Enhancing the Efficiency of Diagnosing and Managing Mental Disorders using Machine Learning

Group ID: 24-25J-322

MENTCARE AI

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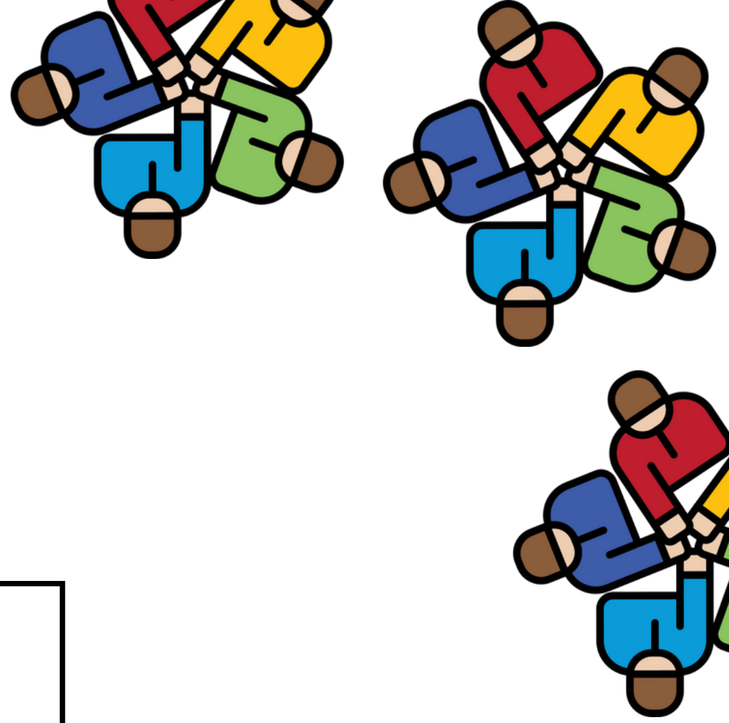
Team Members



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INTRODUCTION

According to the World Health Organization **1 in every 8 people** in the world live with a mental disorder.

Mental disorders, significantly impact an individual's cognitive, emotional, and social functioning.

Early diagnosis is crucial for effective intervention, as it can greatly improve long-term outcomes.

INTRODUCTION

- According to world's Alzheimer's association 1 out of 9 adults (>65) have Alzheimer's.
- Over 700,000 lives have been lost all over the world due to depression. (Global suicide statistics IASP)
- Approximately 1 out of 13 children are being diagnosed with autism. Data and Statistics on Autism Spectrum Disorder | Autism Spectrum Disorder (ASD) | CDC
- Parkinson foundation estimates that by the year 2030 the patients with Parkinson's disease will be rise to 1.2 million (https://www.parkinson.org/understanding-parkinsons/statistics)
- These diseases needed to be identified at the first stages to ensure immediate treatment. That helps patients' family members to plan their lives and keep the situation under control.

Research Problem

- How to leverage machine and deep learning techniques to enhance mental care?
- Up to what extent machine and deep learning can be used to diagnose and analyze mental disorders like Autism, Alzheimer's, Parkinson's, and Depression?
- How trustworthy and useful are the built models?
- How to monitor patients effectively?

Research Objectives

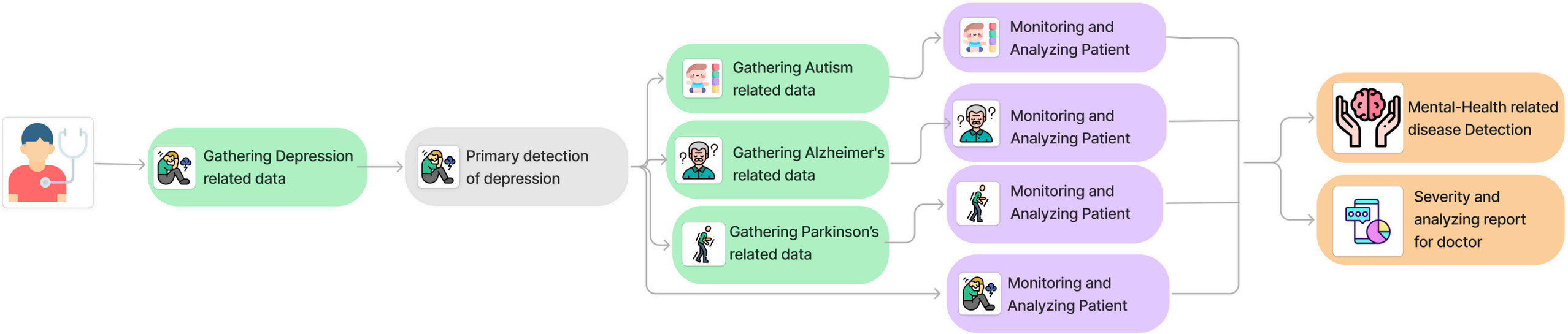
Diagnosing and Analyzing Alzheimer’s Risk through Machine Learning Techniques

Early Detection of Parkinson's: Harnessing Machine Learning for Predictive Risk Modeling.

Early Autism Spectrum Disorder Detection Using Facial Images and Text Analysis

Diagnosing and Analyzing Depression through Text and Facial Images

Overall System Diagram



Diagnosing and Analyzing Alzheimer's Risk through Machine Learning Techniques

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Bachelor of Science (Hons) in Information Technology
Specializing in Data Science

Introduction & Background

Component 1

What is Alzeihmers?

- Alzheimer's disease is a progressive neurological disorder that leads to memory loss, cognitive decline, and behavioral changes.

Introduction & Background

Component 1

Why do we need early detection?

- Early detection of Alzheimer's helps to manage symptoms better and plan for the future.
- It allows for timely treatment, which can slow down the disease's progression.
- Early diagnosis also gives families more time to prepare and seek support.

Introduction & Background

Component 1

How proposed system helps early detection in Alzheimer's?

- Identifying and classifying levels of Alzheimer's using MRI scans is not easy even for doctors.
- Taking the inputs for sleep quality of a patient is also challenging and this system helps to measure it.
- Medical staff like nurses can use this system to evaluate the patient before go to the doctor.

Reference Gap

[1]

This research study about predicting and classifying patients by their severity of Alzheimer's level using MRI scan information

[2]

This research study about measuring the quality of a persons sleep using smart wearable technology.

[3]

This research study about predicting Alzheimer's patients using machine learning techniques for immediate medication

Research Gap

Research	Research [8]	Research [9]	Research [10]	Proposed Solution
MRI scan related prediction	✓	✗	✗	✓
Smart wearable for sleep quality measuring.	✗	✓	✗	✓
Alzheimer's prediction based on user background information.	✗	✗	✓	✓
Alzheimer's medication report visualization.	✗	✗	✓	✓

Research Question

- How to get patient sleep quality measures?
- How to develop a solution to integrate all these components in one application?
- How to feed MRI scan images into the system?
- How to manage the patient status with the medications and treatments through out the time?
- How to make clear visualizations for doctors to evaluate patients' medical history with the treatments?

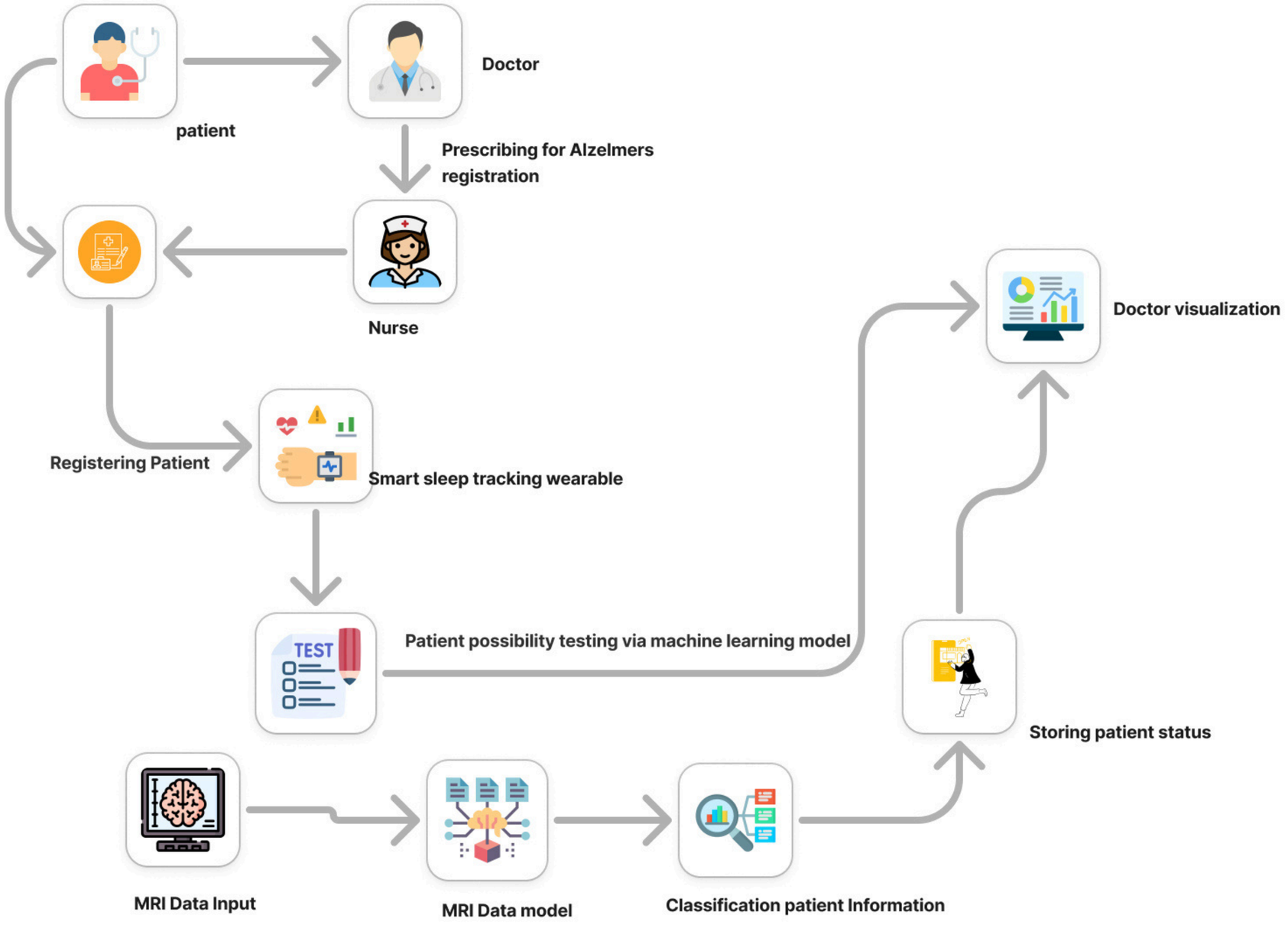
Specific & Sub Objectives

- Classifying patients’ severity using MRI scans.
- Identifying possibility of a patient having Alzheimer's using general information.
- Visualizing patient possibilities and levels of the disease through out the time.

Novelty

- Sleep quality of a patients is considered as a significant measure of their Alzheimer's levels.

- Getting sleep quality of a patient via smart wearable and use it as a input of predicting alzeihmers probability.


patient
Doctor
Prescribing for Alzelmers registration
Nurse
Registering Patient
Smart sleep tracking wearable
TEST
Patient possibility testing via machine learning model
Doctor visualization
Storing patient status
MRI Data Input
MRI Data model
Classification patient Information

Requirements

Personal Requirements

- Dr. Anuradha Baminiwatta
from Ragama hospital

Functional Requirements

- Identifying patients possibility of having the disease using general information inputs.
- Identify and classify the patients disease status using MRI scans
- Visualizing patients' medical history to the doctor.

Non-Functional Requirements

- Create easy to use user interfaces.
-
- Fast user interaction.
-
- Reliable and stable application behaviour.

Tools & Technologies

Technologies

- Flutter
- Python
- ReactJS
- Firebase
- Docker
- Google colab
- ChartJS

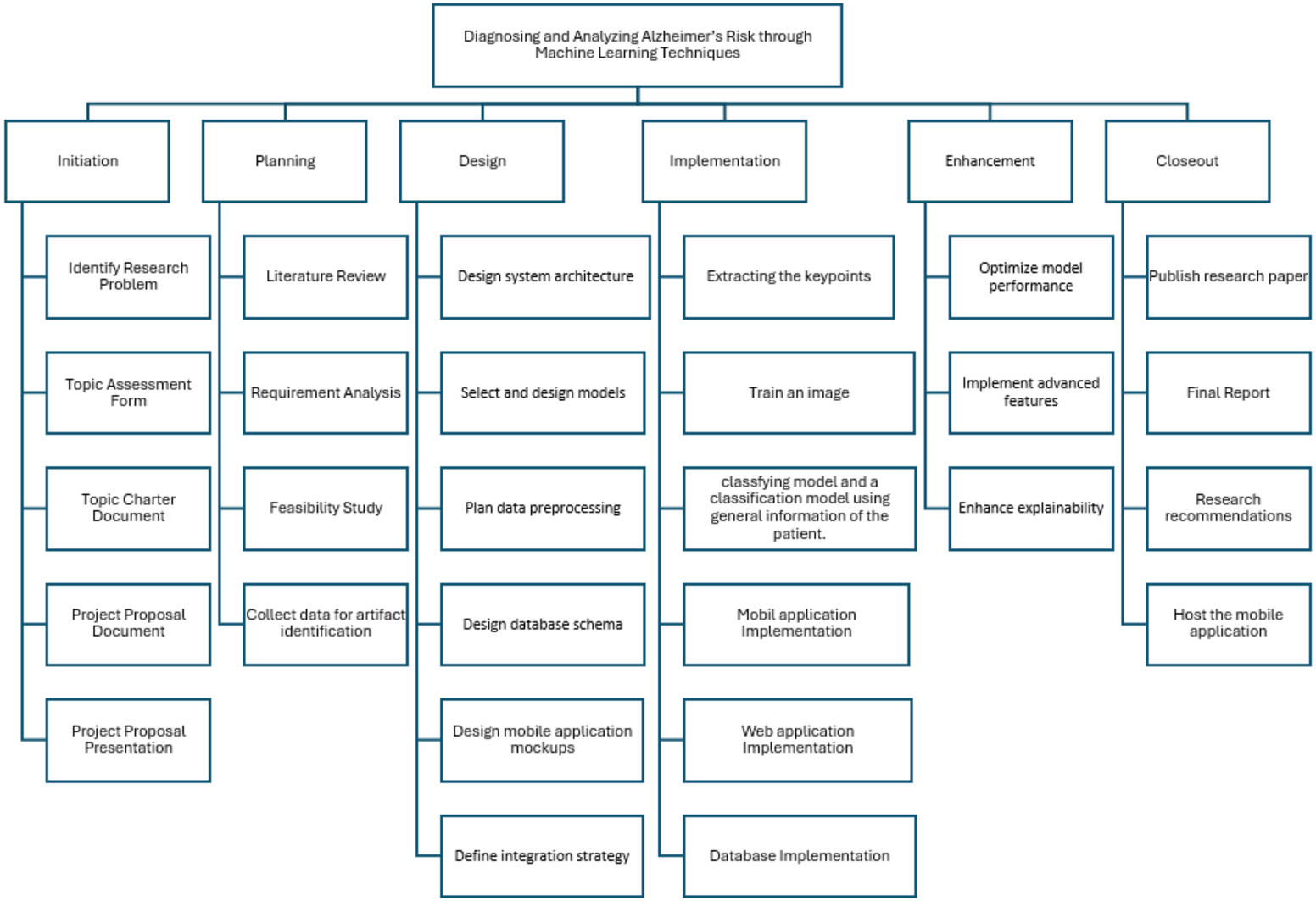
Algorithms

- CNN models.
- Random forest and other suitable machine learning algorithms

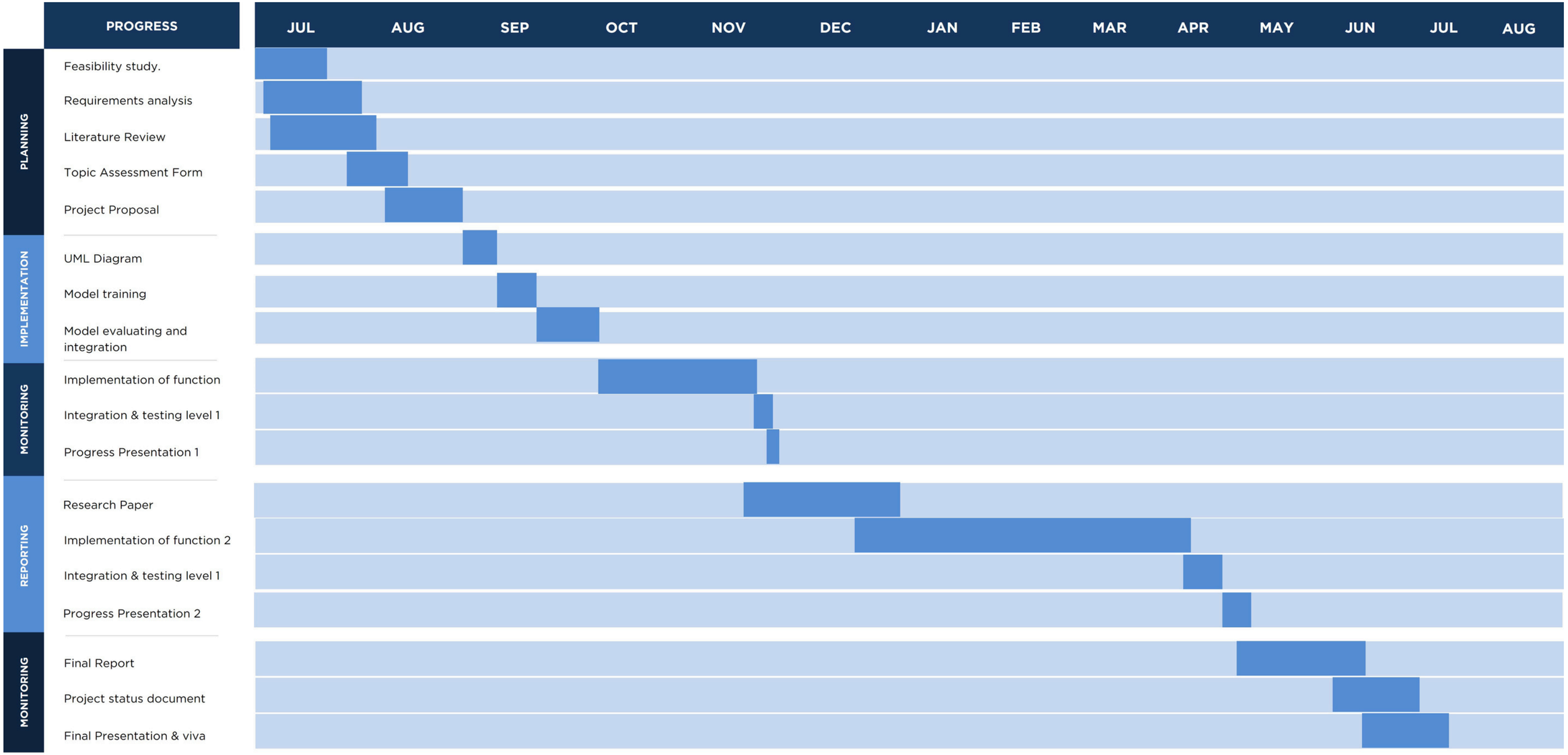
Techniques

- Sleep quality detection.
- Image classification.

Work Breakdown Structure



Gantt Chart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[2] *C. -E. Kuo, Y. -C. Liu, D. -W. Chang, C. -P. Young, F. -Z. Shaw and S. -F. Liang, "Development and Evaluation of a Wearable Device for Sleep Quality Assessment," in IEEE Transactions on Biomedical Engineering, vol. 64, no. 7, pp. 1547-1557*

[3] *Simon A., Deo M., Selvam V., and Babu R., An overview of machine learning and its applications, International Journal of Electrical Sciences & Engineering. (2016)* ***1****, 22–24.*

Early Detection of Parkinson's: Harnessing Machine Learning for Predictive Risk Modeling

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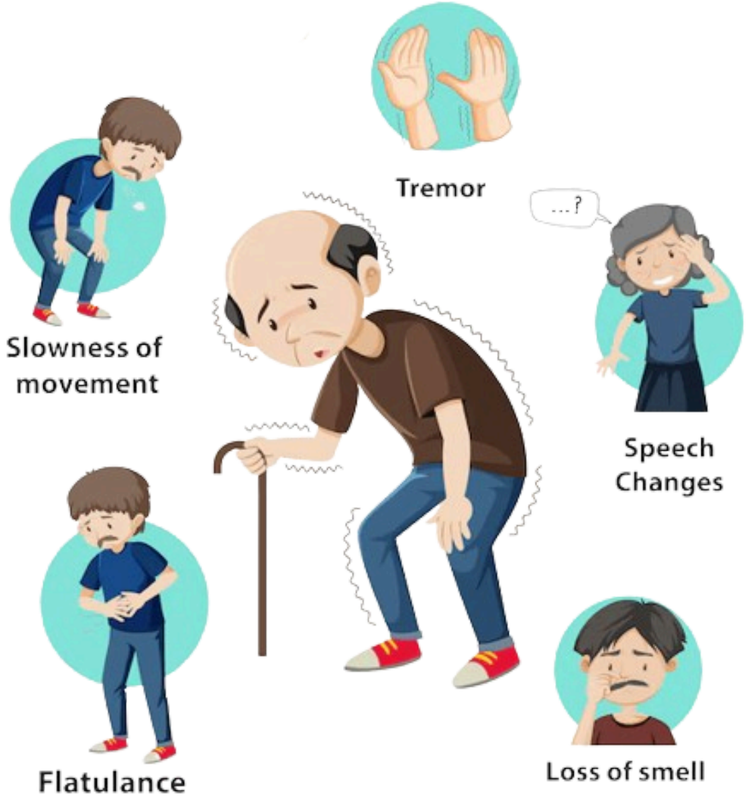
Introduction & Background

Component 2

What is Parkinson’s disease?

- Parkinson's disease is a progressive neurodegenerative disorder affecting millions worldwide. It primarily impacts motor functions due to the loss of dopamine-producing neurons in the brain.



Introduction & Background

Component 2

Importance of Early Detection

- Early detection of Parkinson's disease is crucial for slowing progression and improving quality of life.
- Delays in diagnosis often occur due to subtle early symptoms that are easily overlooked.
- Traditional methods are time-consuming and may miss early signs.
- There is a need for innovative solutions to enhance early detection accuracy.

Reference Gap

[1]

This research focuses on identifying Parkinson's disease through motor symptoms and speech patterns, yet it lacks the integration of emotional cues in the analysis.

[2]

This research study explores handwriting images as a method for detecting Parkinson's disease, highlighting its potential in identifying subtle motor impairments.

[3]

Develop a practical, real-time web application that can be integrated into clinical workflows for Parkinson's detection.

Research Gap

Research	Research [1]	Research [2]	Research [3]	Proposed Solution
Combining voice analysis with emotional insights for precise early detection	✓	✗	✗	✓
Handwriting Images for PD Detection	✗	✓	✗	✓
Multimodal approaches to identify Parkinson's disease	✗	✗	✓	✓
Real-Time Application and Integration	✗	✗	✓	✓

Research Question?

How does the inclusion of emotional cues in voice recordings improve the precision of early-stage Parkinson's disease diagnosis?

How does the inclusion of emotional cues in voice recordings improve the precision of early-stage Parkinson's disease diagnosis?

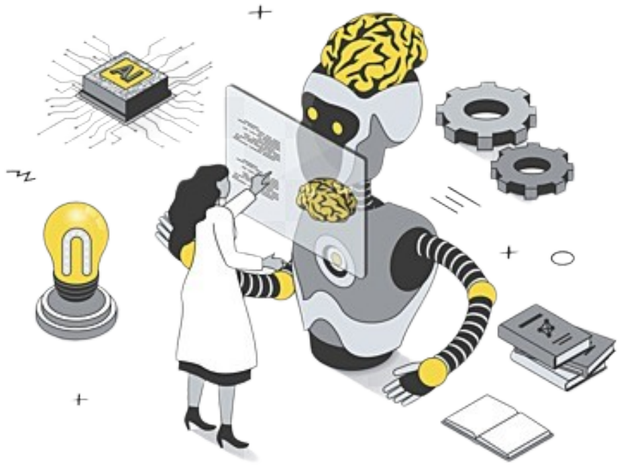
How can early Parkinson’s disease detection be visualized for clinicians with a simple, color-coded risk system?

How can a web-based application utilizing handwriting and voice analysis aid healthcare professionals in the early diagnosis and management of Parkinson's disease?

Specific & Sub Objectives

- Identify Key Features Indicative of Early Parkinson's Disease
- Data Collection and Preprocessing
- Develop a User-Friendly Web Application
- Evaluate the Impact and Effectiveness of the Web Application in Clinical Settings

Novelty

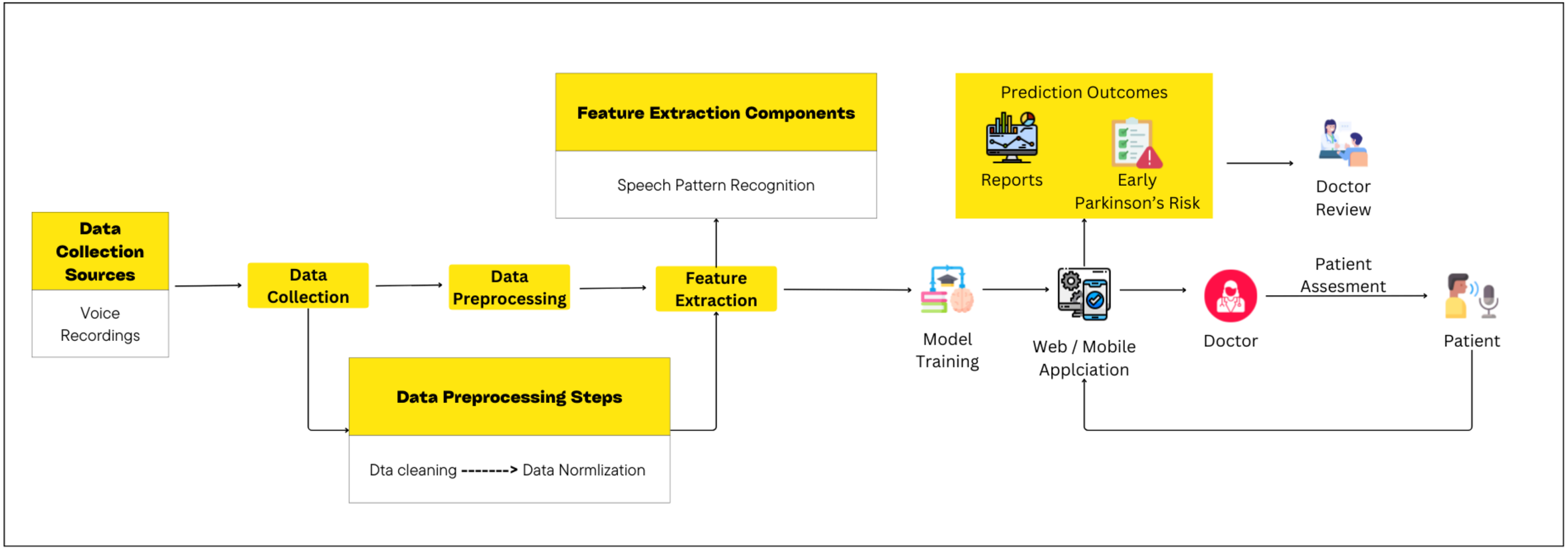


Multi-Level Disease Progression Indicator:

Three-Stage Categorization:

- Green: Indicates early-stage Parkinson’s with minimal symptoms and low risk.
- Yellow: Represents moderate symptoms, suggesting mid-stage Parkinson’s with a noticeable impact on daily life.
- Red: Denotes advanced symptoms, indicating high risk and significant impairment.

Methodology



Requirements

Personal Requirements

- Guidance from Dr. Anuradha Baminiwatta

Functional Requirements

- Data Collection and Preprocessing
- Predictive Modeling
- Feature Extraction and Selection
- Integration and Real-Time Analysis
- Reporting and Visualization

Non-Functional Requirements

- Performance
- Scalability
- Reliability
- Security
- Usability

Tools & Technologies

Technologies

- Flutter
- Python
- ReactJS
- Firebase
- Docker
- Google colab
- ChartJS

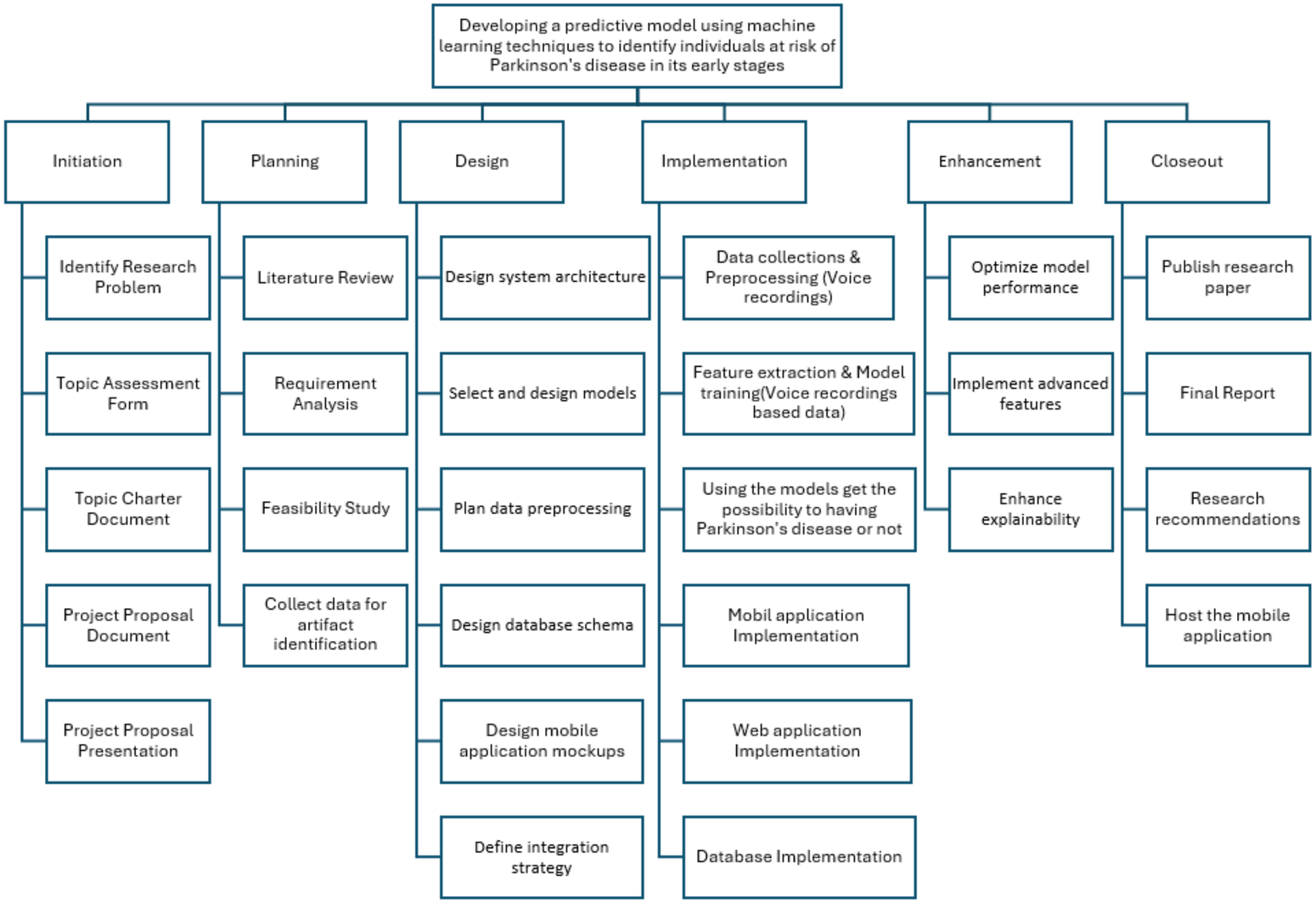
Algorithms

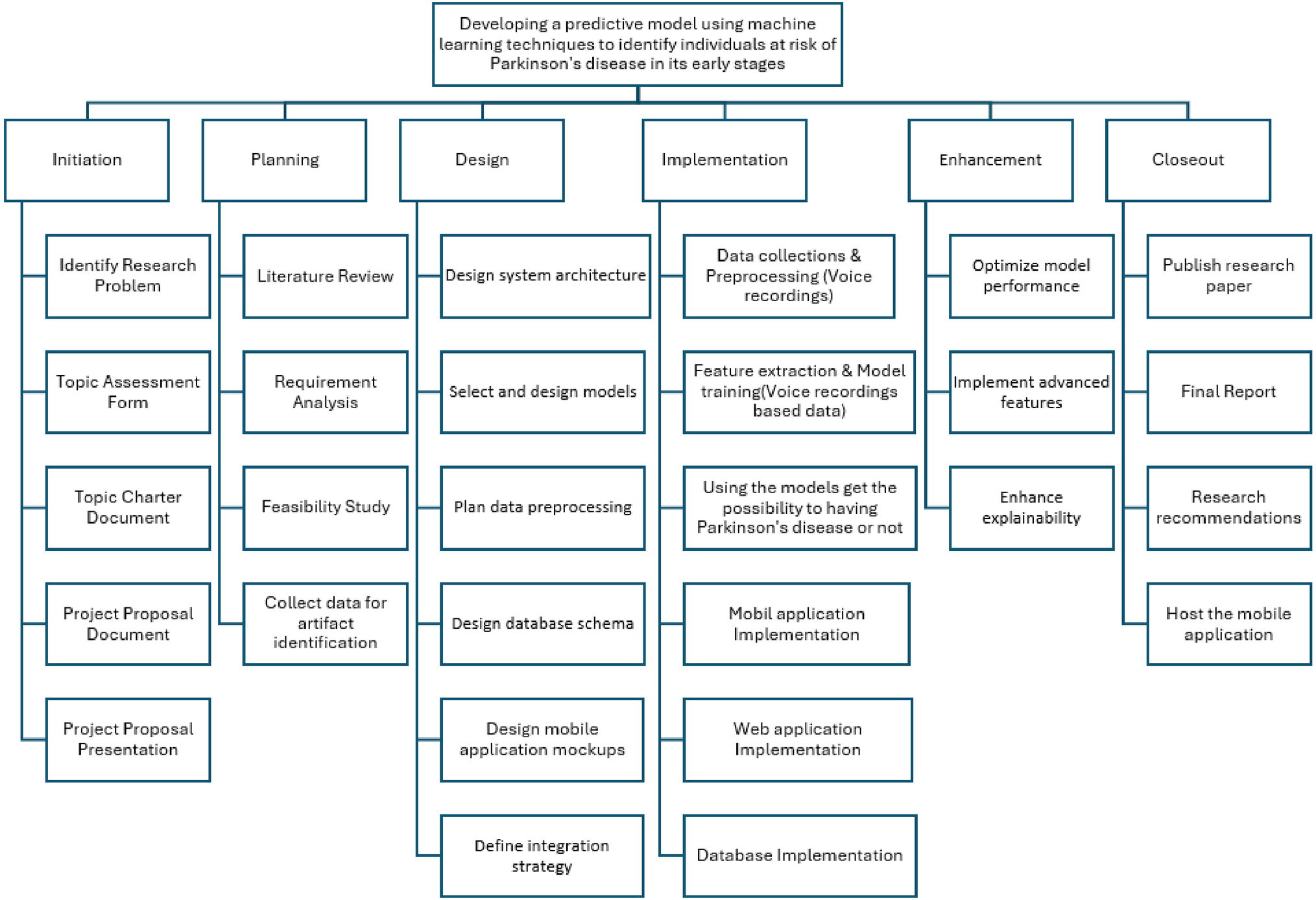
- Support Vector Machines (SVM)
- Random Forest
- Convolutional Neural Networks (CNN)
- Recurrent Neural Networks (RNN) / Long Short-Term Memory (LSTM)

Techniques

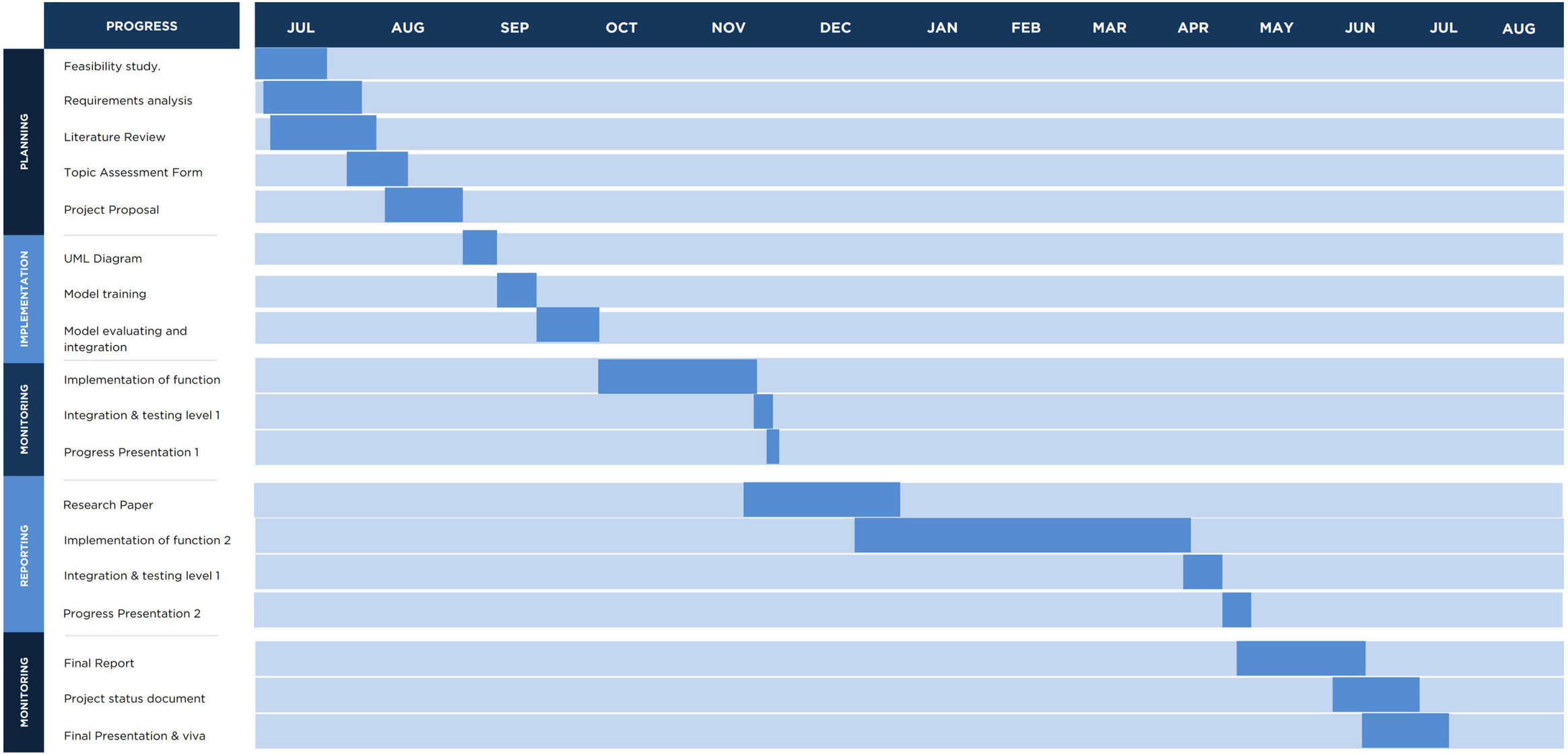
- Voice Classification
- Voice Activity Detection (VAD)
- Image Classification
- Multimodal Fusion

Work Breakdown Structure




Developing a predictive model using machine learning techniques to identify individuals at risk of Parkinson's disease in its early stages
Initiation
Identify Research Problem
Topic Assessment Form
Topic Charter Document
Project Proposal Document
Project Proposal Presentation
Planning
Literature Review
Requirement Analysis
Feasibility Study
Collect data for artifact identification
Design
Design system architecture
Select and design models
Plan data preprocessing
Design database schema
Design mobile application mockups
Define integration strategy
Implementation
Data collections & Preprocessing (Voice recordings)
Feature extraction & Model training(Voice recordings based data)
Using the models get the possibility to having Parkinson's disease or not
Mobil application Implementation
Web application Implementation
Database Implementation
Enhancement
Optimize model performance
Implement advanced features
Enhance explainability
Closeout
Publish research paper
Final Report
Research recommendations
Host the mobile application

Gantt Chart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Early Autism Spectrum Disorder Detection Using Facial Images and Text Analysis

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Introduction & Background

Component 3

What is Autism Disorder?

Autism spectrum disorder is a complex neurodevelopment condition characterized by diverse behavioral, communication, and social challenges. Its prevalence is significant globally, affecting approximately one in 160 children according to the World Health Organization. ASD diagnosis typically occurs around the age of 4.

Introduction & Background

Component 3

Why mainly focus about the autism disease?

- Early diagnosis allows for interventions that can significantly enhance the develop mental progression of a child with autism.
- Interventions can improve social skills, communication, and the ability to form relationships.
- Knowing the diagnosis early can reduce the uncertainty and stress experienced by parents.
- Can lead to long-term economic benefits for families and society.
- Allows parents to understand their child's needs better and seek appropriate help.

Introduction & Background

Component 3

How proposed system helps early detection in autism?

- Identifying and classify the facial images and getting the analyzation of whether having ASD

- Medical staff , nurses can use this system to evaluate the patient before go to the doctor

Reference Gap

[1]

This research introduces deep learning for autism spectrum disorder (ASD) detection using image-based analysis, aiming to enhance diagnostic accuracy and reliability.

[2]

This research focuses on using supervised machine learning, specifically SVM, to evaluate ASD-related text data, demonstrating high performance despite challenges in collecting a large dataset.

[3]

This research focuses on mitigating ASD disorder by leveraging new technologies and employing a data-driven approach to enhance diagnosis and intervention strategies.

Research Gap

Research	Research 1	Research 2	Research 3	Proposed Solution
Face Images Detection	✓	✗	✗	✓
Text Base Data gathering	✗	✓	✓	✓
Get the Feedback through the report base classifications	✗	✗	✗	✓
Mobile Based Application	✗	✗	✓	✓

Research Question?

- How to identify autism patient face detections in an application?
- How to develop self-manageable platform?
- How can we collect more and better-quality data to improve DL and ML models for early ASD diagnosis?
- How to gather text base questions' answers?

Specific & Sub Objectives

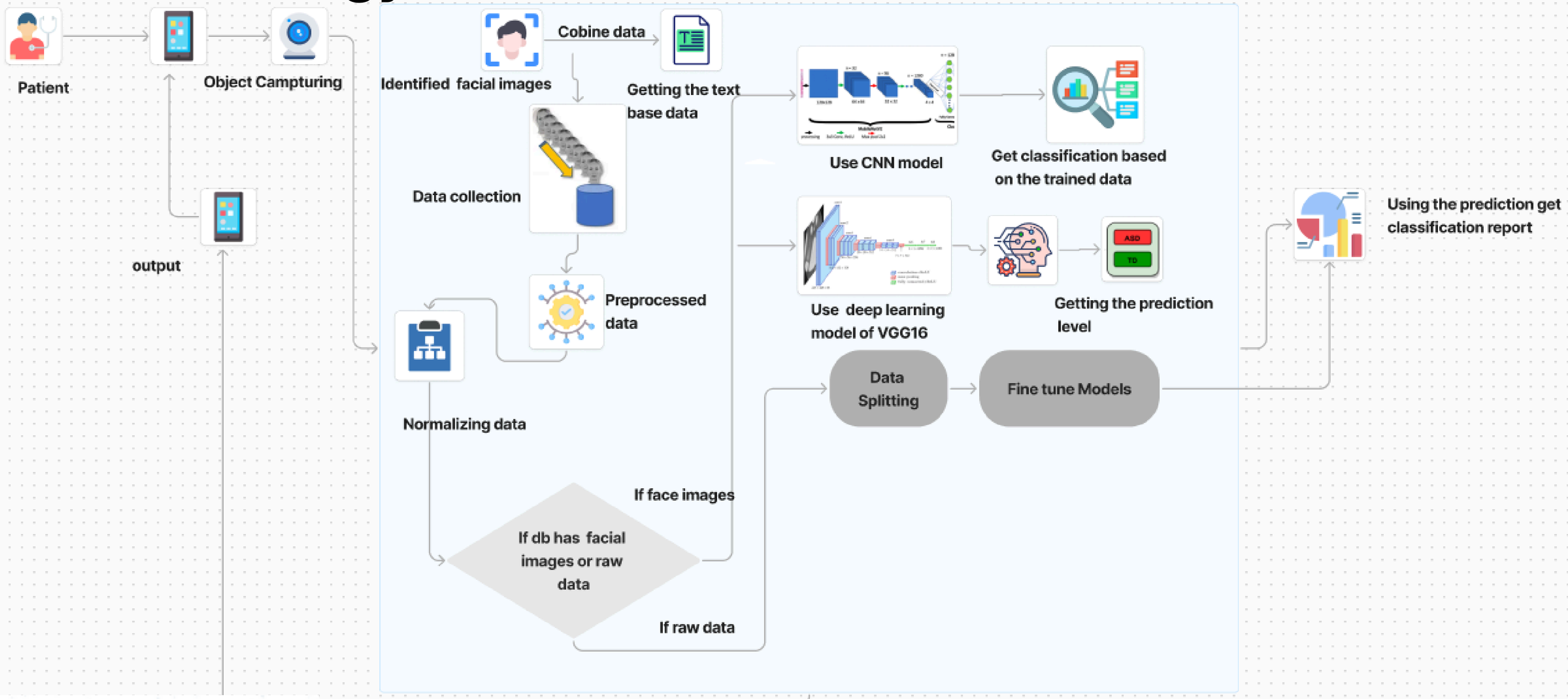
- Detect the facial images of the patients
- Using the machine learning give the possibility for the whether having ASD
- Giving the visualization report for current situation of each patient
- Verify the prediction result use in clinical data

Novelty

- Supporting individuals to automated facial recognition, capturing images of the patient's facial expression via webcam

- Combining text base data with Image Processing to detecting autism disorder

Methodology



Tools & Technologies

Technologies

- Flutter
- Python
- ReactJS
- Firebase
- Docker
- Google colab
- ChartJS

Algorithms

- CNN models
- VGG-16 deep learning model
- Random forest
- Naïve bayes and other related machine learning algorithms

Techniques

- Image classification
- Object detection

Requirements

Personal Requirements

- Dr. Anuradha Baminiwatta
from Ragama hospital

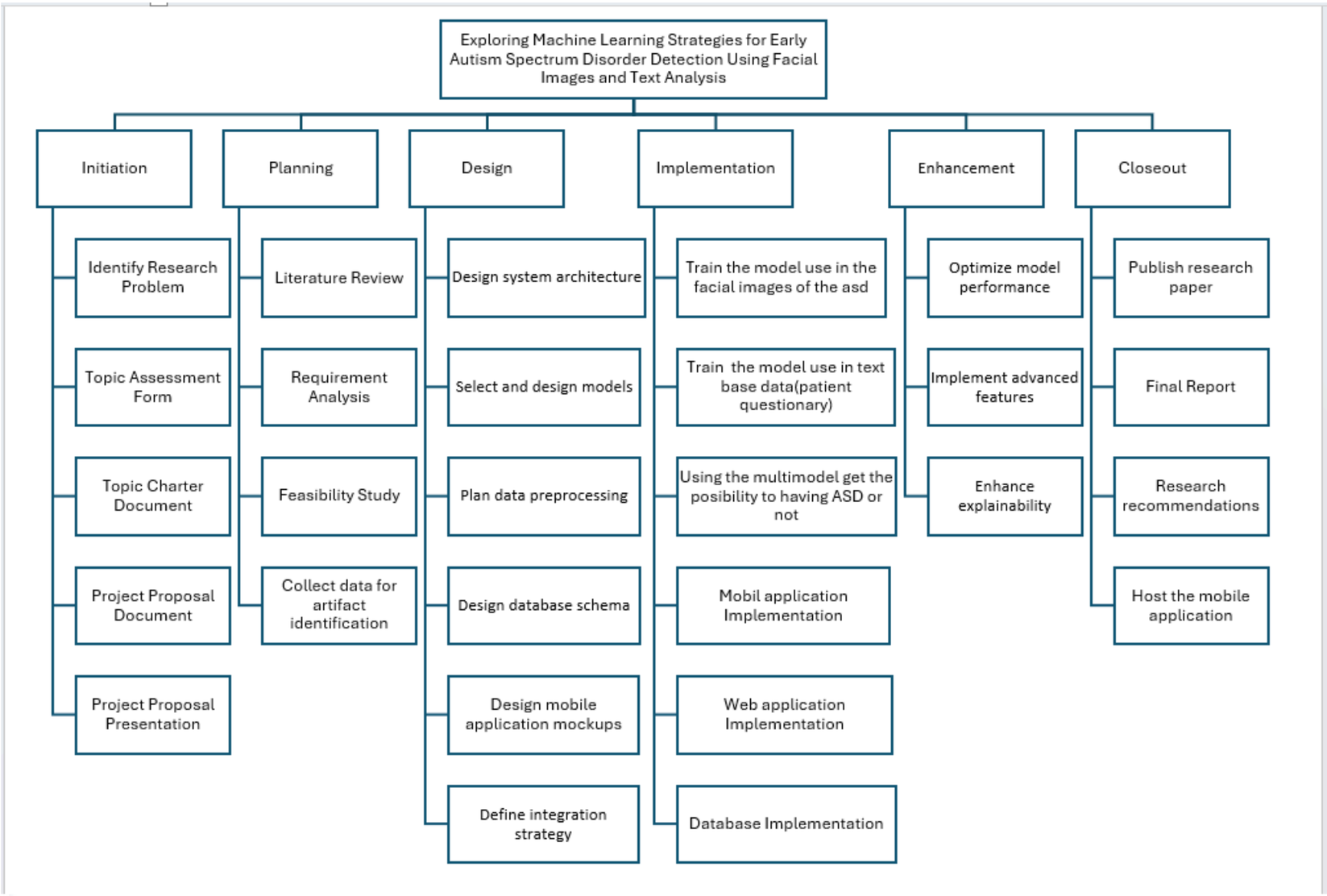
Functional Requirements

- Detecting the facial images
- Identifying the variables to getting rawdata
- Getting the prediction level whether having ASD or not

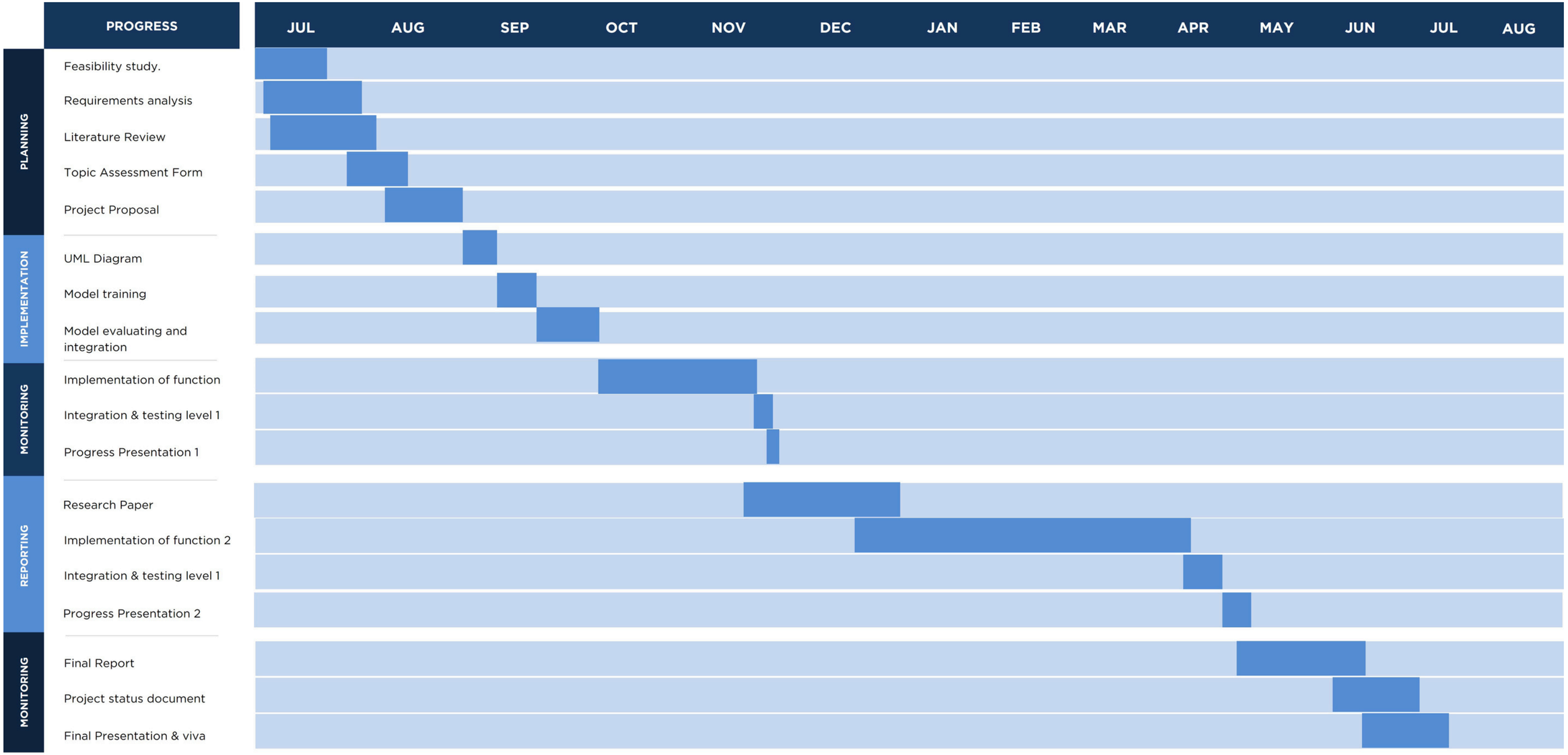
Non-Functional Requirements

- Interfaces should be User-friendly
- Faster result
- Application should properly work for cross platform

Work Breakdown Structure



Gantt Chart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[3] *Rashid, A., & Shaker, S. (2023). Autism spectrum disorder detection using face features based on deep neural network. Wasit Journal of Computer and Mathematics Sciences, 2(1), 74-83.*

Diagnosing and Analyzing Depression Through Text and Facial Images

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Introduction & Background

Component 4

What is Depression?

- Depression is a common mental disorder.
- Globally, an estimated 5% of adults suffer from depression.
- It involves a depressed mood or loss of pleasure or interest in activities **for long periods of time.**
- Depression can lead to suicide.

Why we need AI based Depression diagnosing and monitoring system?

- Depression affects millions worldwide and **needs to be diagnosed early.**
- It takes **too many sessions with patients** to diagnose depression. And doctors **cannot memorize everything.**
- It is especially difficult to diagnose, monitor, and effectively manage depression patients due to limited facilities.
- Our research uses ML to analyze text responses and facial expressions, providing a tool to help doctors detect and monitor depression patients more effectively.

Reference Gap

[1]

This paper demonstrates the potential of ML models to enhance the speed and accuracy of depression detection. But only did detection part.

[2]

This study mainly focuses on depressive and non-depressive tweets classification for depression detection over tweeter data. Only get emotion through texts.

[3]

The research focuses on using machine learning with feature selection techniques for efficient depression detection from social media data.

Research Gap

Research	Research [1]	Research [2]	Research [3]	Proposed Solution
Depression Detection	✓	✓	✓	✓
Develop website or mobile application	✗	✗	✗	✓
Diverse Dataset	✓	✓	✓	✓
Incorporate advance deep learning techniques	✗	✓	✓	✓
Personal Assistant Monitoring System	✗	✗	✗	✓

Research Questions

- How general practitioners can easily diagnose mental disorder like Depression?
- How can practitioners monitor and examine depression patients' behaviors effectively?

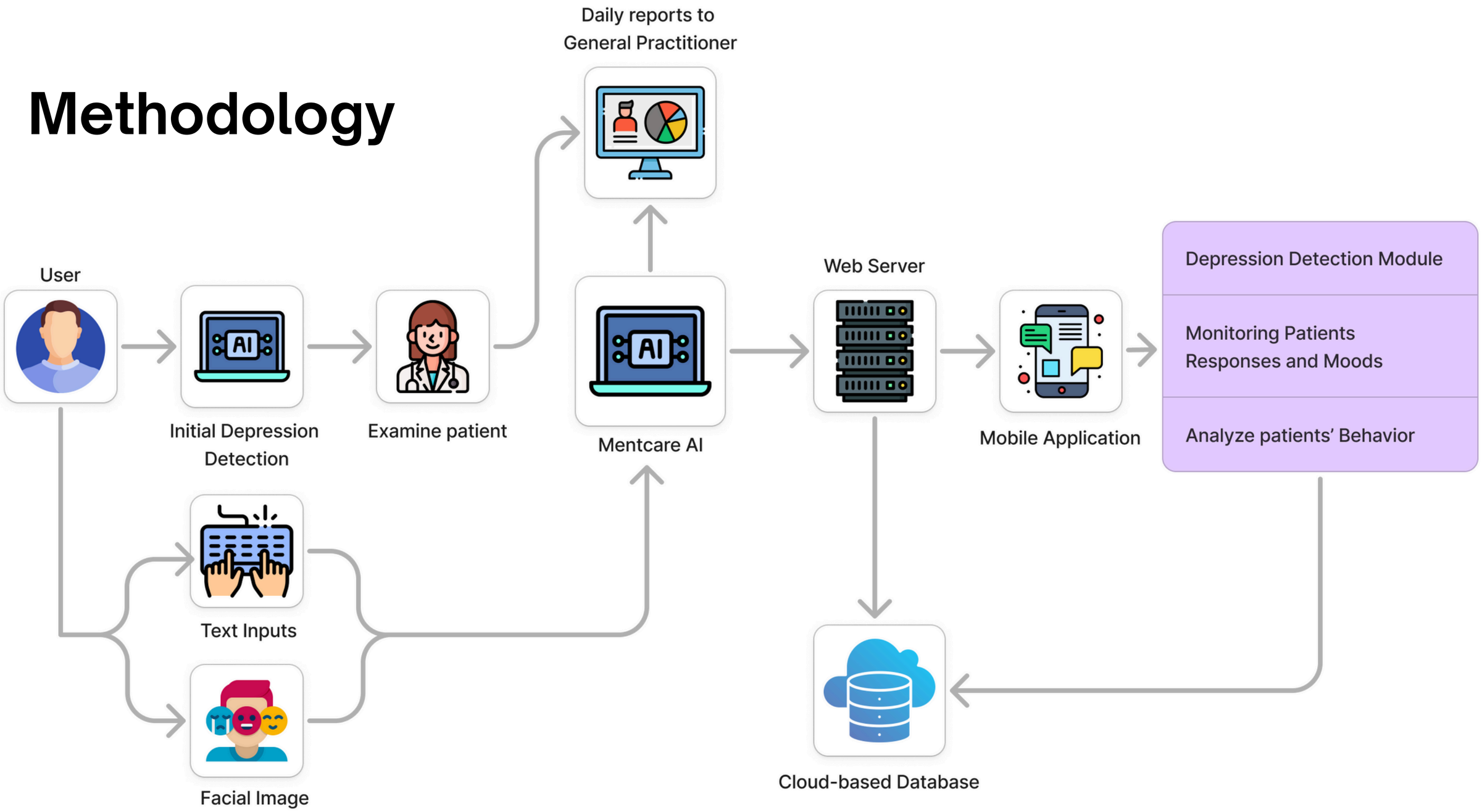
Specifics and Sub Objectives

- Initially determining whether a patient is at risk of having depression.
- Monitoring patients' behavior daily by collecting text inputs and facial images together.
- Give analysis/summary about patients’ current status to doctor.

Novelty

- Develop a personal assistant to track the responses of the patients
- Analyze patient progress using both text, and facial images.

Methodology



Tools & Technologies

Technologies

- Flutter
- Python
- ReactJS
- Firebase
- Docker
- Google colab
- ChartJS

Algorithms

- CNN models
- LSTM models
- Random forest and other related machine learning algorithms

Techniques

- Image classification
- Text Classification

Requirements

Personal Requirements

- Guidance from Dr. Anuradha Baminiwatta.
- Understand the Specific Area of Each Domain to Proceed with the Selected Research Area.

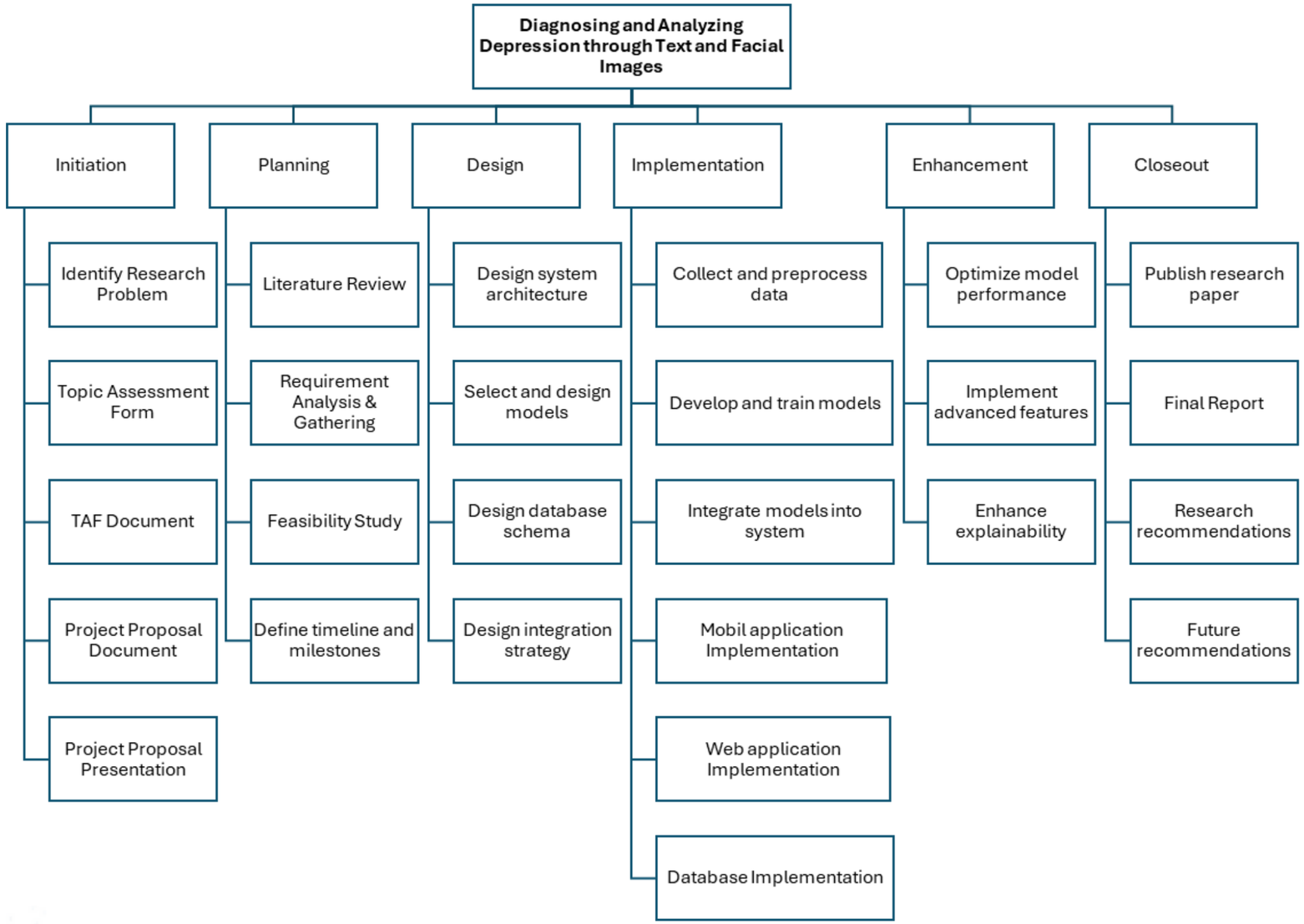
Functional Requirements

- Depression detection module.
- Patients' behaviour monitoring.
- Give analysis to the doctor of patients' current status.

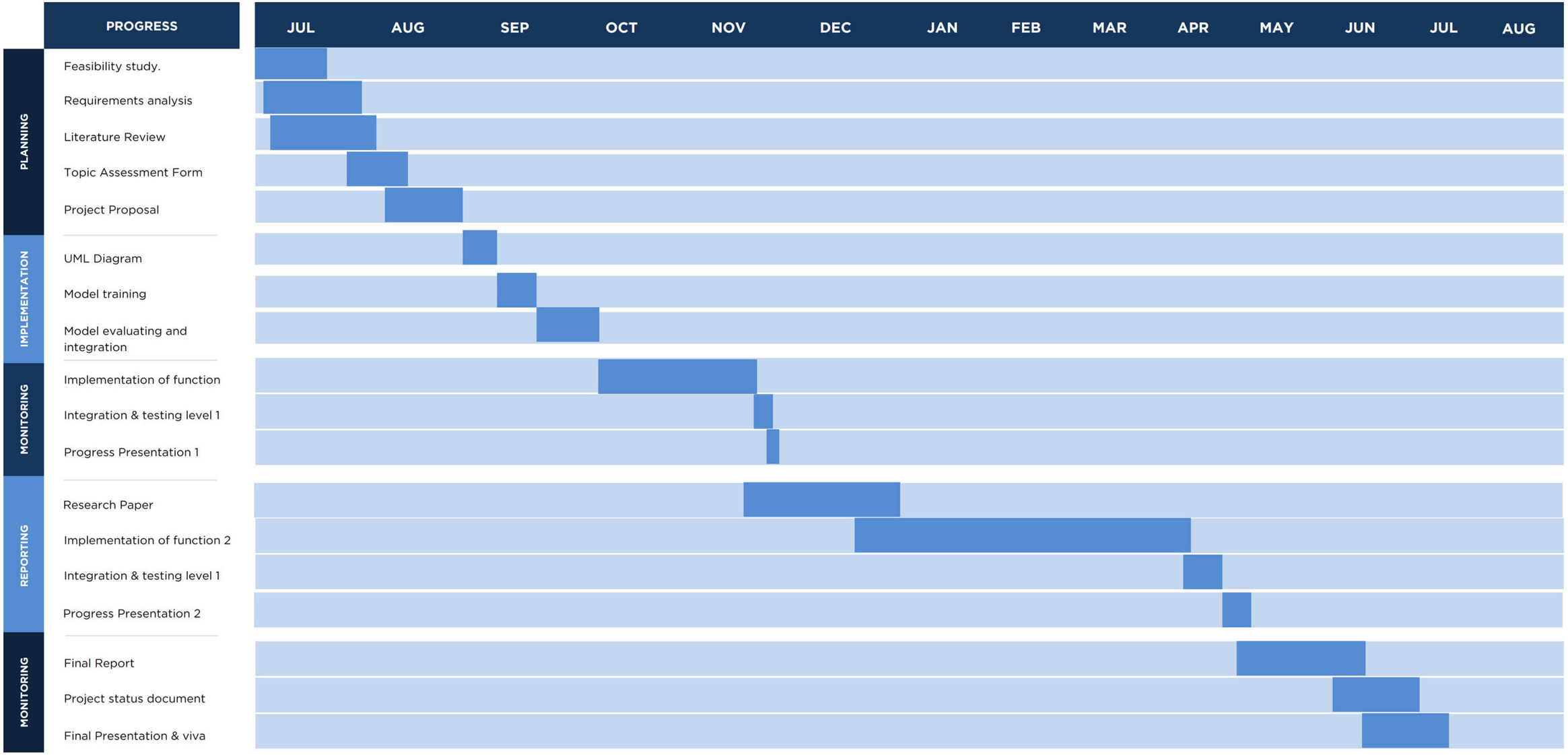
Non-Functional Requirements

- Ensure compliance with healthcare data protection regulations.
- Provide an intuitive and user-friendly interface for both patients and doctors.
- Optimize the system for quick response times during AI-assisted conversations.

Work Breakdown Structure



Gantt Chart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Business Plan of MENTCARE AI

- **April 2024** — Project Initiation
- **August 2024** — Finalize Architecture
- **September 2024** — Model Development and Implementation
- **October 2024** — Begin development of platform
- **Q1 2025** — Complete development of platform and have a working prototype
- **Q2 2025** — Release Mentcure to the market
- **Q2 2025** — Begin marketing campaigns and outreach programs for user acquisition
- **Q3 2025** — Expand the functionality of the platform and focus on new features

Commercialization

Target Market

General Practitioners of the MOH centers

Institutes who learn about mental disorders

General population who wish to take self mental care

Market Size

~12.5% of the world population

Market Access Points

MOH Center

Mentcare Web

Budget Allocation

Component	Amount(LKR)
Create wearable device	10000
Data gathering(Datasets, Data stream cost)	5000
Online Resources and Subscription(APIs, Databases, Cloud Services)	10000
Total	25000

Additional References & Field Visit

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Q & A Session

Thank you for your attention