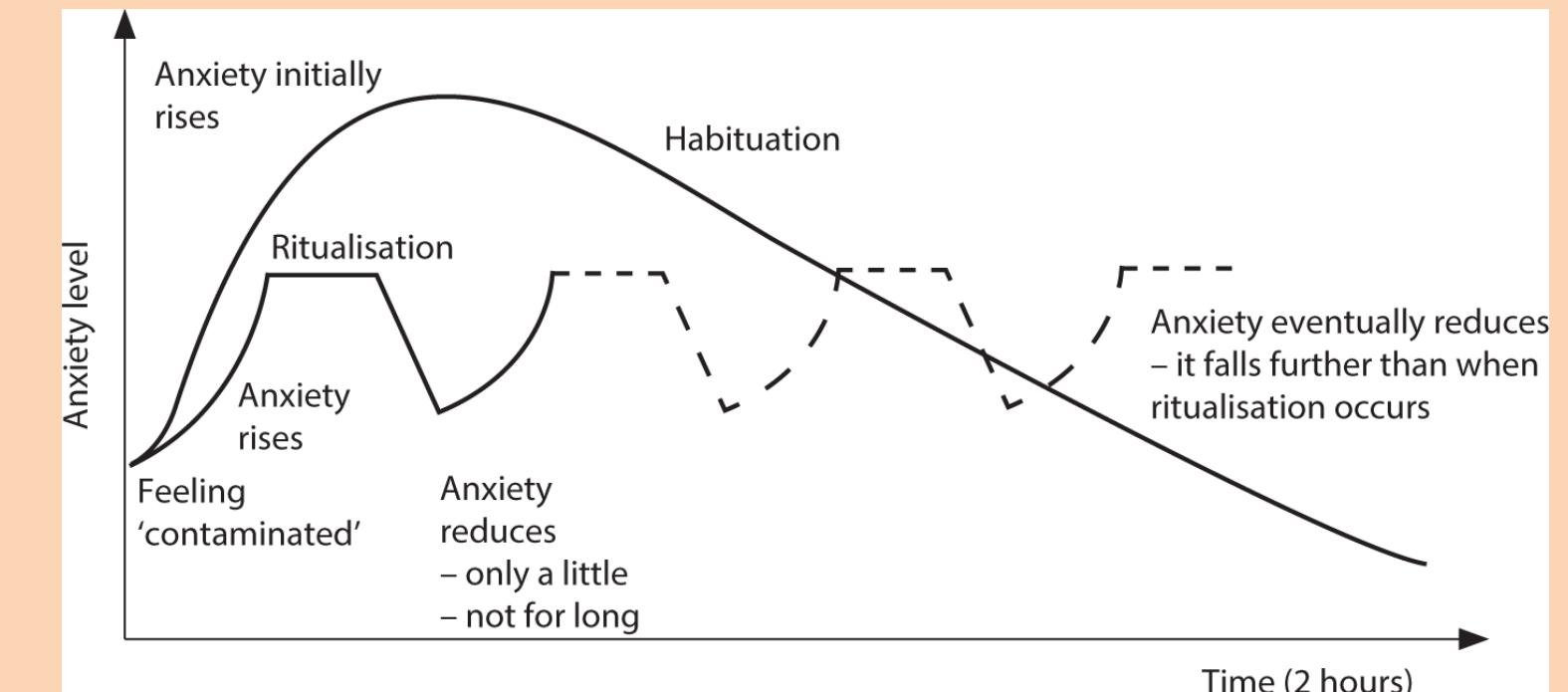
Introduction

Importance of the Study

- ❖ First, the patient is exposed to an OCD-inducing scenario using images/videos.
- ❖ Then the anxiety graph is generated using patient self-reported data and bio metric data.
- ❖ Patients can seek the therapy on their own without consulting a doctor and reduce the symptoms of the OCD.
- ❖ Patients can monitor the effectiveness of treatment by analyzing anxiety charts.



Contamination OCD



Anxiety graph

Research Gap

Feature	Proposed System	GGOC: OCD Relief [1]	NOCD [2]	TalkSpace [3]	OCD Challenge [4]
Expose the user to OCD-triggering situations.	✓	✗	✓	✗	✓
Capture stress/anxiety level using facial expressions	✓	✗	✗	✗	✗
Generate anxiety graph after VERP therapy	✓	✗	✗	✗	✗
Treatment efficacy analysis	✓	✓	✗	✓	✗

Research Questions

- ❖ How can we virtually expose patients to OCD inducing scenarios?
- ❖ How can response prevention therapy be implemented using modern technology?
- ❖ How can the accuracy of response prevention therapy be increased using modern technology?



Objectives

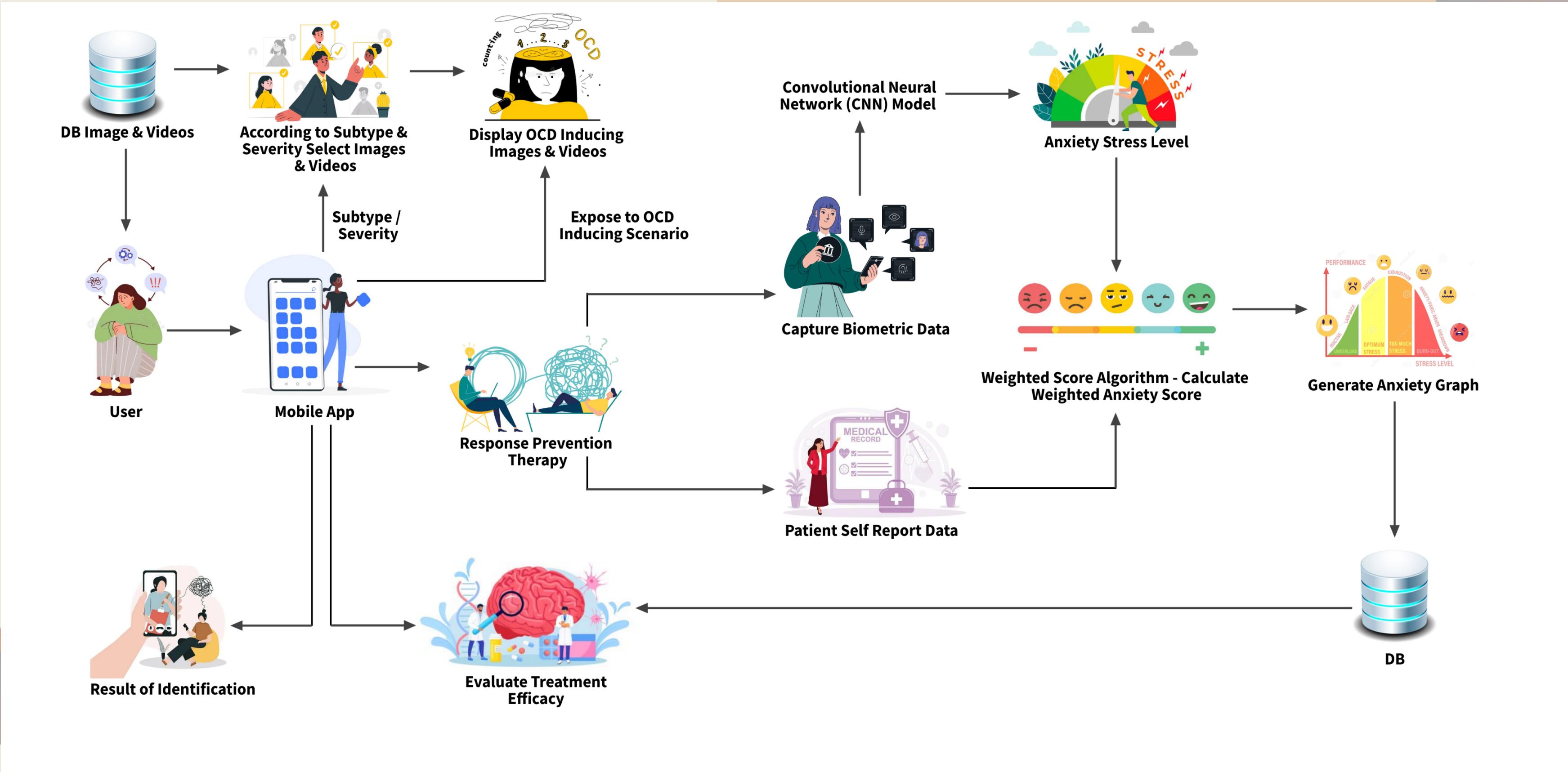
Main Objective

To develop a therapy system that utilizes virtual simulations and biometric data to effectively treat Obsessive-Compulsive Disorder (OCD).

Sub Objectives

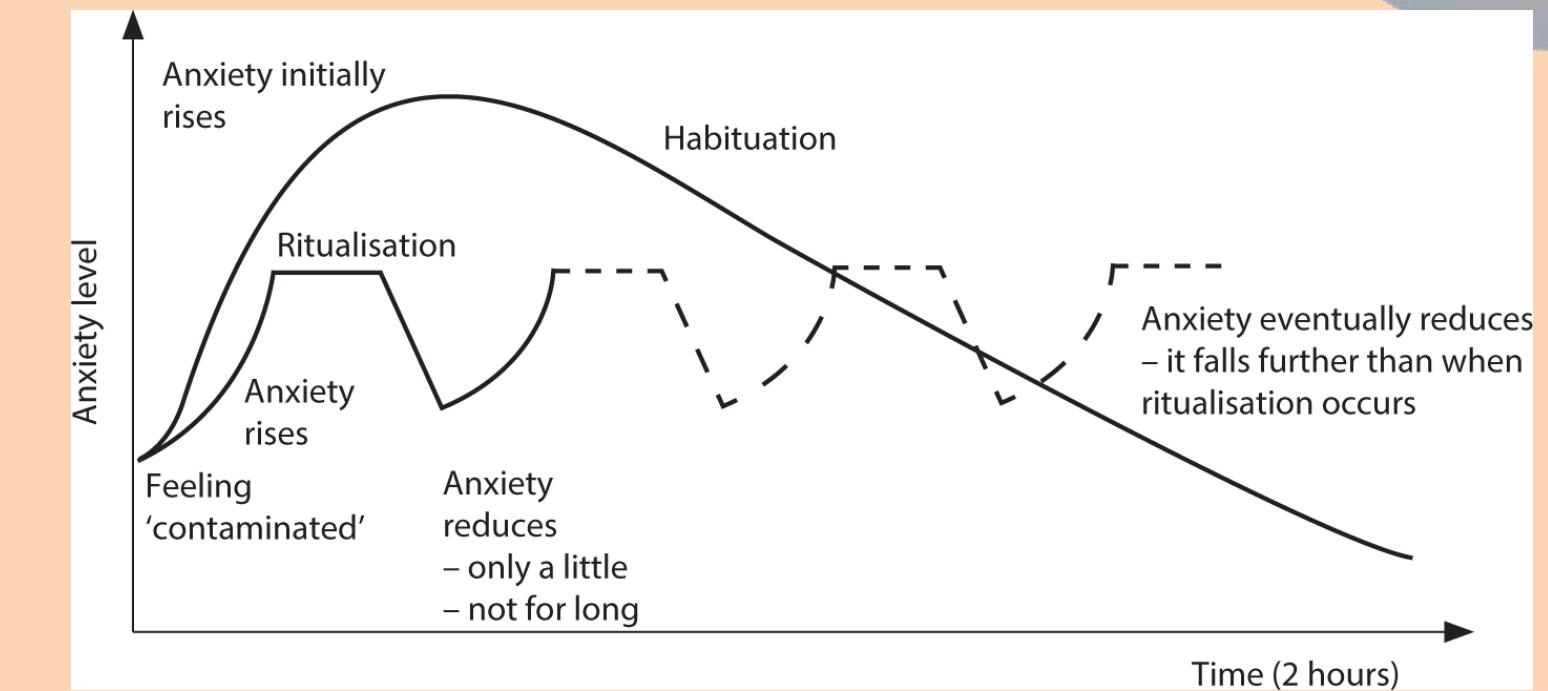
1. Simulate real-life scenarios using tailored videos and images to expose the patient to OCD triggering scenario.
2. Capture biometric data and patient self-reported data during therapy session.
3. Generate the anxiety graph using captured biometric data and self-reported data.
4. Analyze anxiety graphs to predict the patient's treatment efficacy.

Methodology - System Diagram



Novelty Feature

- ❖ Integrate biometric data with patient self-reported data to draw the anxiety graph more accurately.



Methodology – Technologies, Techniques, Algorithms

Techniques

Technologies

- React
- Expo
- React Native
- TensorFlow
- Python Flask
- NodeJs
- MongoDB/Mysql
- Vscode

- Facial recognition
- Emotion detection
- Machine learning
- Deep learning
- Graph visualization.

Algorithms

- Convolutional Neural Network (CNN)
 - Decision Tree algorithm
 - Weighted scoring algorithm
- CNN architectures
- VGG-Face
 - Google Facenet
 - OpenFace
 - ResNet

Methodology – System, Personal, and Software Specification Requirement

Functional Requirements

- Display appropriate image/video based on the OCD sub type and severity of the patient.
- Capture accurate anxiety/stress level using emotion detection during the therapy.
- Capture the patient self-reported data.
- Calculate the weighted anxiety score accurately using facial expression data and user input data.
- Generate the anxiety graph using the weighted anxiety score.
- Analyze anxiety graphs of the patient.

Non-Functional Requirements

- The application should be reliable and efficient.
- Interfaces should be user-friendly.
- The application should be compatible with different devices.
- Patient data must be secure.
- The results of VERP therapy must be accurate.

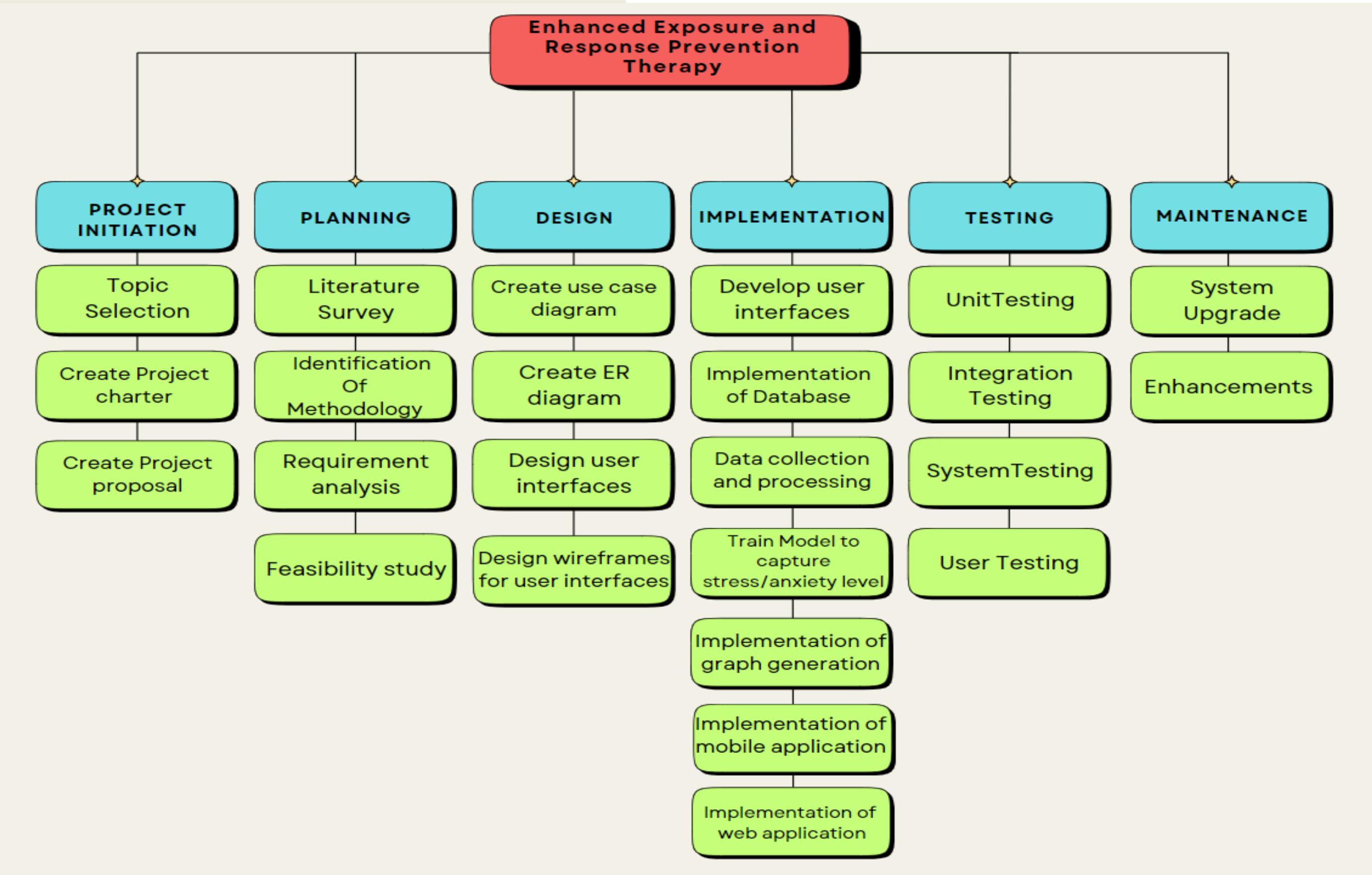
Software requirements

- Python
- Node
- React
- Vscode
- MongoDB/Mysql

Personal requirements

- Guidance of external supervisors to acquire knowledge of healthcare domain.
- Data set to train the CNN model.

Work Breakdown Structure



Completion of the project

Project Timeline Gantt Chart



References

- [1] B. Pascual-Vera, M. Roncero, G. Doron, and A. Belloch, "Assisting relapse prevention in OCD using a novel mobile app-based intervention: A case report," *Bulletin of the Menninger Clinic*, vol. 82, no. 4, pp. 390–406, Dec. 2018, doi: <https://doi.org/10.1521/bumc.2018.82.4.390>.
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- [3] T. D. Hull and K. Mahan, "A Study of Asynchronous Mobile-Enabled SMS Text Psychotherapy," *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*, vol. 23, no. 3, pp. 240–247, 2017, doi: <https://doi.org/10.1089/tmj.2016.0114>.
- [4] E. McIngvale, C. Bakos-Block, J. Hart, and P. S. Bordnick, "Technology and Obsessive Compulsive Disorder: An Interactive Self-Help Website for OCD," *Journal of Technology in Human Services*, vol. 30, no. 2, pp. 128–136, Apr. 2012, doi: <https://doi.org/10.1080/15228835.2012.699368>.

AI Supported Interactive Voice Assistant



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Specialization: Software Engineering

Novelty

- ❖ Combine conversational AI with real-time analysis of voice pitch fluctuations to deliver highly personalized interventions.



Introduction

Stigma in Society

- Mental health disorders are often stigmatized, leading to fear of judgment or discrimination.
- This stigma prevents many from openly discussing their struggles or seeking help, worsening their condition over time.

Reluctance to Seek Help

- Concerns about being labeled or misunderstood result in a hesitation to pursue traditional therapy.
- Cultural pressures and misconceptions around mental health reinforce the idea that seeking help is a sign of weakness.

Geographical Barriers

- Access to mental health services is severely limited in rural and remote areas, where traveling to see a therapist can be impractical or impossible.
- These geographical challenges create a significant gap in mental health care for those living in underserved regions.



Research Gap

Feature	Proposed System	Woebot [1]	Wysa [2]	Replika [3]	Youper[4]
Dynamic Questionnaires	✓	✗	✓	✗	✓
Context-aware Responses	✓	✓	✓	✓	✗
ERP Therapy Integration	✓	✗	✗	✗	✗
Patient Progress Tracking	✓	✗	✗	✗	✓
Personalized Therapy Sessions	✓	✗	✓	✓	✓
Data Privacy	✓	✓	✓	✓	✓

Research Questions

How can AI supported Interactive Voice Assistant enhance accessibility and personalization of ERP therapy for OCD patients?



Objectives

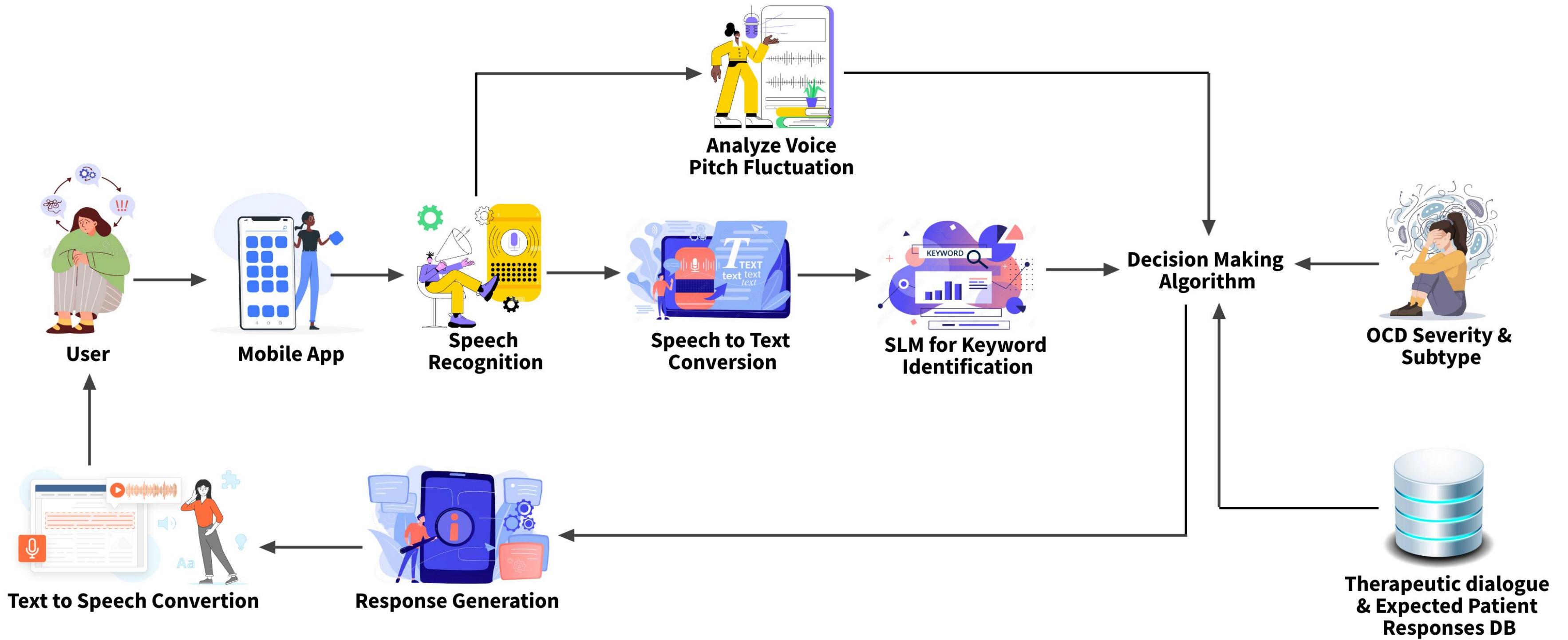
Main Objective

- ❖ Implementation of an AI-Supported Interactive Voice Assistant for ERP Therapy in OCD

Sub Objectives

- ❖ Conduct ERP Therapy Sessions for OCD Subtypes.
- ❖ Generate Appropriate Therapeutic Responses
 - Utilize patient input to dynamically generate and provide personalized therapeutic responses during the therapy session.
- ❖ Analyze Voice Pitch Fluctuations
 - Implement voice analysis algorithms to monitor pitch fluctuations, providing real-time assessment of the patient's emotional state during therapy.
- ❖ Evaluate Patient Progress and Emotional Response

Methodology – System Diagram



Methodology – Technologies, Techniques, Algorithms

Technologies

- Expo
- React Native
- Flask
- NodeJs
- MongoDB/Mysql
- Python
- Vscode
- Google Colab
- Librosa
- Praat
- TensorFlow

Techniques

- Speech recognition
- Voice Pitch analysis
- Keyword detection
- Machine learning
- Data augmentation

Algorithms

- Logistic Regression algorithm
- Decision Tree algorithm
- Matching algorithm

Methodology – System, Personal, and Software Specification Requirement

Functional Requirements

- Use 'pyaudio' to capture audio input from patients for real-time analysis and conversational AI Integration.
- Train a supervised learning model to identify OCD-related keywords from transcribed text.
- Utilize the Logistic Regression algorithm for precise keyword identification.
- Analyze pitch fluctuations to assess emotional state and behavioral insights during therapy sessions.
- Create a comprehensive database of therapist dialogues and anticipated patient responses.
- Design and implement a matching algorithm to pair identified keywords and emotional states with suitable therapeutic responses

Non-Functional Requirements

- Ensure seamless processing of audio data and keyword identification with minimal latency.
- Implement a robust and user-friendly interface that allows easy interaction between the IVA and patients.
- Ensure scalability to support a growing number of users and expanding datasets
- Provide strong data encryption and compliance with GDPR, HIPAA, and other regulations for handling sensitive patient information.

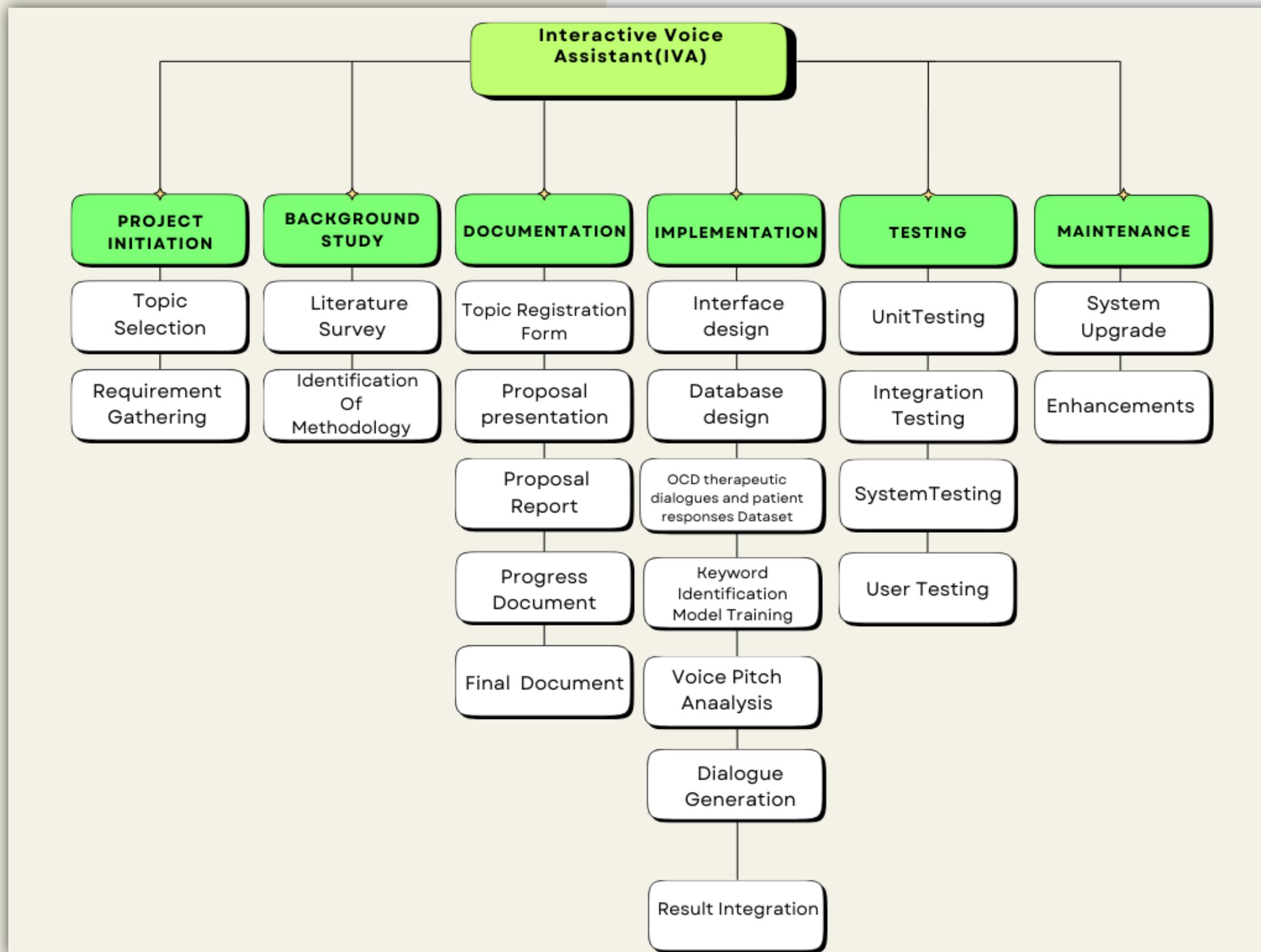
Software requirements

- Python
- Flask
- React Native
- Librosa
- Praat
- Google Colab
- NLTK, scikit-learn, Gensim, TextBlob

Personal requirements

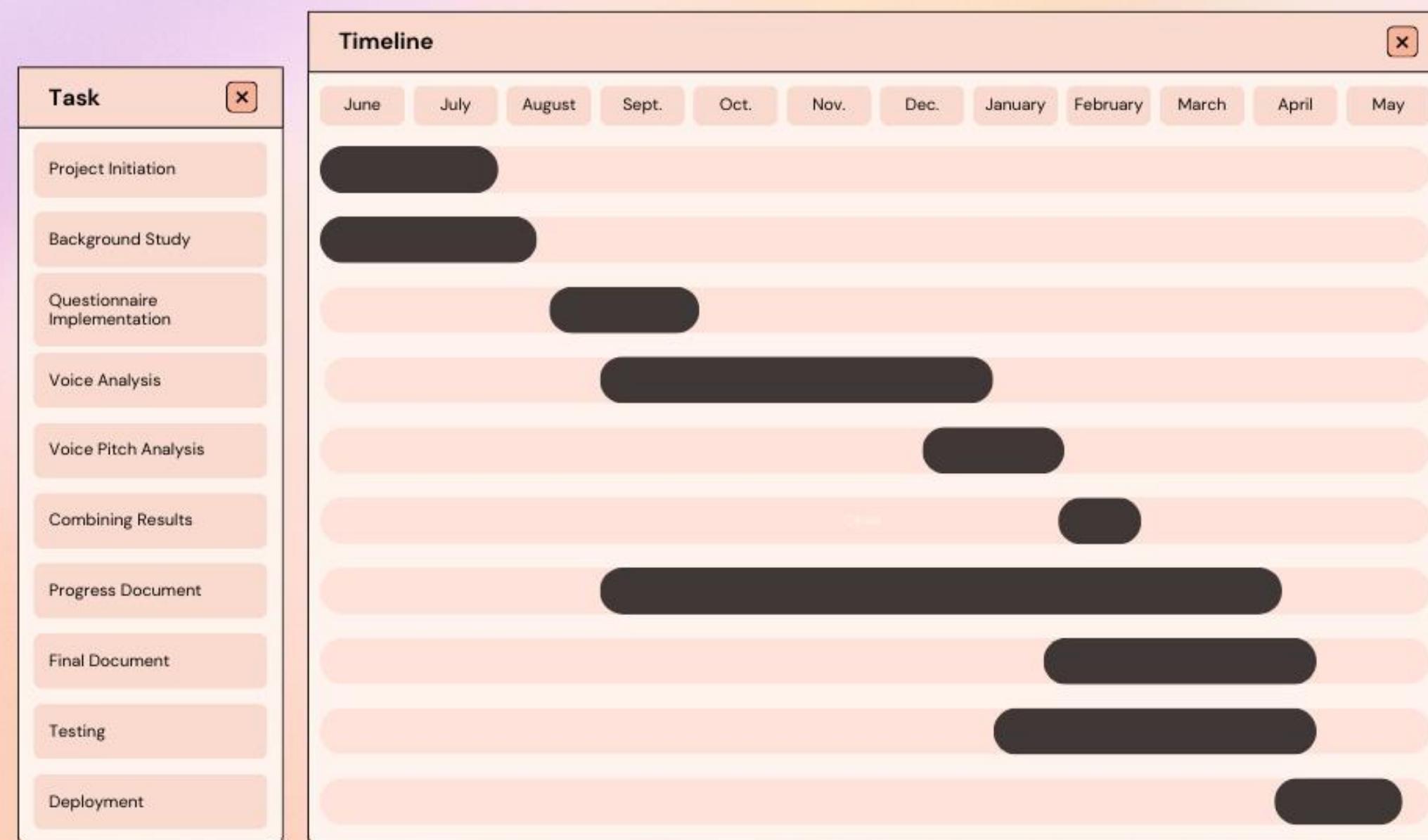
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- Ms. Sandaru Fernando: Psychologist assisting in the development of the dataset and providing expertise in psychological assessment.

Work Breakdown Structure



Completion of the project

Project Timeline Gantt Chart



References

- [1] Woebot: A mental health chatbot that offers support for anxiety and depression but lacks specialized OCD treatment and ERP integration. [Online]. Available: <https://woebohealth.com>. [Accessed: Jan. 20, 2024].
- [2] Wysa: An AI-powered mental health app with conversational capabilities, focusing on generalized anxiety and mood management but not tailored for OCD or ERP. [Online]. Available: <https://wysa.io>. [Accessed: Jan. 20, 2024].
- [3] Replika: A chatbot designed for companionship and support, offering personalized conversations but not specialized for therapeutic interventions like ERP. [Online]. Available: <https://replika.ai>. [Accessed: Jan. 20, 2024].
- [4] Youper: An AI-powered emotional health assistant that tracks mood and offers CBT-based exercises but does not specifically focus on ERP for OCD. [Online]. Available: <https://www.youper.ai>. [Accessed: Jan. 20, 2024].

AI-Enhanced Video Conferencing ERP Therapy



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Specialization: Software Engineering

Introduction

Background on OCD

- ❖ Traditional ERP therapy for OCD needs a lot of time and specialized care, making it hard for many people to access.
- ❖ Stigma around mental health makes people hesitant to seek help, which worsens their symptoms.

Importance of the Study

- ❖ AI-enhanced video conferencing can make ERP therapy more accessible and offer personalized, real-time care.
- ❖ Using biometric analysis, this method can better monitor anxiety and stress levels, improving treatment results.



Research Gap

Feature	Proposed System	Zoom for Healthcare [1]	Doxy.me [2]	Talkspace [3]	Lark Health[4]
Real-time Video Conferencing	✓	✓	✓	✓	✓
AI-based Biometric Analysis	✓	✗	✗	✗	✓
Emotion Detection	✓	✗	✗	✗	✗
Session Analytics	✓	✗	✗	✗	✗
Predictive Analytics	✓	✗	✗	✗	✗
Focus on Mental Health	✓	✓	✓	✓	✓

Research Questions

Primary Questions

- ❖ How does AI video therapy help OCD patients access treatment better than in-person therapy?
- ❖ How effective is AI video therapy in reducing OCD symptoms?
- ❖ How do patients feel about using AI video therapy? Is it easy and acceptable?

Secondary Questions

- ❖ How does biometric analysis help track and improve outcomes in AI video therapy?
- ❖ What are the cost differences between AI video therapy and traditional methods for patients and providers?



Objectives

Main Objective

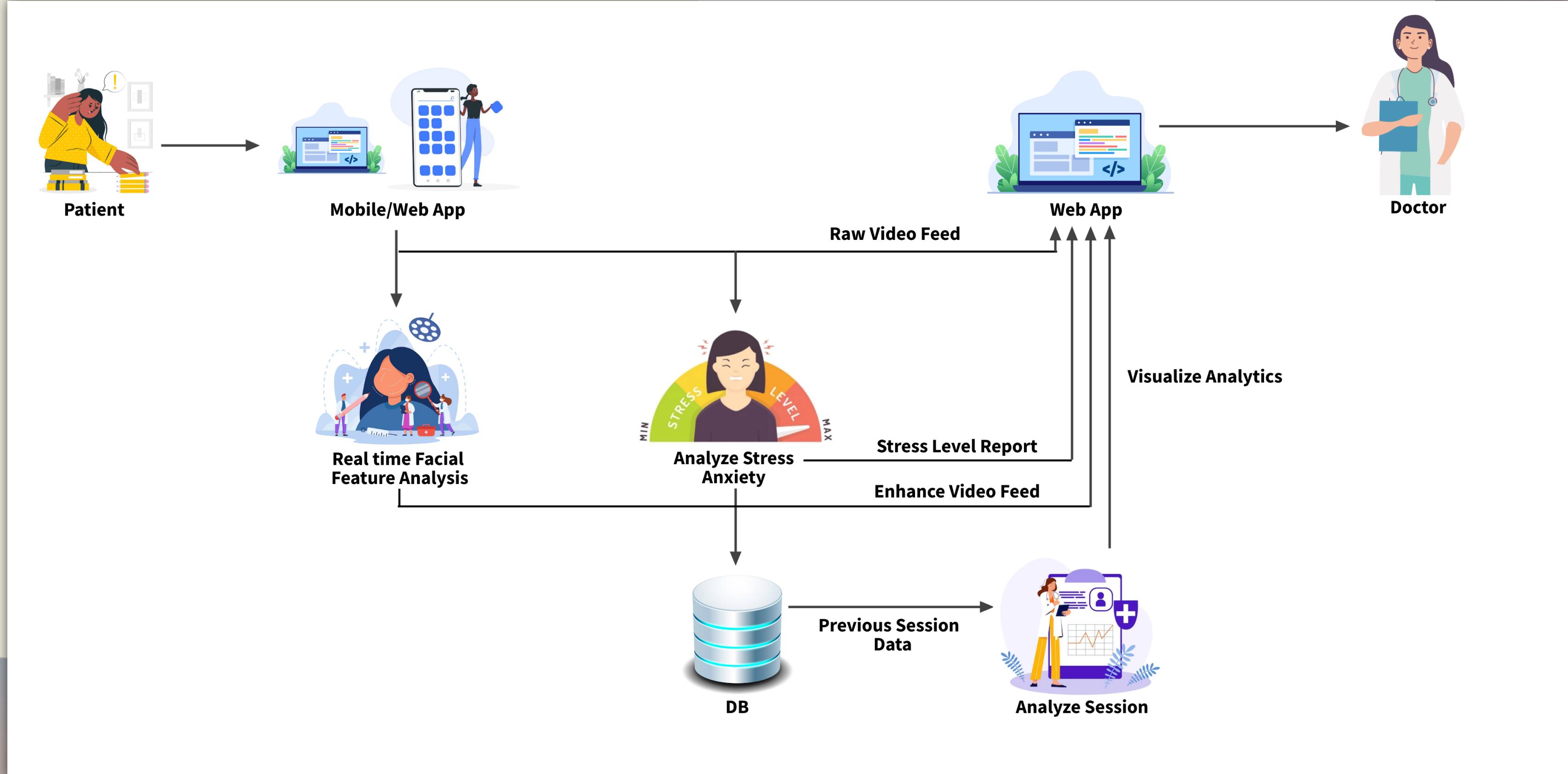
- ❖ Develop an AI-Enhanced Video Conferencing ERP Therapy tool to facilitate more accessible, personalized, and effective OCD treatment.



Sub Objectives

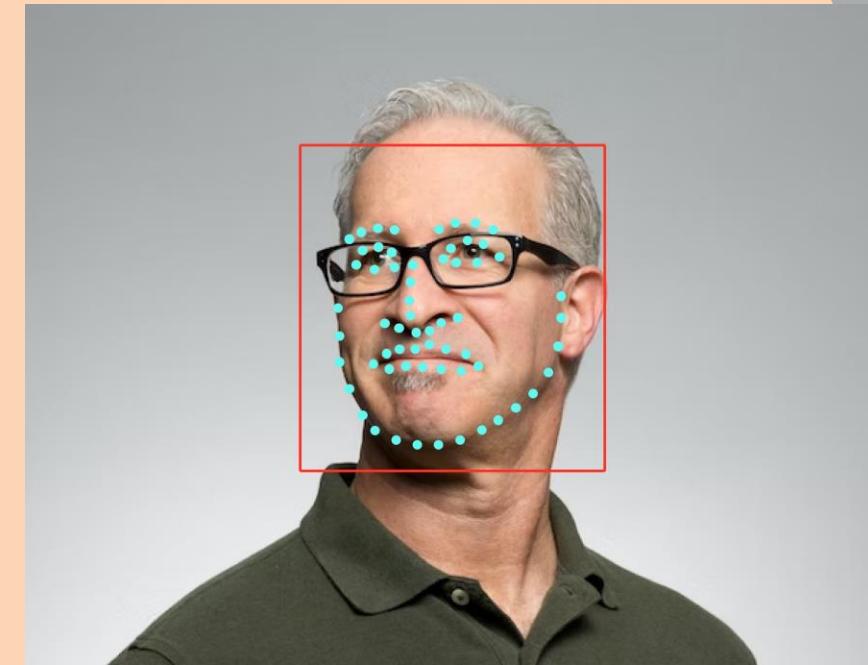
- ❖ **Real-time Biometric Detection:** Implement AI models to capture and analyze facial features for anxiety and stress detection during therapy.
- ❖ **Seamless Video Conferencing:** Develop a platform for uninterrupted audio-video communication between patients and therapists.
- ❖ **Session Analytics:** Provide detailed session metrics and predictive analytics to monitor patient progress.
- ❖ **Enhanced Feedback:** Display critical facial expressions alongside live video for accurate therapist assessment.

Methodology - System Diagram

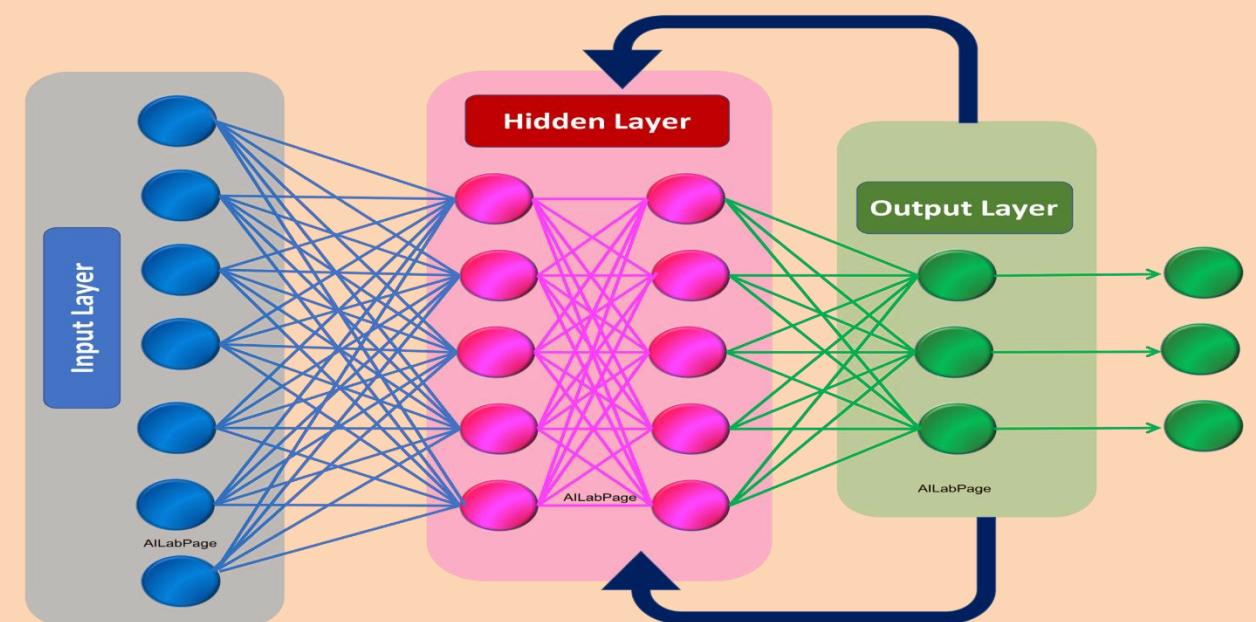


Novelty Feature

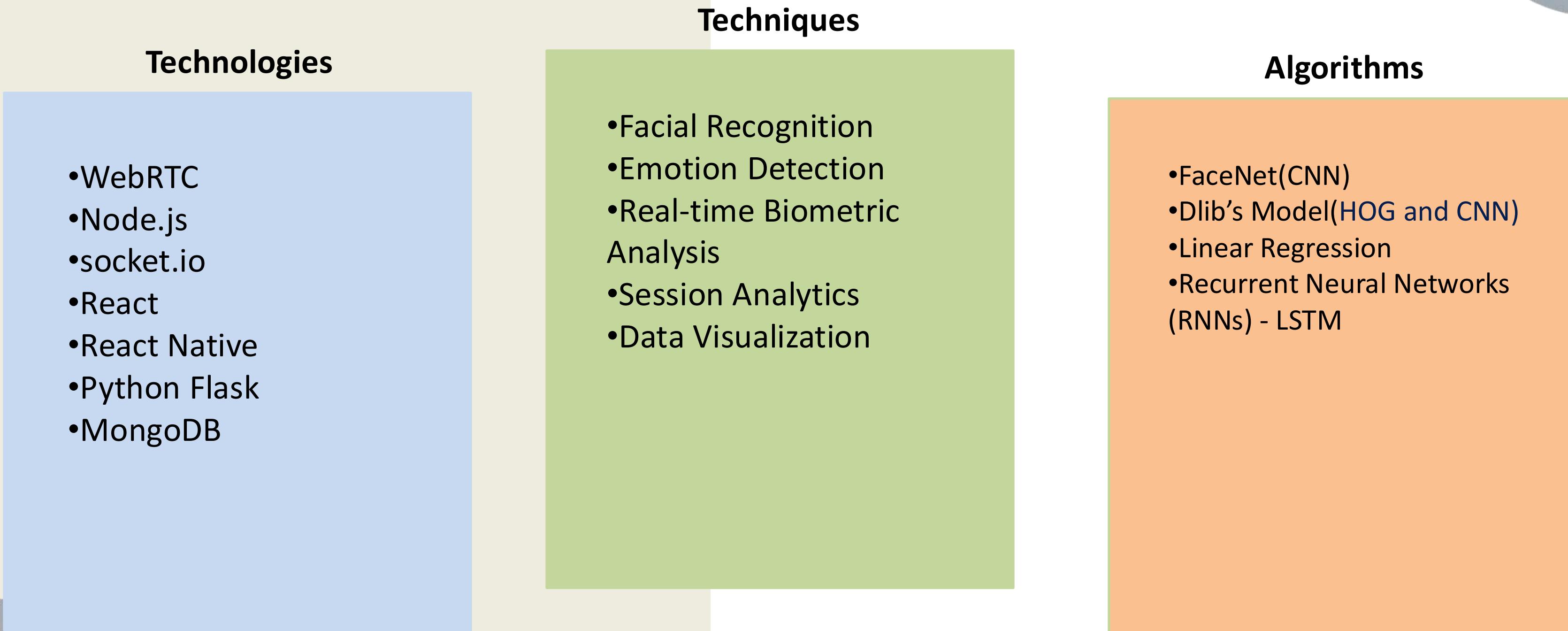
- ❖ Highlight critical biometric facial features on the doctor's screen and stress and anxiety levels to assess the patient's emotional state accurately and efficiently.
- ❖ Predict patient improvement based on previous session analytics and estimate the number of sessions required for the patient to become normal



Recurrent Neural Networks



Methodology – Technologies, Techniques, Algorithms



Methodology – Software, Personal, and Software Specification Requirement

Functional Requirements

- Real-time biometric analysis results should be displayed accurately to the therapist.
- Seamless audio-video communication should be maintained throughout therapy sessions.
- Session analytics should provide detailed and accurate metrics.
- Critical facial expressions and emotional states should be highlighted accurately for therapist monitoring.

Non-Functional Requirements

- Interfaces should be user-friendly and intuitive.
- The platform should be compatible with different mobile devices.
- The application should be reliable and maintain high availability.
- Results should have high accuracy in biometric analysis and emotion detection.
- The platform should be efficient in processing and displaying real-time data.

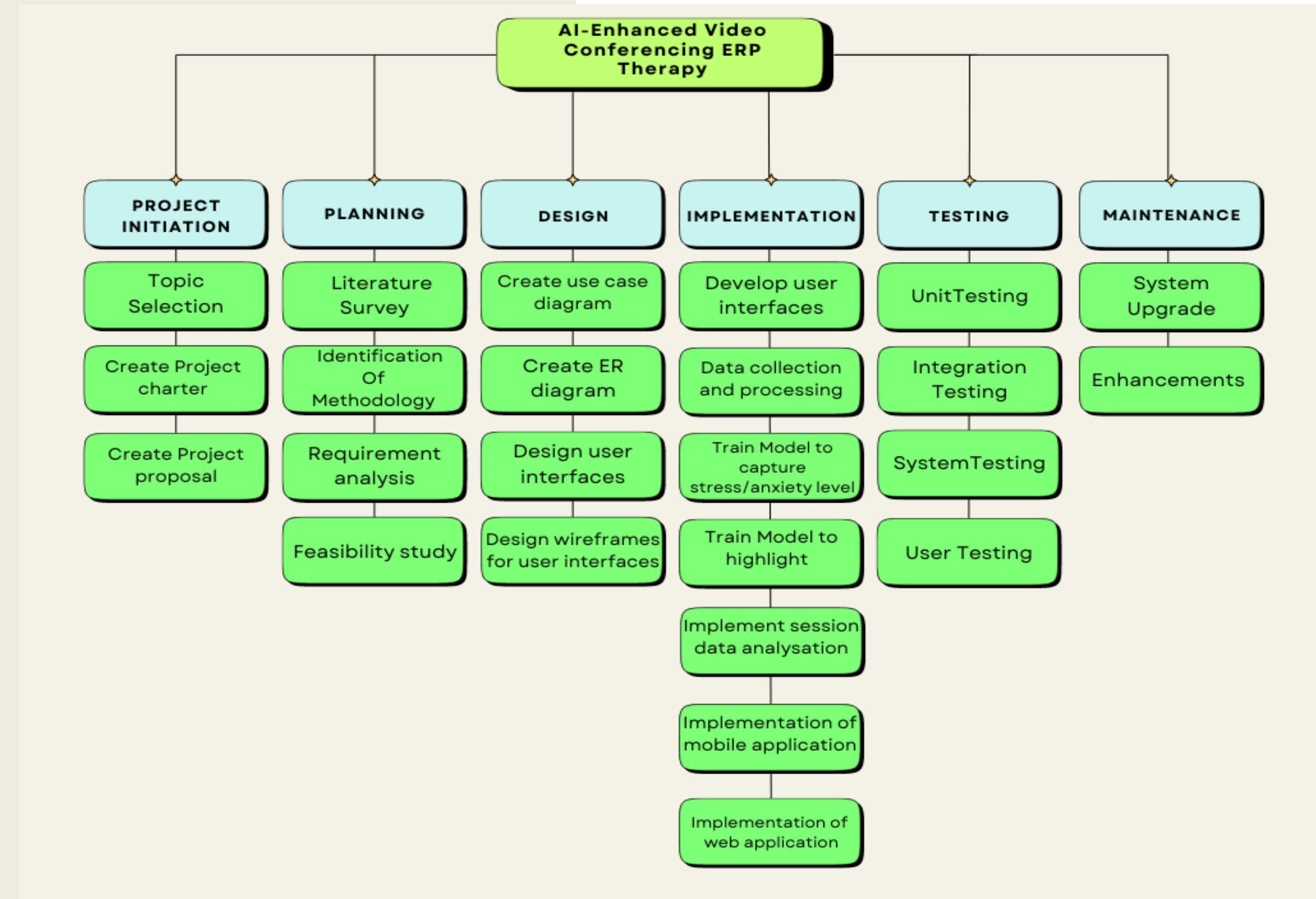
Software requirements

- WebRTC
- Node.js
- React Native
- Python Flask
- MongoDB
- TensorFlow
- OpenCV

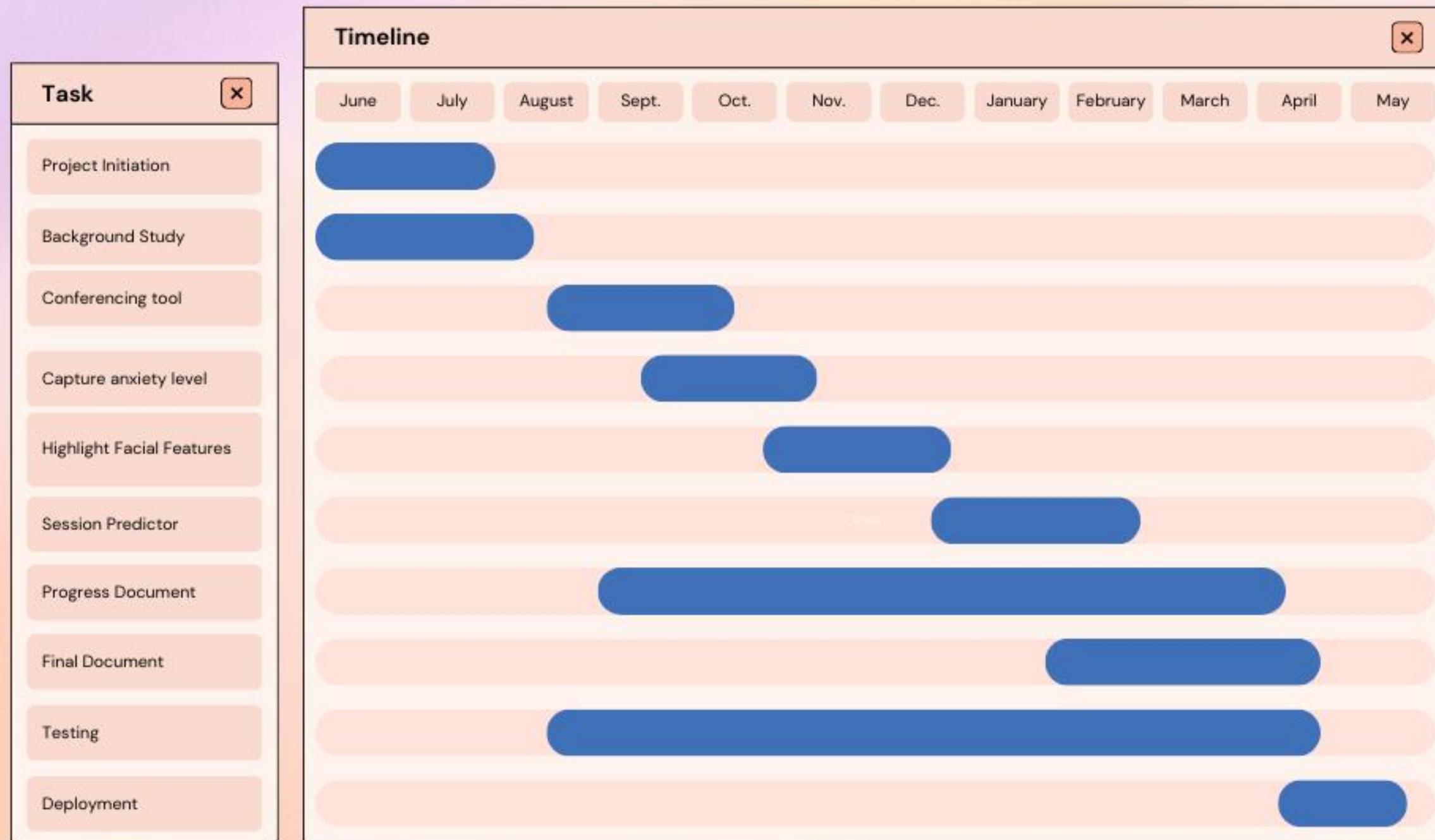
Personal requirements

- Dr. Roshan Fernando: Psychiatrist guiding the overall research project, providing insights into OCD diagnosis and treatment methodologies.
- Ms. Sandaru Fernando: Psychologist assisting in the development of the dataset and providing expertise in psychological assessment.

Work Breakdown Structure



Project Timeline Gantt Chart



References

- [1] S. Domb, E. Manly, and D. Elman, “Pandemic patch-up: Using Zoom™ videoconferencing software to create a virtual teaching clinic,” *Canadian Family Physician*, vol. 67, no. 1, pp. 65–68, Jan. 2021, doi: <https://doi.org/10.46747/cfp.670165>.
- [2] T. Newlin, T. McCall, P. Ottmar, B. Welch, and S. Khairat, “Assessing the Satisfaction of Citizens Using Teleconsent in Clinical Research,” *iospress.nl*, pp. 685–689, 2018, doi: <https://doi.org/10.3233/978-1-61499-852-5-685>.
- [3] D. Darnell, M. D. Pullmann, T. D. Hull, S. Chen, and P. Areán, “Predictors of Disengagement and Symptom Improvement Among Adults With Depression Enrolled in Talkspace, a Technology-Mediated Psychotherapy Platform: Naturalistic Observational Study,” *JMIR Formative Research*, vol. 6, no. 6, p. e36521, Jun. 2022, doi: <https://doi.org/10.2196/36521>.
- [4] K. G. Lockwood *et al.*, “Evaluating a New Digital App-Based Program for Heart Health: Feasibility and Acceptability Pilot Study,” *JMIR Formative Research*, vol. 8, pp. e50446–e50446, May 2024, doi: <https://doi.org/10.2196/50446>.

Supportive Information Commerlization

Target Audience

1) Individuals with OCD

- ❖ Demographics: Adults and adolescents diagnosed with OCD.
- ❖ Needs: Access to effective therapy, personalized treatment plans, and flexible therapy options.
- ❖ Pain Points: Stigma, geographical barriers, cost, and infrequent therapist availability.

2) Mental Health Professionals

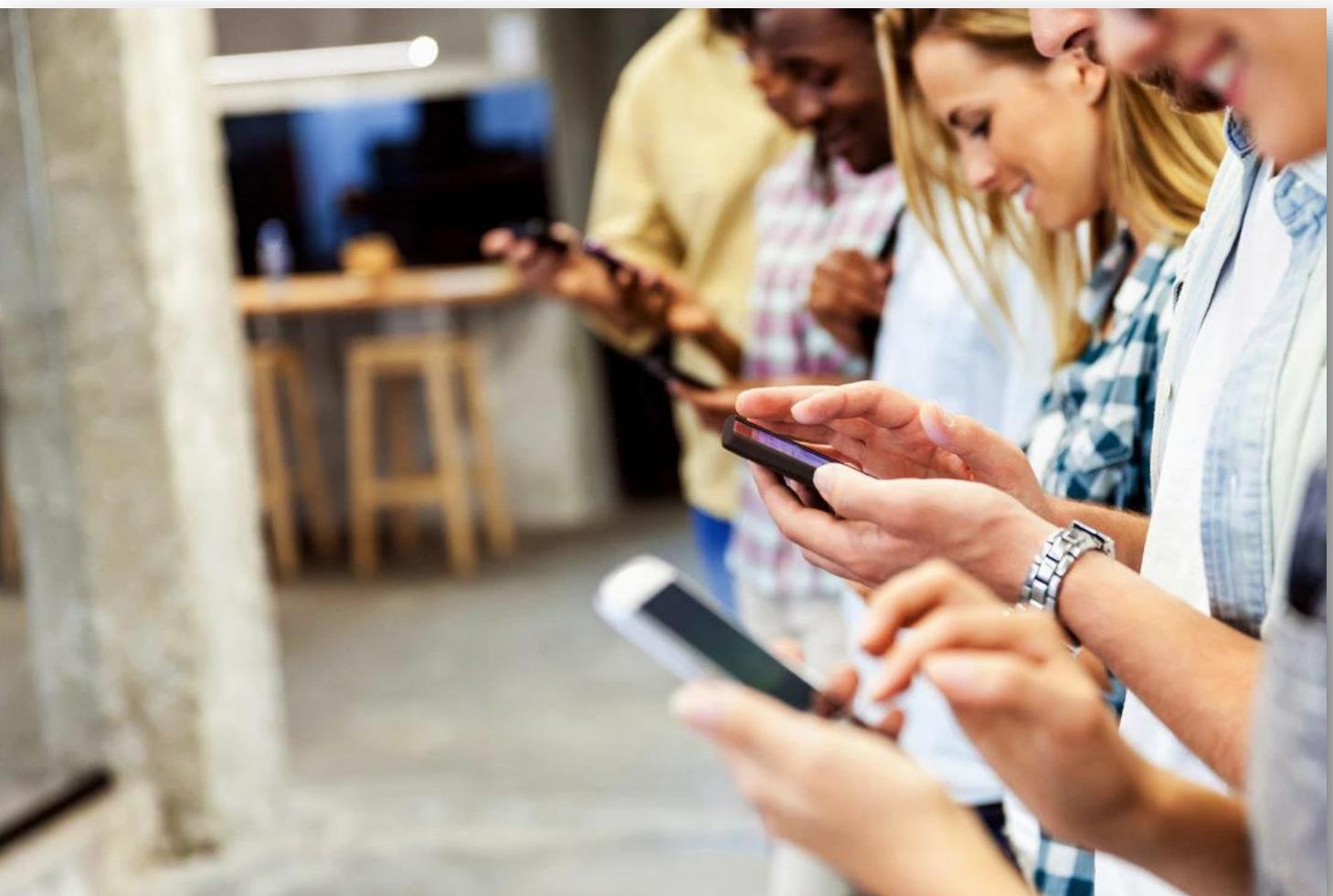
- ❖ Demographhics :Therapists, psychologists, and psychiatrists specializing in OCD and related disorders.
- ❖ Needs: Tools for effective patient management, enhanced treatment delivery, and remote therapy capabilities.
- ❖ Pain Points: Limited time for each patient, difficulty in tracking progress, and need for scalable solutions.

3) Healthcare Institutions

- ❖ Demographics :Clinics, hospitals, and mental health facilities.
- ❖ Needs: Integrated solutions for patient care, data management, and evidence-based treatment.
- ❖ Pain Points: Managing large patient volumes, integrating new technologies, and ensuring data privacy.

Marketplace

- ❖ Mental Health Apps Market
- ❖ Digital Therapy Solutions



Supportive Information Budget

Component	Description	Price
Development Costs	Salaries for developers, designers, and managers	Rs. 300,000 (one-time)
AI & NLP Tools	Licenses/subscriptions for AI and NLP tools	Rs. 10,000 / year
Biometric Analysis Tools	Tools and libraries for biometric analysis	Rs. 5,000 (one-time)
Cloud Services	Cloud storage and computing power	Rs. 15,000 / year
App Maintenance	Ongoing maintenance and updates	Rs. 15,000 / year
Marketing & Promotion	Digital advertising and promotional events	Rs. 25,000 / year
Customer Support	Support staff salaries and tools	Rs. 20,000 / year
Compliance & Security	Data privacy and security compliance	Rs. 7,000 / year
Training & Documentation	Training materials and user guides	Rs. 4,000 (one-time)
Research & Development	Ongoing R&D for feature improvements	Rs. 12,000 / year

Thank You!