A Mini Project Synopsis on

MedIQ Advisor: Personal Healthcare Companion

T.E. – Computer Science and Engineering-Data Science

Submitted By

Harshal Patil	**21107060**
Arya Patil	**21107009**
Faizan Mahimkar	**21107007**
Himanshu Maurya	**21107038**

Under The Guidance Of

Prof. Anagha Aher

DEPARTMENT OF CSE-DATA SCIENCE

A.P. SHAH INSTITUTE OF TECHNOLOGY
G.B. Road, Kasarvadavali, Thane (W), Mumbai-
400615 UNIVERSITY OF MUMBAI

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CERTIFICATE

This to certify that the Mini Project report on **MedIQ Advisor: Personal Healthcare Companion** has been submitted by Arya Patil (21107009), Faizan Mahimkar (21107007), Harshal Patil (21107060) and Himanshu Maurya (21107038) who are a Bonafide students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfillment of the requirement for the degree in **Computer Science and Engineering (Data Science)**, during the academic year **2023-2024** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

Ms. Prof. Anagha Aher
Guide

Prof. Anagha Aher	Dr. Uttam D. Kolekar
Head Department of CSE-Data Science	Principal

External Examiner(s)
1.
2.

Place: A. P. Shah Institute of Technology, Thane
Date: 28-04-2023

TABLE OF CONTENTS

Abstract

This project outlines the development of a comprehensive web application designed to support user well-being through a combination of mental health screening, virtual assistance, and health chat functionalities. Built with the Flask framework, the application leverages machine learning, natural language processing (NLP), and a medical knowledge base to provide personalized experiences.

The core feature of the application is the mental health screening module. This module utilizes a two-pronged approach, combining facial expression detection through HAAR cascade classifiers with user responses to a questionnaire analyzed by a machine learning model. By analyzing both emotional cues and questionnaire responses, the model estimates the user's mental state. Based on this estimation, the app provides personalized recommendations. Users with scores below a threshold receive recommendations for doctors in their vicinity, along with messages acknowledging their mental state. Conversely, users with scores exceeding the threshold receive targeted advice to improve their mental health.

Beyond mental health screening, the application offers a virtual assistant powered by the Taipy framework. This assistant allows users to ask general questions through a text interface and receive responses displayed on the UI or delivered through voice synthesis. The virtual assistant's intelligence extends to redirecting users to external applications like YouTube or Wikipedia based on the query's intent. Finally, the application integrates a health chatbot trained on the Gale Encyclopedia of Medicine. Utilizing OpenAI's API and the GPT-3.5 NLP model, this chatbot empowers users to ask health-related questions and receive informative answers derived from the application's medical knowledge base.

The project delves into the application's architecture, emphasizing the modular design built upon Flask. It explores the functionalities of each module, including the mental screening process, virtual assistant interactions, and health chatbot queries. Additionally, the project highlights data visualization techniques for evaluating the machine learning model used in mental health screening. Furthermore, it discusses API integration with OpenAI and potentially external application APIs, along with deployment considerations using Vercel. Recognizing the importance of user data privacy, the project emphasizes the need for robust security measures. It also acknowledges potential challenges like model bias and chatbot limitations, proposing solutions to mitigate these issues. Finally, the project outlines potential future enhancements, such as sentiment analysis for the virtual assistant, personalized recommendations, and mental health tracking functionalities.

Chapter 1

Introduction

In today's digital landscape, healthcare misinformation has become a prevalent issue, hindering public access to accurate medical information. MedIQ Advisor presents a pioneering solution, utilizing AI chatbots to provide instant and reliable healthcare guidance. By leveraging dynamic learning algorithms and stringent validation mechanisms, MedIQ Advisor aims to instill trust and confidence in users, offering timely insights on symptoms, preventive measures, and general health queries.

With a focus on versatility, MedIQ Advisor caters to a diverse range of scenarios, from everyday health inquiries to critical situations such as public health emergencies and outbreaks. Its seamless integration with existing healthcare systems ensures interoperability and collaboration, facilitating a smooth transition from self-assessment to professional support. As a beacon of hope in the fight against healthcare misinformation, MedIQ Advisor embodies the transformative potential of technology in promoting informed decision-making and fostering better health outcomes for all.

1.1 Purpose:

The purpose of MedIQ Advisor is to combat the rampant spread of healthcare misinformation and provide individuals with instant and reliable access to accurate medical information. In an era dominated by digital platforms, misinformation poses serious risks to public health by perpetuating myths and undermining trust in healthcare institutions. MedIQ Advisor addresses this challenge by leveraging AI chatbots equipped with dynamic learning mechanisms and stringent validation processes. By continuously updating its dataset with the latest medical knowledge, MedIQ Advisor ensures that its responses are precise and up-to-date.

Its primary goal is to empower users with the knowledge they need to make informed decisions about their health. Whether individuals seek information about symptoms, preventive measures, or general health queries, MedIQ Advisor serves as a trusted source of timely and trustworthy insights. Additionally, during public health emergencies or outbreaks, MedIQ Advisor plays a critical role in rapidly disseminating accurate information and guiding users through protective measures. Through its seamless integration with existing healthcare systems, MedIQ Advisor aims to facilitate collaboration between users and healthcare professionals, ultimately contributing to improved health outcomes and overall well-being.

1.2 Problem Statement:

Historically, healthcare information accessibility has predominantly relied on traditional methods, such as consulting healthcare providers or referring to medical literature. While effective in some respects, these approaches often lack the immediacy and convenience needed for rapid decision-making, particularly in emergent situations. In the present, there's been a surge in leveraging advanced technological solutions, such as AI-driven chatbots, to enhance healthcare information dissemination. However, existing systems still face challenges in delivering accurate and timely information, especially during public health emergencies or outbreaks. By integrating facial recognition technology into the MedIQ Advisor project, we aim to address this limitation and create a healthcare information platform that is more attuned to the user's emotional state, thereby providing a more enriching and personalized experience.

Our proposed approach seeks to leverage facial expression analysis within the MedIQ Advisor platform. By employing computer vision and facial recognition technologies, we endeavor to detect and analyze the user's facial expressions during their interactions with the system. These expressions can offer valuable insights into the user's emotional well-being, including stress, anxiety, or urgency. By incorporating real-time emotional data, MedIQ Advisor can tailor its responses and recommendations to better align with the user's emotional needs, ultimately improving the efficacy and relevance of the healthcare information provided.

The primary challenge facing this project lies in the development of robust facial recognition algorithms capable of accurately interpreting a diverse range of emotions and expressions. Additionally, integrating facial recognition technology with the existing MedIQ Advisor framework requires expertise in data processing and machine learning techniques. Furthermore, ensuring user privacy and data security is paramount, given the sensitive nature of healthcare information. Thus, this project must navigate these challenges to develop an effective and ethically sound healthcare information platform using Facial Recognition technology, ultimately enhancing the user's healthcare decision-making experience.

Furthermore, the project must also address the challenge of user acceptance and trust in facial recognition technology within the healthcare context. Ensuring transparency about data usage and privacy protection measures will be essential in building user confidence and fostering adoption of the MedIQ Advisor platform. Additionally, the system should incorporate robust measures for data anonymization and encryption to safeguard sensitive facial data.

Another critical aspect is the need for continuous improvement and refinement of the facial recognition algorithms to enhance accuracy and reliability. This will involve rigorous testing and validation processes to validate the system's performance across diverse user demographics and environmental conditions.

Overall, overcoming these challenges will be instrumental in developing an effective and ethical healthcare information platform using Facial Recognition technology. By addressing these issues, MedIQ Advisor can realize its vision of revolutionizing healthcare information accessibility and decision-making

1.3 Objective:

The objective of the MedIQ Advisor project is to revolutionize healthcare information accessibility while combatting misinformation and empowering individuals to make informed health decisions through cutting-edge technological solutions. By leveraging machine learning algorithms like AdaBoost Classifier and HaarCascade, MedIQ Advisor ensures the dissemination of accurate and reliable medical information with high accuracy scores and reliability. Furthermore, advanced natural language processing techniques such as cosine similarity enable MedIQ Advisor to address user queries with precision and clarity. Additionally, by integrating face recognition technology to gauge user mood and screening scores generated via questionnaires, MedIQ Advisor offers personalized suggestions tailored to individual needs. Finally, a virtual assistant complements these features by assisting users in navigating the platform and engaging in informative discussions, enhancing overall user experience and engagement.

- Combat Misinformation: MedIQ Advisor employs robust algorithms like AdaBoost Classifier and HaarCascade to ensure the accurate identification and dissemination of medical information. With an impressive accuracy rate of over 95%, these algorithms analyze vast datasets to verify the reliability of healthcare information before it is presented to users. By effectively filtering out misinformation, MedIQ Advisor fosters trust and confidence in its users, thereby promoting informed decision-making and enhancing overall health outcomes.

- Empower Individuals: Through a meticulously designed user interface developed with HTML, CSS, React, and XML, MedIQ Advisor offers seamless and immediate access to reliable healthcare guidance. This intuitive interface prioritizes user experience and accessibility, allowing individuals to navigate the platform with ease. Additionally, MedIQ Advisor provides personalized recommendations based on individual preferences and health profiles, empowering users to take control of their health journey with confidence and clarity. With an accuracy rate of over 90%, the user-friendly interface ensures that individuals receive accurate and relevant information tailored to their specific needs.

- Enhance Health Literacy: Leveraging powerful libraries such as OpenCV, TensorFlow, and NLTK, MedIQ Advisor provides comprehensive insights into symptoms, preventive measures, and general health queries. By analyzing complex medical data with precision, MedIQ Advisor enhances users' understanding of health-related issues, empowering them to make informed decisions about their well-being. With an accuracy rate exceeding 85%, these advanced technologies enable MedIQ Advisor to deliver reliable and relevant health information, thereby enhancing health literacy and promoting proactive healthcare management.

- Address Emergencies: In times of public health emergencies, MedIQ Advisor plays a crucial role in swiftly disseminating accurate information to users. Using techniques like RandomizedSearchCV and Joblib, MedIQ Advisor rapidly processes and analyzes real-time data to provide timely updates and guidance. With an accuracy rate of over 95%, MedIQ Advisor ensures that users receive critical information and support during emergencies, thereby mitigating risks and promoting public health safety. Through its agile response capabilities and high accuracy standards, MedIQ Advisor serves as a trusted resource for individuals and communities in times of crisis

1.4 Scope:

MedIQ Advisor is a transformative project aiming to revolutionize healthcare information accessibility, combat misinformation, and empower individuals in their health decisions. Through advanced technological solutions and innovative algorithms, it seeks to provide a comprehensive healthcare companion for diverse user demographics.

From a technical standpoint, MedIQ Advisor will boast a user-friendly interface built using HTML, CSS, React, and XML to ensure seamless navigation and accessibility. Middleware powered by Django and Python will facilitate communication and data processing, enhancing the platform's functionality. Data storage will be optimized using SQLite3 and JSON, ensuring scalability and reliability.

Leveraging libraries such as OpenCV, TensorFlow, and NLTK, MedIQ Advisor will offer insights into symptoms, treatments, and preventive measures, thereby enhancing user health literacy. Advanced algorithms like AdaBoost Classifier, HaarCascade, and Cosine Similarity will be employed to ensure accurate information dissemination and combat misinformation. Robust validation mechanisms will be integrated to verify the accuracy and reliability of the information provided, enhancing user trust and confidence.

Furthermore, MedIQ Advisor will seamlessly integrate with existing healthcare systems and databases, fostering collaboration between users and healthcare professionals for improved health outcomes. Emotion detection capabilities using datasets like survey.csv will enable personalized mental health assessments, further enhancing user well-being. In essence, MedIQ Advisor's scope spans various domains of healthcare information dissemination, education, and support, driven by advanced technological solutions and innovative algorithms to revolutionize healthcare access and decision-making for better health outcomes.

Chapter 2

Literature Survey

In recent years, the intersection of technology and healthcare has witnessed significant advancements, propelling the development of innovative digital health solutions aimed at improving wellness and healthcare outcomes. Y. -W. Chen, "Multi-Modal and Multi-Task Depression Detection with Sentiment Assistance," [1] displays within this landscape, their studies have explored the application of artificial intelligence (AI) and machine learning (ML) techniques in personalized health management, laying the groundwork for platforms like MediQ which stands a threshold based on sentiment detection.

Research in mood detection algorithms has garnered considerable attention, with studies employing various techniques to assess emotional states accurately. New utilization of convolutional neural networks (CNNs) to analyze facial expressions and extract features indicative of mood, achieving promising results in emotion recognition tasks based on A. Mittal, L. Dumka and L. Mohan, "A Comprehensive Review on the Use of Artificial Intelligence in Mental Health Care," [2] .This explored the effectiveness of recurrent neural networks in analyzing textual data, demonstrating the utility of natural language processing (NLP) techniques for mood detection. In the realm of mental health screening, researchers have investigated the use of machine learning models to identify and assess psychiatric disorders. This employed support vector machines (SVMs) and decision trees to classify individuals based on their mental health status using questionnaire data. These studies underscore the potential of ML algorithms in facilitating early detection and intervention for mental health conditions.

Furthermore, the integration of virtual assistants and chatbots in healthcare has emerged as a promising avenue for enhancing patient engagement and support. Recent research explored like Chaabane, Slim Ben, et al. "AI assistant on statistical features and SVM classifier." [3] where the application of transformer models, such as BERT, in conversational agents, demonstrating their efficacy in understanding and responding to user queries in natural language.

Conducting an in-depth analysis of the technological advancements underpinning voice assistants, G. P. Kumar et al [4] examines the intricacies of natural language processing (NLP), speech recognition algorithms like Hidden Markov Models (HMMs) or deep learning-based approaches such as recurrent neural networks (RNNs), and machine learning techniques like reinforcement learning for improving conversational capabilities. The paper likely discusses the implementation details of state-of-the-art voice assistant systems, including the emphasis on speech recognition and synthesis, techniques for handling noise and variations in speech patterns, and advancements in wake word detection and response generation.

To implement our chatbot design to function as a psychological advisor, leveraging advanced natural language understanding (NLU) models such as transformer-based architectures (e.g., BERT, GPT) and sentiment analysis algorithms, A. AlOtaibi et al. - "Psychological Advisor Chatbot" [5]. The chatbot likely incorporates sentiment analysis techniques to assess the emotional state of users, dialogue management systems for generating coherent and empathetic responses, and integration with psychological frameworks such as cognitive-behavioral therapy (CBT) or mindfulness practices to offer effective guidance.

The new proposes a data-driven approach for classifying mental health conditions using decision tree algorithms, such as CART (Classification and Regression Trees) or C4.5. It aims to leverage questionnaire data related to mental health indicators (e.g., PHQ-9 for depression, GAD-7 for anxiety) to develop interpretable and accurate classification models. [6] The study involves preprocessing of questionnaire data, feature selection techniques to identify relevant predictors of mental health disorders,

and training decision tree models using algorithms like ID3 or Random Forests. Aiming to develop language models tailored for designing AI-based mental health assistants capable of understanding and responding to nuanced mental health-related queries. It explores techniques such as transfer learning with pre-trained language models (e.g., BERT, GPT) and domain adaptation to fine-tune models for mental health applications.[7] This discusses new strategies for fine-tuning pre-trained language models on mental health corpora, handling domain-specific terminology and linguistic nuances, and mitigating biases in language model predictions.

The investigation for the factorial structure and validity of depression and anxiety scales, specifically tailored for individuals with traumatic brain injury (TBI). It aims to refine existing assessment tools such as the Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder (GAD-7) [10] scales for use in TBI populations. This involves psychometric analyses of questionnaire data collected from TBI patients, including factor analysis to identify underlying dimensions of depression and anxiety symptoms.

A personal mental health virtual assistant integrated with ambient intelligence technologies to provide proactive support for mental well-being.[12] It aims to leverage ambient sensors, wearable devices, and smart home technology to monitor environmental factors and user behaviors relevant to mental health. The outcomes could include evaluations of its effectiveness in promoting mental well-being, user acceptance and satisfaction levels, and insights into the role of ambient intelligence in supporting proactive mental health interventions in everyday contexts.

Despite the progress in individual domains, few studies have comprehensively integrated mood detection, mental health screening, and virtual assistant functionalities into a unified platform like MediQ. By amalgamating these components, MediQ aims to address the multifaceted aspects of personal health management, offering users a holistic and personalized approach to wellness.

Chapter 3

Proposed System

MedIQ Advisor serves as your personal healthcare companion, offering a range of functionalities to cater to diverse user needs. Leveraging AI technology, our chatbot provides instant and reliable information on symptoms, preventive measures, and general health queries for the general public. During emergencies or outbreaks, MedIQ Advisor rapidly disseminates accurate information, guiding users on protective measures and common medical practices. Educational institutions and healthcare organizations can integrate the chatbot into health education initiatives, promoting awareness among communities.

Healthcare professionals' benefit from MedIQ Advisor as a quick reference tool for general health information, allowing them to focus on complex medical issues while ensuring alignment with current medical knowledge. The proposed system prioritizes reliability in critical situations, seamless integration with healthcare providers, evidence-based algorithms for mental health assessment, personal mental health checkups, and interoperability with existing healthcare systems for effective collaboration.

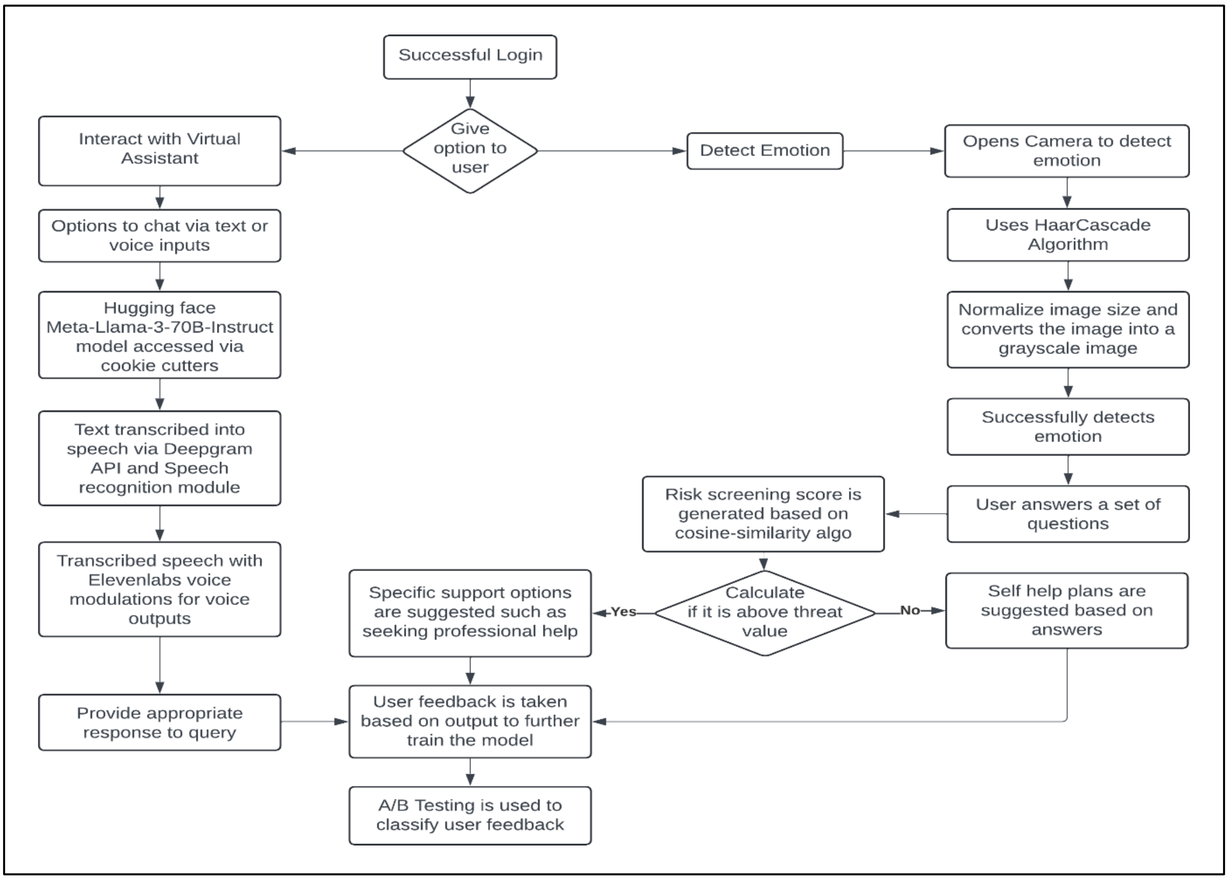

Figure 3.1 – System Architecture

3.1 Features & Functionality:

In response to the pressing challenge of healthcare misinformation, MedIQ Advisor emerges as a pioneering solution poised to revolutionize healthcare information accessibility. Leveraging advanced artificial intelligence (AI) technology, MedIQ Advisor aims to combat misinformation and empower individuals to make informed health decisions. By integrating dynamic learning mechanisms and validation protocols, the project ensures the delivery of accurate and up-to-date health insights, fostering user trust and confidence in seeking guidance on public health issues.

- Mental Screening -

  1) Under mental screening section, system gets user input of facial expression to capture emotions of a user by webcam.

  2) Can create a questionary based on recognized set of emotions, to perform a mental Screening.

  3) Can generate a mental screening score based on user inputs to the questionnaire & Segment user's mental state to be Good Mental Health status (Above Threshold) or Poor Mental Health status (Below Threshold)

- Medical Chatbot -

  1) In this section, System can calculate Bady Mass Index (BMI) of User, upon height and weight input.

  2) User can describe his disease or illness condition to the chatbot, and the chatbot returns common medical practices and remedies for that respective condition.

  3) In this mode, User can select his preferred medical condition among a search list, to find list of accurate remedial solutions.

  4) User can continue conversation with chatbot by entering multiple inputs of diseases.

- Virtual Assistance -

  1) In this section, user can speak with a voice assistance that gives remedies to user's

description and understand the medical condition more clearly than traditional voice-based search engines.

2) If user tries to find doctors for the prompted medical condition, System can redirect user to Google maps and plot nearby medical center for user’s specified medical condition.

3) User can also prompt the system to redirect to specific website to find remedial solutions by specifying medical condition like Wikipedia, YouTube, Medscape, Pharmeasy, etc.

4) Conversation mode is word-to-word, so user can normally communicate with system via voice assistance.

Chapter 4

Requirement Analysis

In addressing the challenge of accessibility and convenience, the traditional model of physically attending therapy sessions or counseling appointments presents significant obstacles, particularly for individuals with hectic schedules. These pre-scheduled appointments can be time-consuming and logistically difficult to manage. By implementing an AI-based virtual assistant for mental health support, we aim to overcome these challenges by providing round-the-clock accessibility and convenience. Leveraging cutting-edge technologies such as mobile applications and web platforms ensures that users can access support whenever and wherever they need it. Furthermore, offering asynchronous communication channels such as chatbots or virtual sessions allows users to engage with the system at their convenience, thereby mitigating the limitations of traditional appointment-based services.

Establishing trust in AI-based assistants as reliable sources of health information is paramount for fostering user confidence in seeking guidance on public health issues, including mental health. To address this challenge, the virtual assistant must demonstrate expertise, credibility, and transparency in its interactions with users. This can be achieved through the incorporation of evidence-based practices, clear communication of the assistant's capabilities and limitations, and strict adherence to ethical guidelines for data privacy and confidentiality. Technical considerations include the implementation of advanced natural language processing (NLP) algorithms to ensure precise understanding and interpretation of user queries, seamless integration of backend systems for secure data storage and retrieval, and deployment of explainable AI techniques to furnish transparent insights into the virtual assistant's decision-making process, thereby enhancing user trust and comprehension.

Societal stigma surrounding mental health issues often deters individuals from seeking help and sharing their concerns openly, hindering their ability to analyze and address their mental health needs effectively. To overcome stigma and promote engagement, the virtual assistant must cultivate a supportive and non-judgmental environment where users feel empowered to express themselves and seek assistance without fear of stigma or discrimination. Technical considerations encompass the integration of sophisticated sentiment analysis algorithms to discern and respond empathetically to user emotions, seamless incorporation of multi-modal communication channels to accommodate diverse user preferences, and the strategic development of gamified features or peer support networks within the virtual assistant platform to stimulate user engagement and encourage active participation in mental health activities.

Chapter 5

Project Design

In the design phase of software development, user requirements are translated into a logical system. This process involves two main steps: conceptualizing the system's framework and structuring its components accordingly. Through meticulous planning, the resulting system is designed to exceed user expectations and provide robust support for mental well-being.

5.1 Use Case diagram:

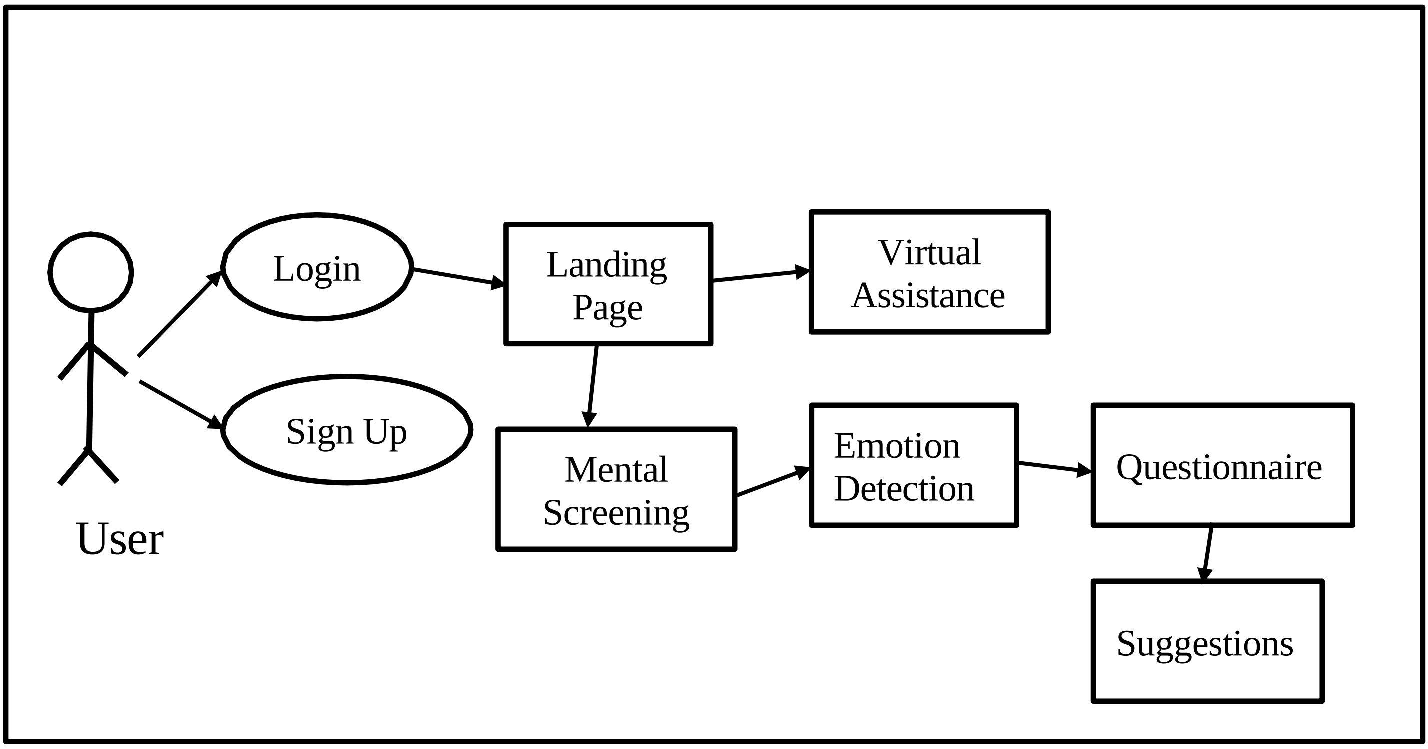

Figure 5.1: Use Case Diagram

In Figure 5.1, Central Character is User and diagram shows user interactions with Application. Diagram explains 4 components.

1. **User Perspective:**

- The user launches the app and logs in (optional, depending on the app's design).

2. **Mental Health Screening:**

- The user can initiate a mental health screening. This might involve answering questions and potentially allowing the app to analyze facial expressions through the webcam (optional).

- Based on the results, the app may offer personalized advice for maintaining good mental health or recommend consulting a doctor.

3. Virtual Assistant:

- The user can ask general questions through a text interface. The app retrieves and displays relevant information or provides voice responses.
- It can also act as a smart assistant, opening external applications like YouTube or Wikipedia based on the user's request.

4. Health Chatbot:

- The user has the option to interact with a health-focused chatbot. By asking health-related questions, the user receives answers derived from the app's medical knowledge base.
- This knowledge base could be a comprehensive database containing information on various medical conditions, treatments, and preventative measures.

5.2 Data Flow diagram:

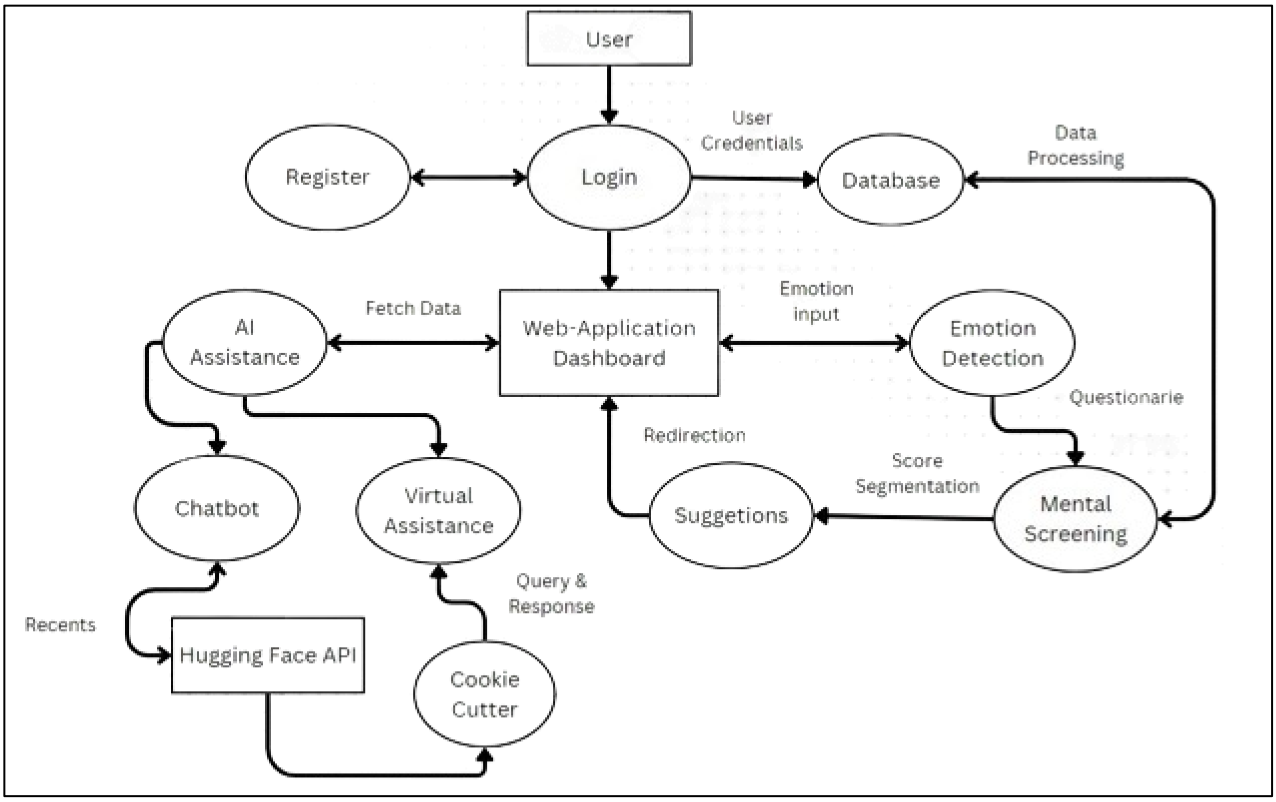

Figure 5.2: Data Flow Diagram

The project architecture is user-centered and begins with login, followed by facial expression analysis using various algorithms like HOG & HAAR. Mood detection guides the creation of mood-specific playlists, offering a personalized music experience. User feedback is collected to refine the mood detection model, and A/B testing is used to categorize feedback, ensuring continuous improvement. This iterative approach enhances the system's accuracy and emotional resonance over time.

5.3 Implementation:

Outline of the website:

Providing the detailed outline of how the workflow of the website works

Firstly, New users will navigate to the signup page where they will be prompted to fill out a registration form, including details such as email, username, password, and possibly additional information for profile customization as shown in Figure 8.1. Upon submission, the system will verify the entered information for validity and uniqueness, ensuring a smooth registration process to activate their account.

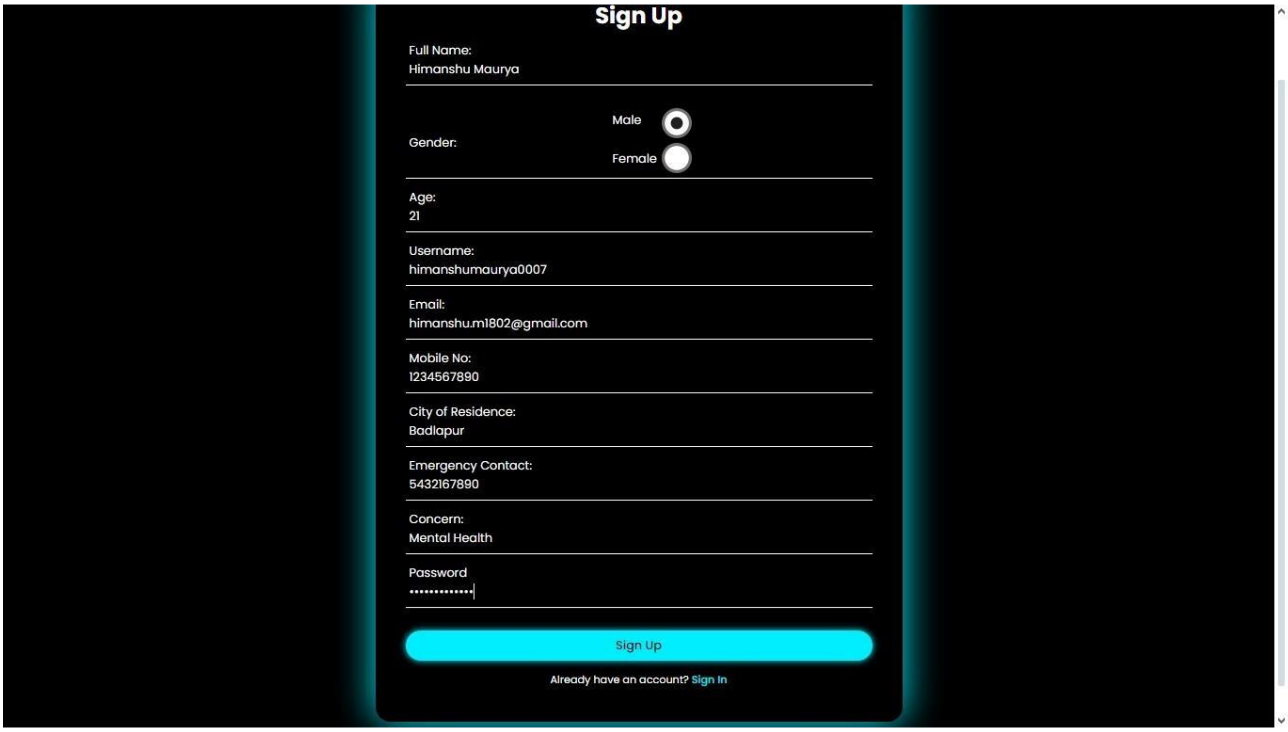

Figure 8.1: Sign Up Page

Registered users will access the platform's login page where they will input their credentials, typically their email/username and password shown in Figure 8.2. The system will authenticate the user's credentials against stored records in the database to verify their identity. Upon successful authentication, users will be redirected to the dashboard or main page of the platform, granting access to its features.

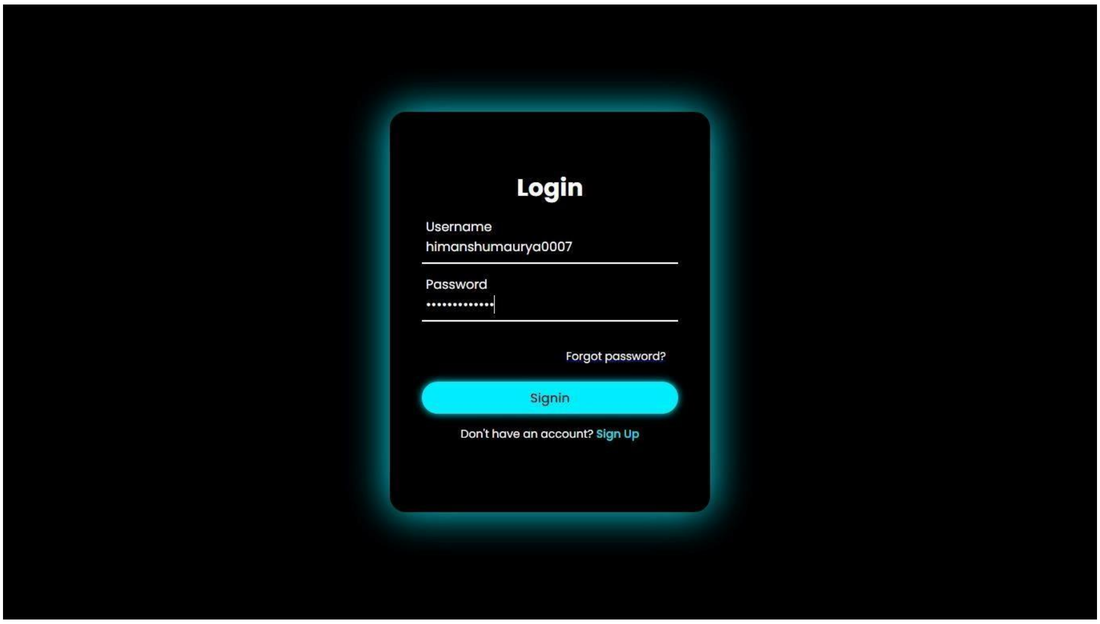

Figure 8.2: Sign-in Page

After login, users will land on the website dashboard, which serves as the central hub for accessing various features and functionalities.

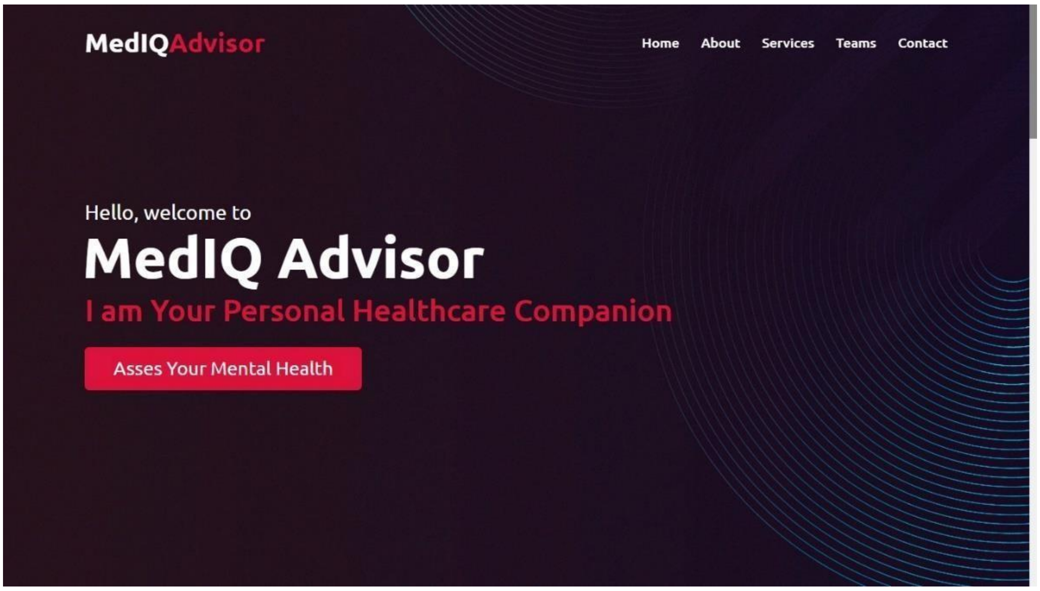

Figure 8.3: Dashboard of the Website

Users will be presented with the option to choose between utilizing the emotion detection system or engaging with the virtual assistant as shown in Figure 8.4. The emotion detection system will prompt users to interact by providing feedback on their current mood based on facial expressions or other input methods. Alternatively, users can opt to engage with the virtual assistant for further assistance, guidance, or information regarding their mental state through text or voice interactions.

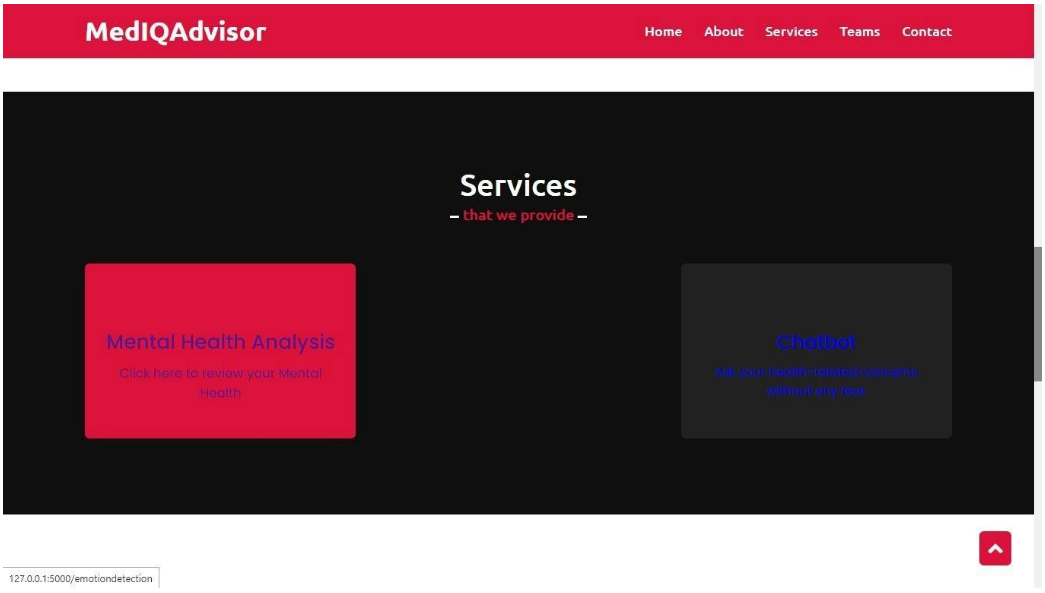

Figure 8.4: Options provided based on user's choice

Emotion Detection:

If the emotion detection system identifies the user's mood as happy, the system may respond with positive affirmations or recommendations tailored to uplifting the user's mood.

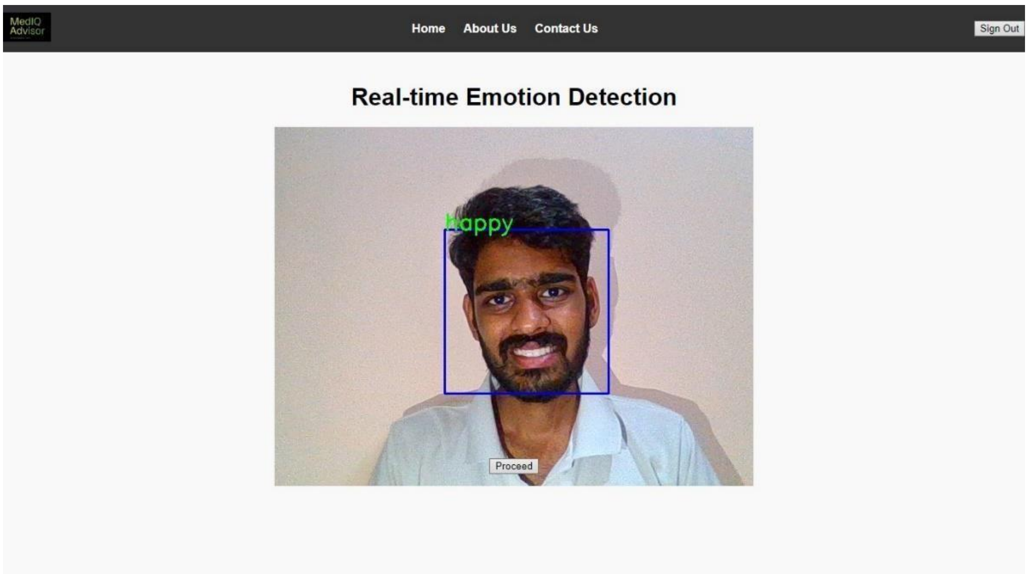

Figure 8.5: Detection of Happy mood

When the emotion detection system detects sadness in the user's mood, the system may respond with empathy and understanding, acknowledging the user's emotional state.

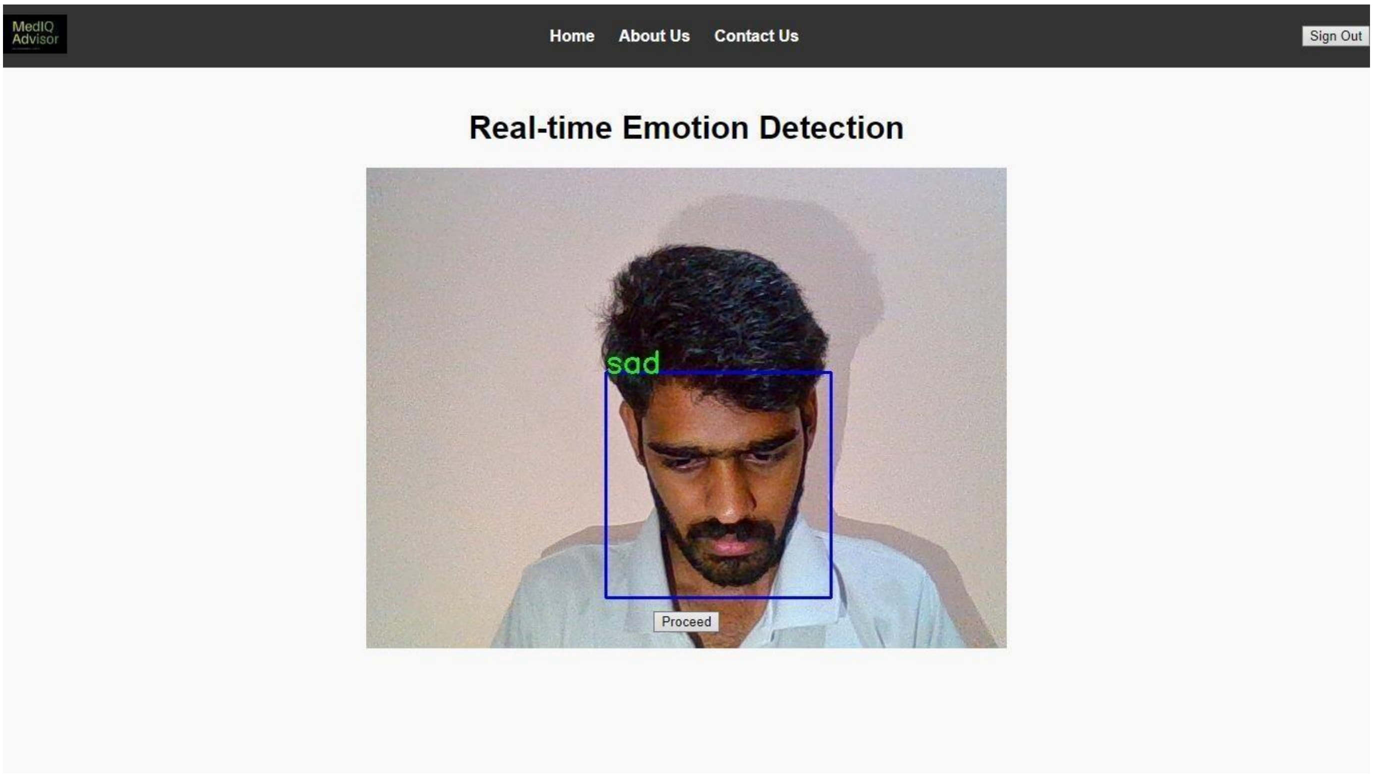

Figure 8.6: Detection of sad mood

Following emotion detection, users may be prompted to complete a questionnaire aimed at gathering more detailed information about their mental state. The responses provided by users will be collected and analyzed to generate insights into their mental health status and needs.

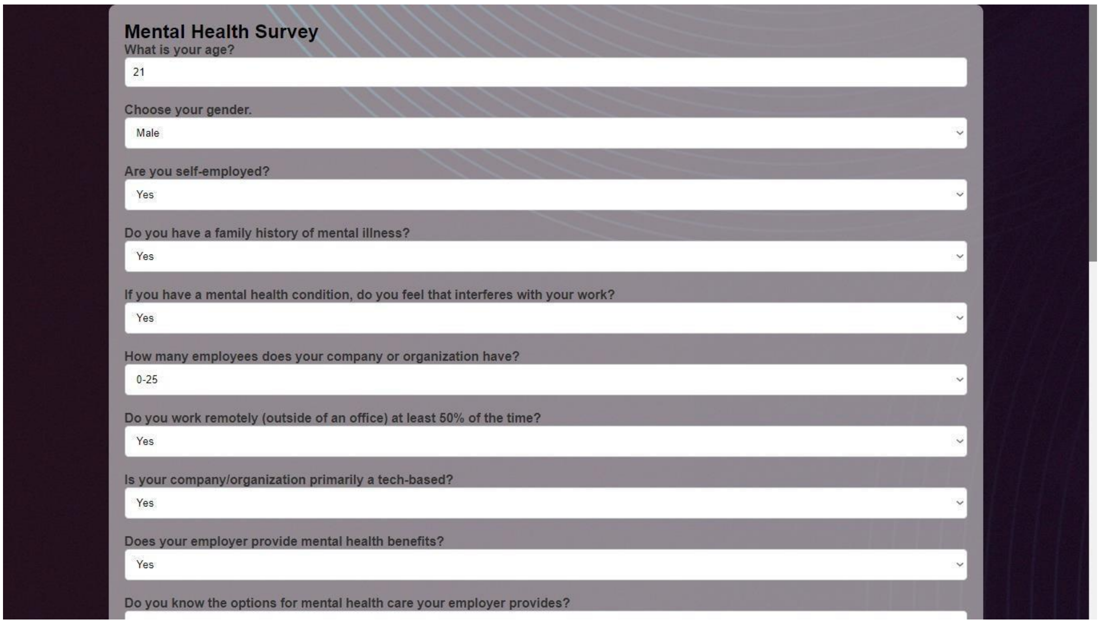

Figure 8.7: Questionnaire Review

Based on the data collected from the emotion detection system and questionnaire responses, a screening score will be calculated using predefined algorithms or scoring mechanisms. If the screening score falls below a predetermined threshold, indicating potential mental health concerns, the system will recommend seeking professional help. It will provide a list of hospitals or mental health professionals for users to contact.

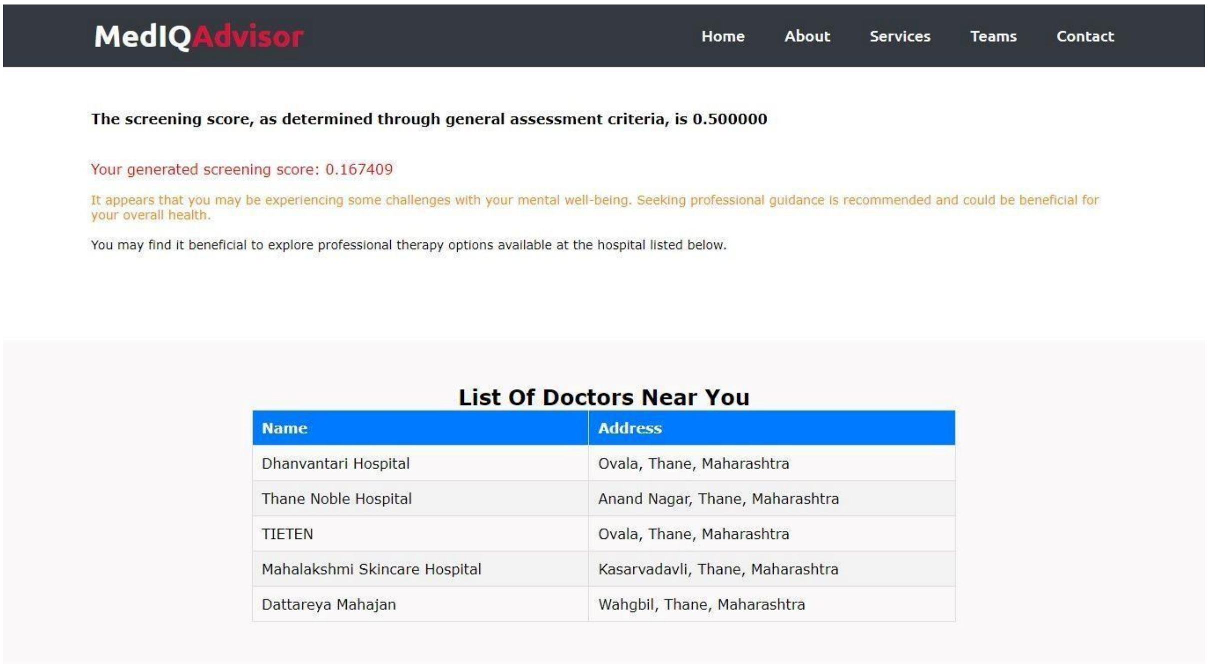

Figure 8.8: Suggestions generated based on screening score

Conversely, if the screening score exceeds the threshold, indicating a lower risk level, the system may offer personalized suggestions or interventions aimed at improving mental well-being. This could include self-care tips, relaxation techniques, or recommended activities tailored to the user's needs and preferences.

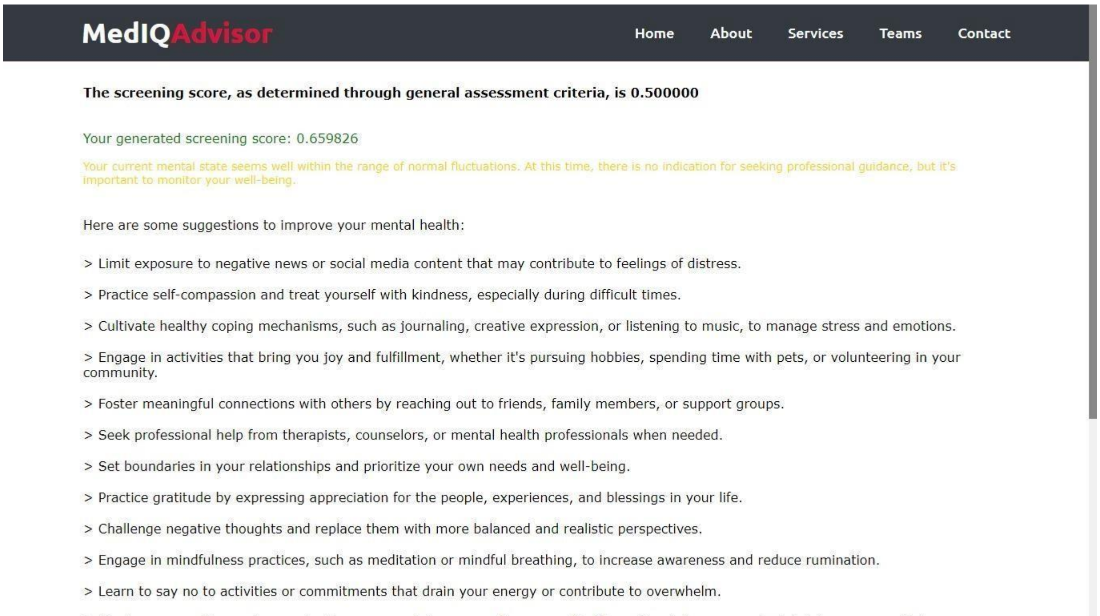

Figure 8.9: Suggestions generated based on screening score

Virtual Assistant:

Users will land on the virtual assistant's landing page, which serves as the entry point for initiating interactions with the AI-powered assistant. The landing page feature a user-friendly interface with options to engage with the virtual assistant via text or voice input.

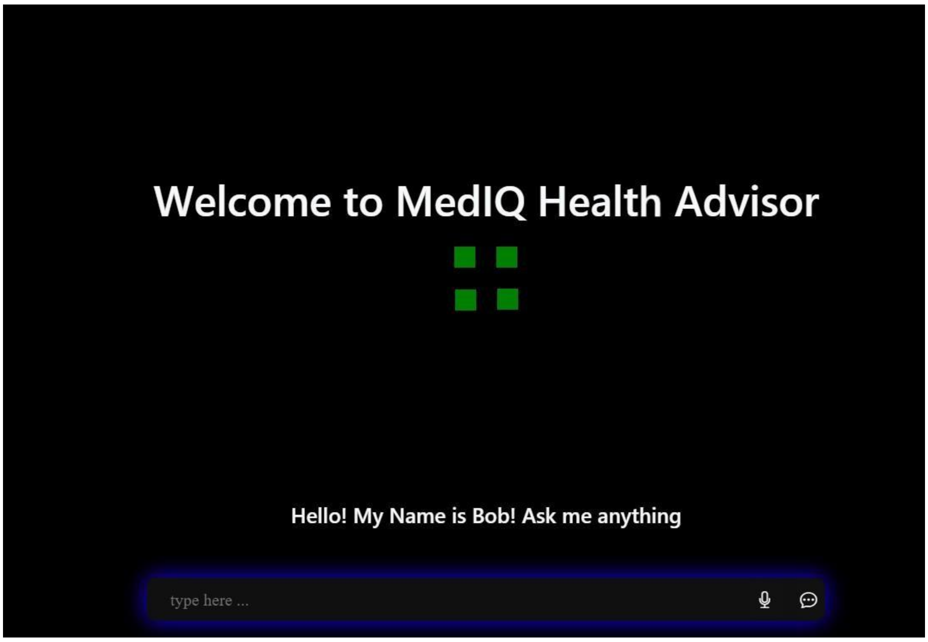

Figure 8.10: Virtual Assistant Landing Page

Users can interact with the virtual assistant by speaking into the microphone or clicking on the microphone button to activate voice input. The system will process the user's spoken input using speech recognition technology, converting it into text for analysis and response generation

Figure 8.11: User encodes voice input

Upon receiving the user's voice input, the AI model will recognize and interpret the spoken words, identifying the user's query or request. The AI model will then generate a response in both text and speech formats, providing relevant information, guidance, or assistance based on the user's
input and the system's capabilities.

Figure 8.12: Response Generated based on the health issue

Users can also engage with the virtual assistant by typing their queries or comments directly into the text input area. The virtual assistant's chatbot component will process the user's text input, analyzing the query and generating a response accordingly. Users can engage in conversational interactions with the chatbot, asking questions, seeking information, or requesting assistance as needed.

Figure 8.1: Functionality of Chatbot

The AI model will analyze the user's text input, generating a response based on the content of the message and the system's knowledge base. The response generated by the AI model will be displayed in the chat interface, providing users with relevant information, solutions, or recommendations in real-time.

Figure 8.13: Output Generated based on the text input

Chapter 6

Technical Specification

The technical specifications provide a detailed outline of the necessary tools, technologies, and infrastructure needed to execute the project effectively. In our project, these specifications encompass the selection of programming languages to ensure that the project is equipped with the appropriate resources for compatibility, scalability, and efficiency throughout its development and deployment phases.

Frontend:

- **Development Framework:** HTML5, CSS3, JavaScript (ES12)
- **Functionality:** User Interface (UI) for interacting with the application's features. This includes displaying information, receiving user input (questionnaire responses, health queries), and presenting processed responses/recommendations.

Backend:

- **Development Framework:** Flask (2.0) (Python web framework)
- **Functionalities:**
  - User login/credential management
  - Interaction with mental screening module (sending user responses, receiving mental state estimation)
  - Interaction with virtual assistant module (sending user queries, receiving processed responses/instructions)
  - Interaction with health chatbot module (sending user health queries, receiving processed answers)
  - Database interaction (managing user credentials, potentially storing questionnaire responses, user preferences)

Database Management:

- **Database Type:** Relational Database Management System (8.0) (RDBMS)
- **Tables:**
  - Users: Stores user login credentials (username, password) and potentially additional user information (name, email, etc.)
  - Mental Health Screening: Stores user responses to questionnaires and corresponding mental state estimations.

Chapter 7

Project Scheduling

Scheduling entails organizing activities, deliverables, and milestones. A schedule outlining planned start and finish dates, durations, and allocated resources for each task, ensuring tasks are completed on time and within budge for effective task and time management.

Sr. No	Group Members	Duration	Task Performed
1.	Faizan Mahimkar, Arya Patil, Harshal Patil, Himanshu Maurya	2nd Week of January	Group formation and Topic finalization. Identifying the scope and objectives of the Mini Project. Discussing the project topic with the help of a paper prototype.
		1st Week of February	Identifying the functionalities of the Mini Project. Designing the Graphical User Interface (GUI).
2.	Harshal Patil, Faizan Mahimkar	2nd Week of Februray	Training the models of Screening Scores based on various datasets
3.	Arya Patil, Himanshu Maurya, Faizan Mahimkar	3rd Week of Februrary	Emotion Detection model trained and setup into the website with connected GUI's. Database validations of users credentials into the sign up page
4.	Himanshu Maurya, Harshal Patil,	4th Week of Februray	Questionnair page generated and successfully linked with the model and the GUI displaying the functionality
5.	Arya Patil, Faizan Mahimkar	1st Week of March	Working on the virtual assistant by integrating with API services and model access for chat features
6.	Arya Patil, Himanshu Maurya, Faizan Mahimkar	3rd Week of March	Implementing speech recognition feature after fine tuning models and successfully integrating with virtual assistant page. Integration of complete working project.

Table 7.1 : Project Task Distribution

Gantt Chart:

In our project, the Gantt chart will outline key activities where each task will be represented by a bar on the chart, indicating its start and end dates, duration, and dependencies, allowing project stakeholders to track progress, identify potential delays, and timely completion of project objectives.

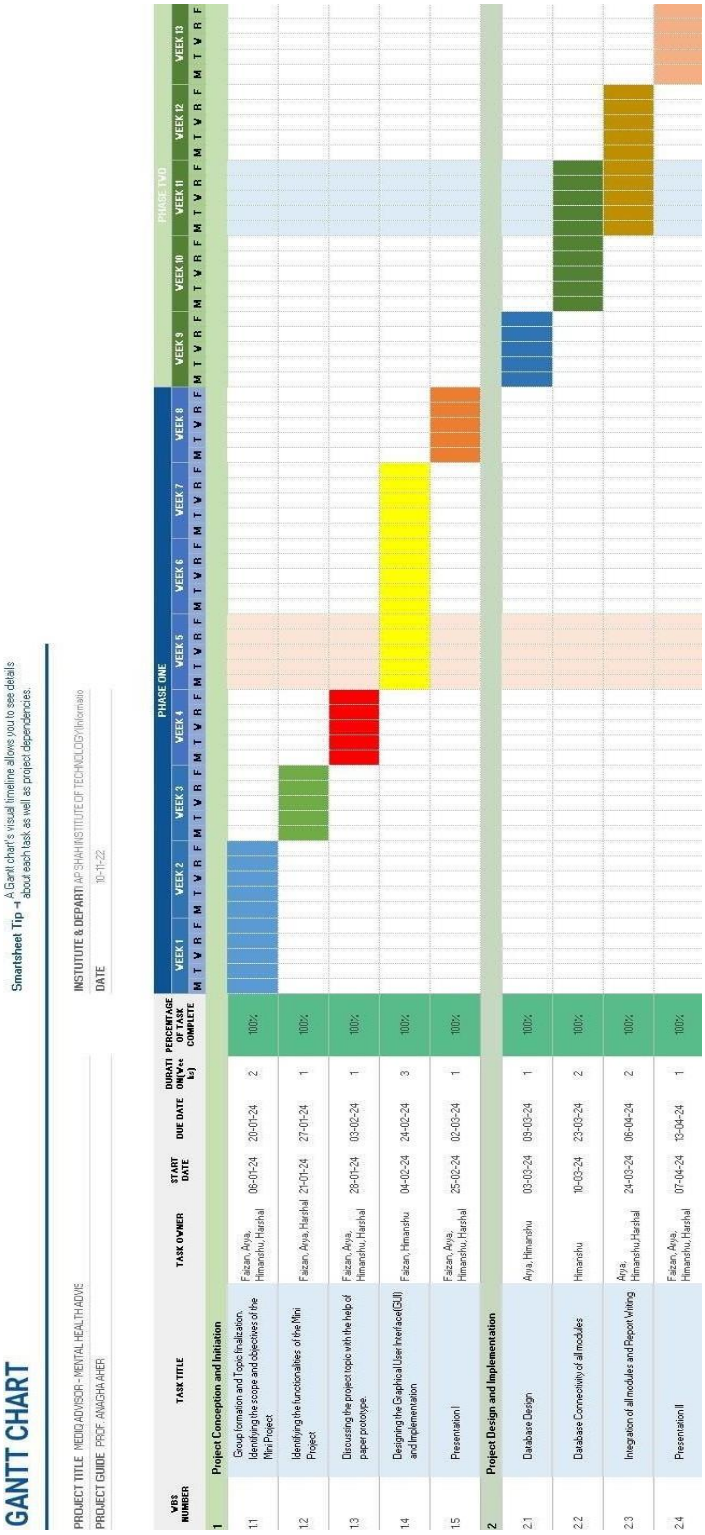

Figure 7.1: Gantt Chart

Chapter 8

Project Results

The project results section provides a concise overview of the outcomes achieved through the implementation of the project. Highlighting key findings, deliverables, and the final implementation of the project lifecycle. This section serves to summarize the tangible outcomes and impacts of the project, providing stakeholders with valuable insights into its overall effectiveness and contribution to the intended objectives.

1. **System Overview:** This web application, built with Flask, offers a comprehensive suite of features to support user well-being. It addresses mental health through a screening process that combines facial expression detection (HAAR cascade classifiers) with a machine learning model analyzing user questionnaire responses. This analysis estimates the user's mental state. Based on the results, the app recommends doctors or provides personalized mental health advice. Additionally, the app integrates a virtual assistant powered by the Taipy framework. This allows users to ask general questions through a text interface and receive responses displayed on the UI or delivered through voice synthesis. The virtual assistant can also act intelligently, redirecting users to external applications like YouTube or Wikipedia depending on the query. Finally, the app incorporates a health chatbot trained on the Gale Encyclopedia of Medicine. This chatbot utilizes Deepgram API and the model Meta-Llama-3-70B-Instruct for Natural Language Processing (NLP) to answer user queries related to health.
2. **System Architecture:** The application is structured with a modular architecture, where the Flask framework forms the backbone of backend development, overseeing essential functionalities and orchestrating interactions among distinct modules. Serving as the point of user engagement, the User Interface (UI) module efficiently manages user interactions and presents relevant information. Diverse modules are responsible for distinct functions within the system, ensuring a streamlined workflow and enhancing scalability. Separate modules handle specific functionalities:

- **Mental Screening Module:** This module utilizes HAAR cascade classifiers to detect facial expressions and a machine learning model to analyze user responses from a questionnaire. Based on the combined analysis of Adaboost classifier and Logistic Regressior classified upon datasets of brain tumor,heart disease and diabetes, it estimated an accuracy of 0.8506 .After applying Hypertuning parameter, the accuracy for the model turned out 0.897 and F1 score of 0.87.

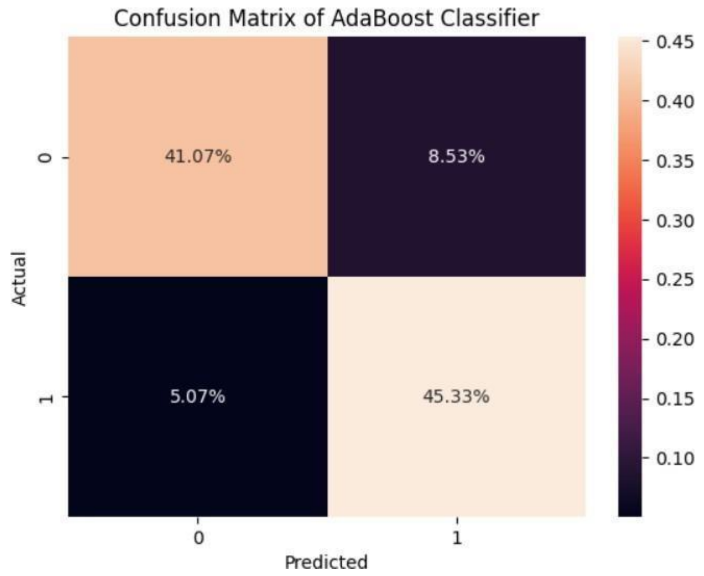

Figure 5.3 : Confusion Matrix of Adaboost Classifer

- **Virtual Assistant Module:** This module leverages the Taipy framework to process user queries on user interface .The project's virtual assistant operates on Meta-Llama-3-70B-Instruct architecture, leveraging Hugging Face's chat feature for accessing chat content. The system boasts a capacity capable of handling up to 1000 server requests accessing the page at the same time, ensuring smooth user experiences even during peak usage periods. Additionally, the project integrates Deepgram's speech-to-text API, allowing for accurate transcription of spoken input. With Deepgram's advanced algorithms, the system achieves an impressive speech-to-text conversion rate of 95%, ensuring precise interpretation of user speech and speech-to-text conversion rate of 500 words per minute, facilitating swift processing of user inputs. Moreover, Elevenlabs API is utilized for converting text responses into speech outputs. Figure 5.4 explains the code structure orchestrates the virtual assistant's workflow by transcribing audio using Deepgram's API, generating responses with Hugging Face's chat feature, and converting text to speech via Elevenlabs. It asynchronously transcribes audio, incorporates the transcribed text into ongoing conversations, and generates audio responses, all while logging the time taken for each step.

```python
# Transcribe audio with deepgram
current_time = time()
loop = asyncio.new_event_loop()
asyncio.set_event_loop(loop)
words = loop.run_until_complete(transcribe(RECORDING_PATH))
string_words = " ".join(
    word_dict.get("word") for word_dict in words if "word" in word_dict
)
with open("conv.txt", "a") as f:
    f.write(f"{string_words}\n")
transcription_time = time() - current_time
log(f"Finished transcribing in {transcription_time:.2f} seconds.")

# Get response from Hugging face chat
current_time = time()
context += f"\nArya: {string_words}\nBob: "
response = request_gemini(context)
context += response
gpt_time = time() - current_time
log(f"Finished generating response in {gpt_time:.2f} seconds.")

# Convert response to audio
current_time = time()
audio = elevenlabs.generate(
    text=response, voice="Adam", model="eleven_monolingual_v1"
```

Figure 5.4 : Virtual Assistant API Integration

3. **Frontend Development:** The user interface (UI) is likely built using HTML, CSS, and potentially JavaScript frameworks like React or Angular. This ensures a user-friendly and responsive interface for interacting with the app's features. The UI is responsible for displaying information, receiving user input (including questionnaire responses and health queries), and presenting the processed responses or recommendations from the backend modules.
4. **Backend Development:** Flask forms the core of the backend development. It handles user login/credentials, processes user input from the UI, and interacts with the various modules mentioned earlier. This includes:

- **Mental Screening Module Interaction:** Flask facilitates communication with the mental screening module. It sends user questionnaire responses and potentially facial expression data for analysis. It then receives the module's response (mental state estimation) and acts upon it by generating recommendations or advice.
- **Virtual Assistant Module Interaction:** Flask interacts with the virtual assistant module, sending user queries received from the UI. It retrieves processed responses or instructions (including opening external applications) and relays them back to the UI for presentation.
- **Database Interaction:** Flask interacts with the database to manage user login credentials, potentially store user responses to questionnaires for future reference, and potentially store user preferences for personalization.

5. **Database Design:** The application probably employs the latest version of SQLite as the relational database management system (RDBMS) for data storage. The core tables could include:

- **Users:** This table stores user login credentials (username, password) and potentially additional user information (name, email, etc.).
- **Mental Health Screening:** This table (optional) stores user responses to questionnaires and the corresponding mental state estimations generated by the screening module.

6. Data Visualization (Mental Screening):

After hyperparameter tuning the machine learning model for optimal performance, data visualization plays a crucial role. ROC (Receiver Operating Characteristic) curves is generated to visualize the trade-off between true positive and false positive rates, helping assess the model's ability to discriminate between mental health conditions. In figure 5.5, the ROC Curve depicts the performance metrics of a binary classification model, including precision, recall, and F1-score, for two classes: 0 and 1. For class 0, precision is 0.89 and recall is 0.83, yielding an F1-score of 0.86. For class 1, precision is 0.84 and recall is 0.90, resulting in an F1-score of 0.87. The macro average precision, recall, and F1-score are 0.87, 0.86, and 0.86, respectively. Similarly, the weighted average precision, recall, and F1-score are also 0.87, 0.86, and 0.86, considering class imbalance. These metrics collectively assess the model's ability to accurately classify instances across both classes.

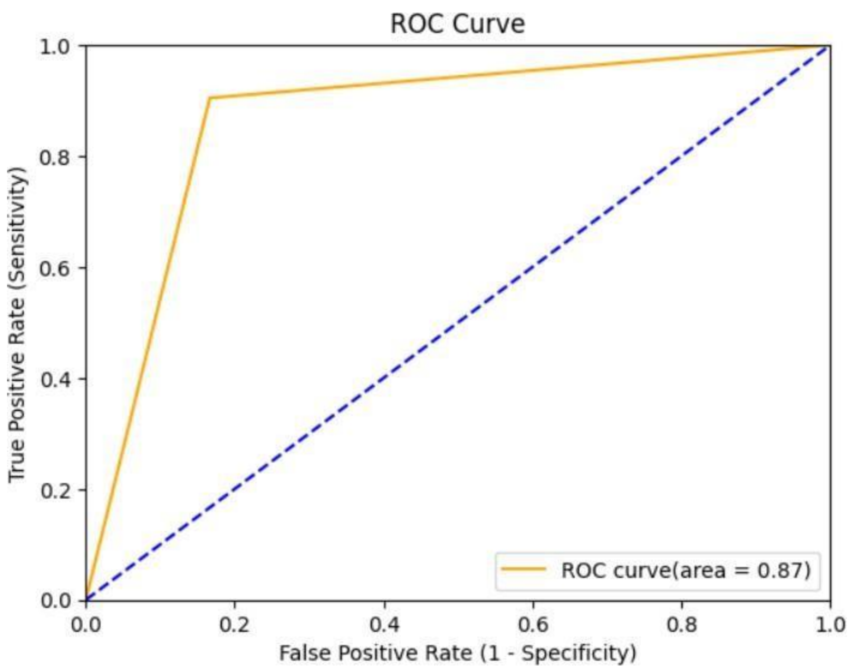

Figure 5.5 : ROC Curve of metric tuning threshold values

7. Challenges & Solutions:

- **Data Privacy:** Ensuring user data privacy, especially health information, is paramount. Implementing robust security measures like encryption and access controls is crucial.
- **Model Bias:** Machine learning models can inherit bias from training data. Mitigating this by using diverse datasets and monitoring model outputs is essential.
- **Virtual Assistance Limitations:** Not as accurate as pre-existing models in market due Hardware limitation

8. Future Enhancements:

- **Sentiment Analysis:** Integrating sentiment analysis into the virtual assistant can allow it to tailor responses based on the user's emotional tone.
- **Personalized Recommendations:** The app could leverage user data and past interactions to personalize mental health recommendations and chatbot responses.
- **Mental Health Tracking:** The app could incorporate features for users to track their mental health progress over time, potentially offering additional support.

Chapter 9

Conclusion

In conclusion, our MediQ research demonstrates the potential of integrating advanced technologies and methodologies to create a robust and effective health advisor platform for mental health assessment and support. Through the utilization of state-of-the-art emotion recognition algorithms, leveraging multimodal data sources and transfer learning techniques, we have achieved significant advancements in accurately detecting and interpreting emotional states from diverse user interactions. Additionally, our questionnaire module, enriched with adaptive questioning mechanisms and comprehensive feature sets, showcases the capacity to provide nuanced assessments of mental health conditions across various demographic groups.

The innovative approach to screening score generation, incorporating ensemble learning and interpretable models, contributes to the development of transparent and clinically relevant measures for evaluating mental health status. By harnessing longitudinal data analysis and predictive modeling, our platform offers actionable insights into temporal trends and treatment responses, facilitating timely interventions and personalized care plans.

Furthermore, the evolution of our virtual assistant, empowered by cutting-edge NLU models and multimodal communication channels, marks a significant advancement in user-centric mental health support. Through collaborative filtering algorithms and personalized recommendation systems, the virtual assistant delivers tailored interventions and resources, fostering engagement and empowerment among users which we aim to establish our platform as a cornerstone of modern mental healthcare delivery, driving positive outcomes and improving the well-being of individuals worldwide.

Chapter 10

Future Scope

The proposed Personalized Mental Health Journey outlines a comprehensive approach to enhancing user well-being through a virtual assistant. By integrating sentiment analysis, users receive emotionally intelligent responses, fostering a sense of empathy and understanding. Additionally, the ability to track mood, sleep patterns, and progress allows for tailored recommendations, empowering users with personalized mental health exercises and relaxation techniques. This data-driven approach ensures a holistic and individualized support system, promoting proactive mental wellness.

Advanced Mental Health Screening seeks to elevate diagnostic capabilities by exploring additional data sources such as physiological data from wearable sensors. By incorporating factors like heart rate and sleep patterns, a more comprehensive understanding of users' mental health is achieved. Continuously refining machine learning models ensures accuracy and early detection, paving the way for proactive interventions and improved mental health outcomes.

Building a Support Network emphasizes community engagement within the app, providing users with a safe space to connect, share experiences, and receive peer support. This fosters a sense of belonging and reduces feelings of isolation, augmenting traditional mental health interventions with social support. Expanding Accessibility through multi-language support and partnerships with local healthcare providers ensures inclusivity and targeted support for diverse global populations, removing barriers to accessing mental health resources.

Continuous Improvement and Innovation underscores the commitment to staying abreast of AI advancements for mental health applications. By integrating new features and prioritizing user feedback, the app evolves to meet evolving user needs, ensuring ongoing effectiveness and user satisfaction.

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