SENTIMENT VOICE ANALYSIS ALERT SYSTEM FOR AGED PEOPLE USING AI

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SENTIMENT VOICE ANALYSIS ALERT SYSTEM FOR AGED PEOPLE USING AI

ABDULAZIZ TAWFIK OTHMAN

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Bachelor of Computer Science (Computer Networks & Security)

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ABSTRACT

Aged people in retirement homes are susceptible to emotional instability due to inadequate personalized emotional monitoring, potentially leading to depression, increased social withdrawal, and a significant reduction in quality of life. No retirement homes currently utilize Artificial Intelligence (AI) to proactively assess or manage the emotional well-being of aged people, which underscores a critical gap in utilizing advanced technology for caregiving. This study introduces the Sentiment Voice Analysis Alert System for Aged People, an innovative solution that employs AI to analyze emotional states through voice analysis. Utilizing machine learning algorithms and neural networks, the system processes voice recordings from caregivers, providing real-time emotional insights displayed on a system's dashboard. This system also includes a live chat feature to enhance immediate communication between caregivers and family members, fostering better support and involvement. Emotional state notifications are sent to family members via SMS, keeping them informed and engaged in the care process. The proposed integration of this AI system into every retirement home aims to revolutionize caregiving practices by providing continuous emotional support and improving intervention timeliness, thus significantly enhancing the overall well-being and emotional health of aged people. The project achieved its set objectives by developing a voice-based sentiment analysis system for elderly care, incorporating essential features like live chatting to enhance communication between caregivers and patients' relatives. The system, based on user requirements, effectively aids in monitoring and alerting caregivers about the emotional states of the elderly. A sophisticated machine learning model using neural networks and MLP classifiers was developed and tested, accurately classifying emotions such as panic, calm, and happy from voice samples. The robustness of the sentiment analysis model and the SMS alerting mechanism was confirmed through extensive testing with a large dataset. The addition of a live chat feature further enhances real-time interaction, allowing for immediate response and support, thereby significantly improving the system's utility and the quality of care provided to elderly individuals. By leveraging AI and sentiment analysis techniques, the system has brought forth an innovative solution to combat the challenges faced by aged individuals in retirement homes. The achievements of the project objectives highlight the potential of the system to make a positive impact on the lives of the aged people, addressing their emotional needs and fostering a sense of well-being, support, and connection. One potential area for improvement lies in the refinement of the sentiment analysis model. As the system evolves, incorporating a larger and more diverse dataset can enhance the accuracy and robustness of emotion detection. By training the model on a broader range of voice recordings and emotions, the system can better capture subtle nuances and variations in emotional states. Additionally, exploring advanced machine learning techniques or alternative sentiment analysis algorithms can provide further insights into emotional patterns and improve the system's performance.

ABSTRAK

Warga emas di rumah persaraan terdedah kepada ketidakstabilan emosi disebabkan oleh pemantauan emosi peribadi yang tidak mencukupi, yang berpotensi membawa kepada kemurungan, peningkatan penarikan sosial dan pengurangan ketara dalam kualiti hidup. Tiada rumah persaraan pada masa ini menggunakan Kecerdasan Buatan (AI) untuk menilai atau mengurus secara proaktif kesejahteraan emosi warga emas, yang menggariskan jurang kritikal dalam menggunakan teknologi canggih untuk penjagaan. Kajian ini memperkenalkan Sistem Makluman Analisis Suara Sentimen untuk Orang Tua, penyelesaian inovatif yang menggunakan AI untuk menganalisis keadaan emosi melalui analisis suara. Menggunakan algoritma pembelajaran mesin dan rangkaian saraf, sistem memproses rakaman suara daripada penjaga, memberikan cerapan emosi masa nyata yang dipaparkan pada papan pemuka sistem. Sistem ini juga termasuk ciri sembang langsung untuk meningkatkan komunikasi segera antara penjaga dan ahli keluarga, memupuk sokongan dan penglibatan yang lebih baik. Pemberitahuan keadaan emosi dihantar kepada ahli keluarga melalui SMS, memastikan mereka dimaklumkan dan terlibat dalam proses penjagaan. Cadangan penyepaduan sistem AI ini ke dalam setiap rumah persaraan bertujuan untuk merevolusikan amalan penjagaan dengan menyediakan sokongan emosi yang berterusan dan meningkatkan ketepatan masa intervensi, sekali gus meningkatkan dengan ketara kesejahteraan keseluruhan dan kesihatan emosi warga emas. Projek ini mencapai objektif yang ditetapkan dengan membangunkan sistem analisis sentimen berasaskan suara untuk penjagaan warga emas, menggabungkan ciri penting seperti sembang langsung untuk meningkatkan komunikasi antara penjaga dan saudara-mara pesakit. Sistem ini, berdasarkan keperluan pengguna, berkesan membantu dalam memantau dan memberi amaran kepada penjaga tentang keadaan emosi warga tua. Model pembelajaran mesin yang canggih menggunakan rangkaian saraf dan pengelas MLP telah dibangunkan dan diuji, dengan tepat mengklasifikasikan emosi seperti panik, tenang dan gembira daripada sampel suara. Kekukuhan model analisis sentimen dan mekanisme amaran SMS telah disahkan melalui ujian meluas dengan set data yang besar. Penambahan ciri sembang langsung meningkatkan lagi interaksi masa nyata, membolehkan tindak balas dan sokongan segera, dengan itu meningkatkan dengan ketara utiliti sistem dan kualiti penjagaan yang diberikan kepada individu warga emas. Dengan memanfaatkan AI dan teknik analisis sentimen, sistem itu telah menghasilkan penyelesaian yang inovatif untuk memerangi cabaran yang dihadapi oleh individu berumur di rumah persaraan. Pencapaian objektif projek menyerlahkan potensi sistem untuk memberi impak positif kepada kehidupan warga emas, menangani keperluan emosi mereka dan memupuk rasa kesejahteraan, sokongan dan perhubungan. Satu bidang yang berpotensi untuk penambahbaikan terletak pada penambahbaikan model analisis sentimen. Apabila sistem berkembang, menggabungkan set data yang lebih besar dan lebih pelbagai boleh meningkatkan ketepatan dan keteguhan pengesanan emosi. Dengan melatih model pada rangkaian rakaman suara dan emosi yang lebih luas, sistem boleh menangkap nuansa dan variasi halus dalam keadaan emosi dengan lebih baik. Selain itu, meneroka teknik pembelajaran mesin lanjutan atau algoritma analisis sentimen alternatif boleh memberikan cerapan lanjut tentang corak emosi dan meningkatkan prestasi sistem.

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LIST OF ABBREVIATIONS

AI	-	Artificial Intelligence
ANN	-	Artificial Neural Network
CMS	-	Content Management System
CSS	-	Cascading Style Sheets
FR	-	Functional Requirements
HTML	-	Hypertext Markup Language
HTTPs	-	Hypertext Transfer Protocol Secure
RDBMS	-	Relational Database Management System
ML	-	Machine Learning
MLP	-	Multilayer Perceptron
MVC	-	Model View Controller
MFCC	-	Mel-Frequency Cepstral Coefficients
NFR	-	Non-Functional Requirements
SMS	-	Short Message Service
UTM	-	Universiti Teknologi Malaysia

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Sentiment Voice Analysis Alert System for Aged People using AI is a proposed solution aimed at enhancing the emotional well-being of aged individuals residing in retirement homes. This innovative system harnesses the power of artificial intelligence (AI) to analyse the sentiment of voice recordings manually submitted by caregivers. By leveraging machine learning algorithms and neural networks, the AI model can effectively assess the emotional state of aged individuals and provide a comprehensive mood indicator accessible through a user-friendly dashboard for caregivers.

The Sentiment Voice Analysis Alert System goes beyond the confines of the retirement home. It ensures that family members are kept informed about the emotional state of their aging parents through weekly SMS messages. By receiving regular updates, sons and daughters can gain peace of mind and promptly address any concerns or take necessary actions if their parent is experiencing negative emotions.

1.2 Problem Background

Aged people residing in retirement homes face a significant challenge in terms of limited social interaction and emotional support, which can profoundly affect their well-being. The absence of regular social connections and companionship often leads to feelings of loneliness, isolation, and a diminished sense of belonging. The emotional needs of aged individuals are crucial, as they strive to maintain a positive outlook and overall quality of life during this stage of their journey.

Aged individuals may encounter difficulty in expressing their emotions effectively, exacerbating the emotional strain they experience. The inability to articulate their feelings can hinder communication and hinder the provision of appropriate support and care. This, in turn, can negatively impact their mental and physical health, leading to increased vulnerability and diminished overall well-being.

1.3 Project Aim

The aim of this project is to develop an AI-based Sentiment Voice Analysis Alert System for Aged People in retirement homes. The project seeks to create an AI model that analyses the sentiment of voice recordings of aged individuals, which are manually submitted by caregivers. By utilizing machine learning and artificial neural network (ANN) techniques, the AI model will accurately assess the emotional state of the aged person and generate a mood indicator accessible to Caregivers through a dedicated dashboard. aim shows what you plan to achieve in one sentence.

the project aims to enhance family involvement and support by implementing a weekly SMS notification system. The system will automatically generate updates on the emotional state of the aged person and send them to their sons and daughters. This feature will give family members peace of mind and enable them to take proactive measures if their parent is experiencing negative emotions. By keeping family members informed, the project aims to foster a stronger support network and promote the overall emotional well-being of aged individuals.

To further support real-time interaction and engagement, the project will incorporate a live chat system tat will allow family members to communicate directly with the Caregivers overseeing their aged person relatives' care. The live chat aims to facilitate immediate consultation and advice, enhancing the responsiveness and effectiveness of the emotional support provided.

1.4 Project Objectives

The objectives of the project are:

(a) To study the user requirements for the voice-based sentiment analysis system that will help take care of the aged people and alert their caregiver in case of panic emotions.

(b) To develop a machine learning model using neural network and MLP classifier that will perform sentiment analysis on the voice files uploaded to the system and classify them into categories such as panic, calm, and happy.

(c) To test the accuracy and reliability of the developed sentiment analysis model and the SMS alerting system using a large dataset of voice samples, and to improve the system based on feedback from users and testing results.

1.5 Project Scope

The scopes of the project are:

(d) Development of a machine learning-based AI model that analyses the sentiment of voice recordings submitted by Caregivers of aged people in retirement homes.

(e) Integration of the AI model with a dashboard accessible to caregivers, providing them with a mood indicator showing the emotional state of many aged persons over time.

(f) Focusing on detecting the 3 most important emotions happy, calm and panic

(g) 1 time a day updating the family relative via SMS message

1.6 Project Importance

The project's importance lies in its potential to enhance emotional support, facilitate timely interventions, strengthen family engagement, promote a holistic approach to well-being, and advance the integration of AI in healthcare. By addressing the emotional well-being of aged individuals in retirement homes, the project aims to improve their quality of life, reduce feelings of isolation, and establish a more comprehensive and person-centered care approach.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide an overview of the integral technologies that form the foundation of the proposed project: sentiment voice analysis, AI, and alert systems for aged individuals. This chapter aims to explore the current state of these technologies, examine their real-world applications, and identify their existing limitations.

2.2 Background study of AI sentiment analyses

Python AI sentiment analysis, particularly in voice recognition, leverages powerful Python libraries such as Librosa and Scikit-learn to develop advanced applications in speech emotion recognition. This technology utilizes audio files to identify and classify different human emotions expressed through speech, essential in settings like retirement homes where understanding emotional states from residents' voices can greatly enhance caregiving.

Key to this process is the extract_feature function, which processes sound files to extract acoustic features integral to determining emotional context. These features include Mel Frequency Cepstral Coefficients (MFCCs), which are crucial for capturing the essence of speech that relates to emotional states. Additionally, the analysis involves Chromagram from Short-Time Fourier Transform (STFT) and Mel-scaled spectrogram.

The emotion recognition model hones in on a subset of emotions, defined in a dictionary that maps specific emotional states to certain audio file labels, derived from the RAVDESS dataset. This focused approach allows the system to train on targeted emotional expressions, enhancing both its accuracy and efficiency. The system employs the Multi-Layer Perceptron (MLP) classifier—a type of Artificial Neural Network (ANN) known for its effectiveness in handling pattern recognition tasks. By training this classifier on the extracted features, the system can accurately predict emotions from new audio inputs.

This AI-based analysis forms part of a broader Content Management System (CMS) designed for Caregivers to monitor and manage the emotional wellbeing of aged people efficiently. The underlying architecture of this system is based on the Model View Controller (MVC) design pattern, ensuring a clear separation between data models, user interfaces, and the control logic. Additionally, the system's data is managed through a Relational Database Management System (RDBMS), which supports complex queries and transactions necessary for handling extensive data involved in AI analyses.

2.2.1 Retirement houses currently

Currently, retirement homes primarily utilize conventional systems for managing and storing data about patients. These systems, while functional, lack the advanced capabilities that artificial intelligence (AI) can offer. The incorporation of AI into these systems could significantly enhance the efficiency and effectiveness of care provided to aged people.

The introduction of AI technologies in retirement homes could lead to several transformative benefits. For instance, AI-driven analytics can monitor health trends and predict potential medical issues before they become severe, thereby allowing for timely medical intervention. Furthermore, AI can personalize care procedures based on the individual health data of residents, ensuring that each patient receives the most effective treatment tailored to their specific needs.

Moreover, AI can automate routine tasks such as scheduling, medication management, and the monitoring of vital signs. This automation would not only reduce the workload on healthcare staff but also minimize human error, leading to higher standards of care. Additionally, AI-powered systems can provide companionship and mental stimulation to residents through interactive applications, which is crucial for maintaining mental health.

2.3 Current System Analysis

There are two systems that have been chosen in this project consist AI in sentiment analysis, the ElliQ robot device by Sending Notification Through Messaging System to the family members for communication and health report, and the Voiceitt system analysing the voice recording. The purpose of the analysis to discuss several functionsand component similarities with the current system to sending an alert or a notification application and analysing patient voice.

2.3.1 ElliQ

ElliQ is an advanced social robot designed to assist and provide companionship to older adults. Created by Intuition Robotics, ElliQ is named after Elli, the Norse goddess of aging. This robot is engineered to promote healthy, independent aging at home by providing emotional support and companionship. ElliQ is proactive and voice-operated, offering a range of services such as medication reminders, entertainment, health and wellness support, and even engaging in conversation to alleviate loneliness. Its design integrates subtle movements, lights, and sounds to create personalized interactions, making it a unique presence in the lives of seniors (Robotic, 2023). The main objective of the voice submission is to improve the emotional well-being of aged individuals residing in retirement homes. The voice will help Caregivers to address the challenges faced by these individuals, such as the lack of social interaction and emotional support, which often leads to feelings of loneliness and isolation enabling caregivers fast interventions and support by analysing voice recordings. Here is the figure to illustrate system flow:

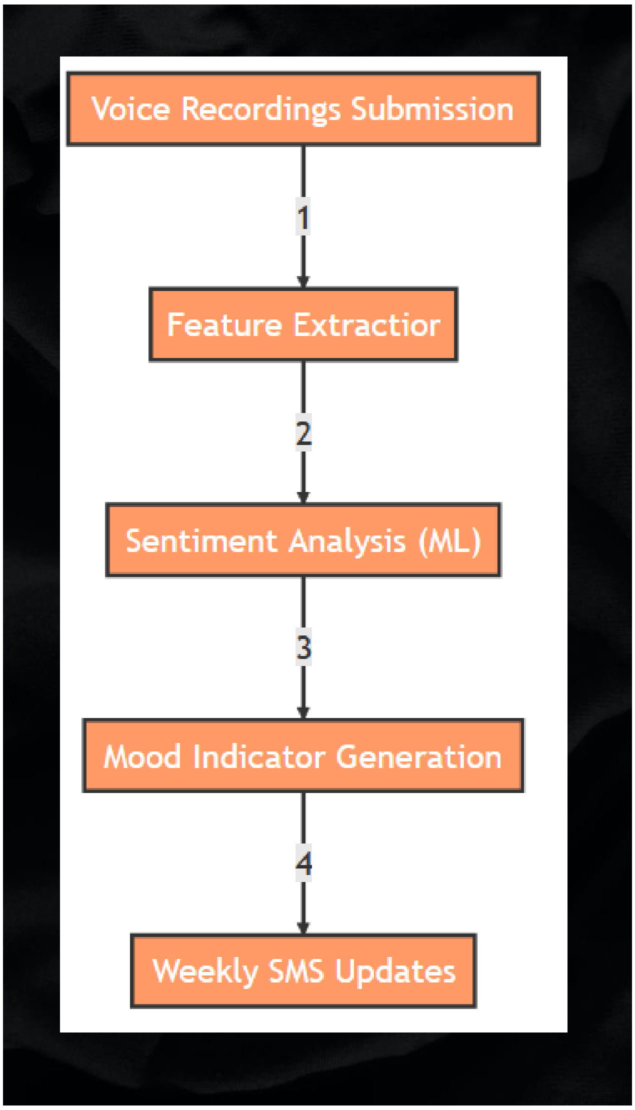


Figure 2.1 System flow, submitting voice

After the record is submitted, the AI model will start extracting the features in the voice. And by Features I mean the details that makes the model certain that this record is for an aged person or for a sad aged person for example and that can be things like the waves form and other more complex algorithms in the library that will train our AI model. Once the model is trained, it will generate the categorical result, either the person is sad, happy, relaxed and this is what will be returned to the dashboard and the family as a feedback of weekly SMS updates.

2.3.2 Voiceitt

Voiceitt is an accessible and inclusive voice AI technology designed primarily for people with speech disabilities (voiceitt, 2024). It functions as both an Augmentative Alternative Communication (AAC) tool and an Assistive Technology (AT) tool. Voiceitt enables individuals with non-standard speech or speech impairments to communicate effectively with others or interact with technology. It provides features like speech-to-text and speech-to-speech translation, allowing users to control their environment, including dictation and home automation.

2.4 Similarities between existing systems

While there is currently no existing system or application that shares the same goals or concept as the proposed system, an application known as Voiceitt deserves mention. Voiceitt employs state-of-the-art speech recognition technology with the objective of deciphering and comprehending speech patterns and vocalizations of individuals with speech impairments. Although its primary focus is not specifically on sentiment voice analysis for the aged people, it exemplifies the progress made in voice recognition technology that could potentially have applications within the aged people population.

Another notable application in this domain is ElliQ. Serving as an interactive robot companion, ElliQ is purposefully crafted to offer social and emotional assistance to the aged people. By harnessing the power of AI technology, it possesses the ability to discern and address the emotional cues and individual needs of its users. While its primary focus may not revolve around sentiment voice analysis, ElliQ serves as a prime example of seamlessly integrating AI advancements into the realm of senior care, fostering companionship and emotional well-being for older adults.

Table 2.1 Similarities table Voiceitt, ElliQ and current system

Feature	**ElliQ**	**Voiceitt**	**Sentiment Voice Analysis Alert System**
Target Audience	Aged people	Individuals with speech impairments	aged people in retirement homes
Objective	Social and emotional assistance	Deciphering speech patterns	Improve emotional well-being
AI Technology	Yes	Yes	Yes
Voice Analysis Capability	Analyses emotional cues	Analyses speech patterns	Analyses sentiment in voice recordings
Data Storage and Analysis	Collects and stores user data	Collects and analyses user speech data	Collects and analyses voice recordings
Centralized Data Management	Yes	No	Yes
Historical Data Preservation	Yes	No	Yes
Personalization	Tailored to individual needs	Tailored to individual speech patterns	Tailored to individual emotional state
Companionship	Offers companionship and interaction	Focuses on speech recognition	Focuses on emotional well-being
User Interface	Robot companion with interactive features	Mobile application	Web-based dashboard and SMS updates
Integration with Family	Yes	Yes	Yes

In comparison, the proposed AI system places a greater emphasis on serving as a centralized platform for organizations, facilitating the storage of data related to aged people while also preserving historical sentiment analysis results. This comprehensive approach enables the collected data to be further studied and analysed. By providing a centralized hub for data management, the proposed AI system caters specifically to the needs of organizations working with aged people, offering an avenue for comprehensive analysis and insight generation from the accumulated data.

2.5 Literature Review of Technology Used

This part of the literature review will be explaining in more detail, the type of technologies,software, hardware, and tools that will be used to develop this system. The technologies that will be used in this system such as Django, Twillio API, pusher API and Visual Code Studio.

2.5.1 Django

Django is a programming framework that makes deploying the project and handling the database structure easy and with a few commands in any system. The project will relay on Django as it is compatible with the AI model and easy to integrate to feed the AI the data and get the results of the mood indication and store it in the database to further use the data and make it as information for the Caregivers so they can make rational decision and have overview on their patients.

2.5.2 Twillio API

Twilio API plays a crucial role in enhancing the communication capabilities of applications. It offers a broad suite of communication tools which include SMS, voice calls, and even video chats. For this project, the Twilio API is particularly important because it allows the system to send automated SMS messages and potentially make voice calls as part of the notification system. This capability is essential in ensuring that users are kept up-to-date with relevant information in real-time, improving user engagement and satisfaction.

2.5.3 Pusher API

Pusher API is integral to enabling real-time functionality in web applications. It is primarily used for adding real-time data and interactivity features such as live chats and notifications. In this project, Pusher will be utilized to handle instant data updates without requiring users to refresh their browsers. This not only enhances the user experience but also ensures that the application can handle asynchronous data with high efficiency.

2.5.4 Visual Studio Code

Visual Studio Code is a lightweight code editor with built in support for JavaScript, TypeScript, and Node.js, as well as a robust eco-system of extensions for other programming languages including C ++, Java, C #, PHP, Go, Python and Dart. It also provides developers with a tool for quick code build debugging, leaving complex workflows behind. Furthermore, because VSC supports a wide range of feature extensions, writing code using dart programming is faster and more efficient. As a result, Visual Studio Code was chosen as a platform for writing code for web applications, and it also includes debugging capabilities similar to Android Studio.

2.5.5 ANN

Artificial Neural Networks (ANNs) are inspired by the neural structure of the human brain. In the literature, ANNs have been extensively researched and applied across various domains. They have demonstrated remarkable success in areas such as image and speech recognition, natural language processing, and medical diagnosis. ANNs are particularly effective for tasks that involve complex, high-dimensional data due to their ability to learn and model non-linear relationships. The foundational work on ANNs dates back to the mid-20th century, but significant advancements have been made in recent decades with the development of deep learning techniques and more sophisticated network architectures.

2.6 Chapter Summary

The chapter emphasized the importance of considering factors such as programming language familiarity, project requirements, scalability needs, and community support when selecting a web development framework. By understanding the features and benefits of different frameworks, developers can make informed decisions and choose the framework that best suits their specific needs.

CHAPTER 3

SYSTEM DEVELOPMENT METHODOLOGY

3.1 Introduction

The development of the proposed emotion detection and alerting system for aged people in retirement homes involves a systematic and well-defined methodology to ensure its successful implementation. This section outlines the system development methodology that will guide the project from inception to completion. The methodology encompasses various stages, including requirements gathering, system design, development, testing, and deployment.

3.2 Methodology Choice and Justification

The Agile methodology is well-suited for projects that require frequent iterations, adaptability to changing requirements, and close collaboration with stakeholders. Agile methodology is an iterative process in project management and system development where it strongly focuses on the user experience and input for the system. Scrum is a method in the agile methodology that concentrates on managing and structuring the workflow of the system and every iteration in Scrum is known as a sprint. Every small process will be evaluated and tested by the customer over the previous release. Through this method, the improvement and problems can be solved quickly during the evaluation with the customer to deliver a high-quality result. The other approach in agile methodology is the Kanban method that continuously flows of work that only focuses on the priority task in the system development and it also does not have a sprint. In Kanban, the release update of the system will deliver the task that completed at any time without having a specific schedule or predetermined due dates. Thus, for this project, Kanban in Agile methodology will be used during system development. following are the phases involved to develop the proposefpusherd system with the help of in the chosen methodology:

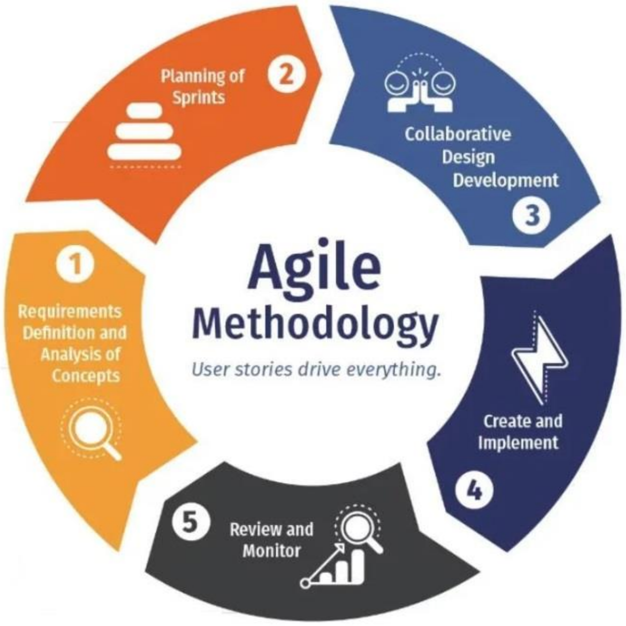

Planning of Sprints
2
Collaborative Design Development
3
1
Requirements Definition and Analysis of Concepts
Agile Methodology
User stories drive everything.
Create and Implement
4
5
Review and Monitor

Figure 3.1 Agile methodology lifecycle

3.3 Agile Phases

3.3.1 Requirements Definition and Analysis of the Concepts

reading researches and papers about the aged people in the retirement house, how are their emotions and mental health. Making sure the system I’m creating will be helpful for the aged people and gathering the requirement for the system and what the system should be capable of doing.

Figure 3.2 Python is the best integration option for system development with AI integration

Selecting the best programming language and framework to be used for the purpose of developing the system was one of the keys to get into the final result. In my case Python was the best programming language option to be considered because my AI model is developed using python, so it was much easier to use a framework developed by python so that the integration process will take less time than with other framework like Laravel or angular. Beside that, python have all the libraries one will need to create such complex model that uses advance algorithms with human voice frequency levels and pitches.

3.3.2 Planning of Sprints

Determine the scope of each sprint of the sentiment analysis system, breaking down requirements into manageable tasks for PSM 1 and PSM 2, estimating effort and resources, and creating a sprint backlog.

First step of the plan was to communicate with a caregiver in the field who works in a retirement house and get what he would expect the system pages to be and the functionalities in the system. After knowing this, figuring out how the final system UI should be is more into imagination and creativity.

Second step is to start developing the most important functionalities and features in the system and display it to the caregiver to get his opinion, what to add, anything to delete or if any idea would be better than the one implemented

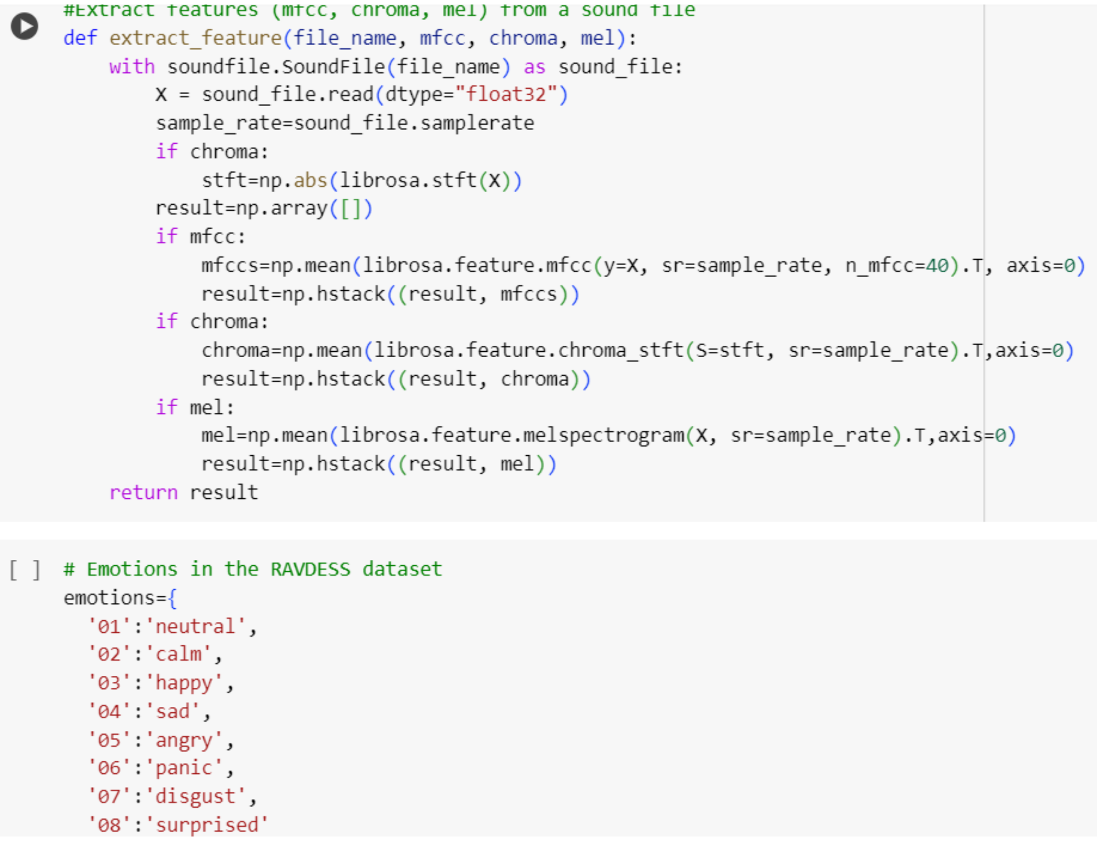
After that is to continue developing until getting the system near the production stage. The system then displayed to the same caregiver and the feedbacks are taken into notes and fixed and launching the system.

3.3.3 Collaborative Design Development

Designing the UI and system mechanisms according to the previous gathered information to make sure the system is as near to the users as they would like it to be in a smooth and ease. Designing the AI MFCC voice features extraction model.

The UI design planned to be using normal html css markup languages. The design is inspired by the the project I have done during taking application development subject in UTM, where I was hanlding the backend and helping the front end developers in some of the design portion. The colors selected to reflect pleasure and positivity and avoided colors like black or gray.

The AI model designed and run using Google Colab. All whole dataset is uploaded to the platfrom to be used by python codes that will train the model. The model is designed to run outside Google Colab and thus it was saved as .sav file which is like a standalone AI model that can be run from anywhere.



```
#Extract features (mfcc, chroma, mel) from a sound file
def extract_feature(file_name, mfcc, chroma, mel):
    with soundfile.SoundFile(file_name) as sound_file:
        X = sound_file.read(dtype="float32")
        sample_rate=sound_file.samplerate
        if chroma:
            stft=np.abs(librosa.stft(X))
        result=np.array([])
        if mfcc:
            mfccs=np.mean(librosa.feature.mfcc(y=X, sr=sample_rate, n_mfcc=40).T, axis=0)
            result=np.hstack((result, mfccs))
        if chroma:
            chroma=np.mean(librosa.feature.chroma_stft(S=stft, sr=sample_rate).T,axis=0)
            result=np.hstack((result, chroma))
        if mel:
            mel=np.mean(librosa.feature.melspectrogram(X, sr=sample_rate).T,axis=0)
            result=np.hstack((result, mel))
    return result
```

```
# Emotions in the RAVDESS dataset
emotions={
  '01':'neutral',
  '02':'calm',
  '03':'happy',
  '04':'sad',
  '05':'angry',
  '06':'panic',
  '07':'disgust',
  '08':'surprised'
```

Figure 3.3 AI Design

The model is designed to handle one request per time where the caregiver can upload once voice to be analysed which take about 30sec to be function and then they can upload another. During the upload and getting the result the SMS alert functionality was integrated with the AI model which takes around 10 secs sums up to 40 sec for the AI model to analyses the SMS alert to alert the relatives.

3.3.4 Create and implement

Preparing the system for deployment, addressing any issues, and ensuring a smooth deployment process.

The system was deployed into the internet to be publically usable using servers in Singapore and paid domain name.

3.3.5 Review and Monitor

Engaging in ongoing feedback loops, incorporating phycologists feedback and suggestions, and continuously refining and iterating the system based on changing requirements and emerging insights.

The caregiver's feedback and suggestion was always in mind during the developing face and after the production face. The live chatting system was a suggestion from the caregiver which was implemented and uploaded as an updated version of the system v2.0

3.4 Technology Used Description

3.4.1 Front End

3.4.1.1 Dashboard and Analytical Tools

A dashboard will be developed to provide Caregivers with an accessible interface for viewing and analyzing the emotional states of aged individuals over time. Technologies such as HTML, CSS, and JavaScript will be used to create an interactive and user-friendly dashboard.

3.4.2 Back end

3.4.2.1 Django

Django is a programming framework that makes deploying the project and handling the database structure easy and with a few commands in any system. The project will rely on Django as it is compatible with the AI model and easy to integrate to feed the AI the data and get the results of the mood indication and store it in the database to further use the data and make it as information for the Caregivers so they can make rational decision and have overview on their patients.

3.4.2.2 SMS API

Twillio API free account will be used in the system to illustrate updating the family members with SMS messages.

3.4.2.3 Python

Python is a versatile and widely-used programming language that will serve as the primary language for developing the system. Its extensive libraries and frameworks make it suitable for tasks such as data processing, machine learning, and web development.

3.4.2.4 Librosa

Librosa is a Python library specifically designed for music and audio analysis. It provides functionality for audio feature extraction, including tools for analysing the emotional content of voice recordings. Librosa will be utilized for pre-processing and extracting relevant features from the voice data.

3.4.2.5 Machine Learning and Neural Network

In this project, an AI-based Sentiment Voice Analysis Alert System will be developed to enhance the emotional well-being of aged individuals in retirement homes. By leveraging machine learning and neural networks, the system aims to provide accurate assessments of the emotional states of the aged individuals, which will be displayed on a dedicated dashboard for caregivers. The development of the AI-based Sentiment Voice Analysis Alert System involves several steps, including data preprocessing, feature extraction, model training, and evaluation. The following describes the method used to implement the Artificial Neural Network (ANN) for this project.

i. Data Preprocessing

The dataset used in this project is the RAVDESS (Ryerson Audio-Visual Database of Emotional Speech and Song) dataset, which contains voice recordings with various emotional expressions. The relevant emotions for this study are 'calm', 'happy', 'panic', and 'disgust'. The data preprocessing steps include:Scikit-learn

i. **MFCC (Mel-frequency cepstral coefficients)**: Captures the short-term power spectrum of the audio signal.

ii. **Chroma**: Represents the intensity of the 12 different pitch classes (semitones of the musical octave).

iii. **Mel-spectrogram**: Provides a representation of the short-term power spectrum of the sound on a nonlinear mel scale of frequency.

The extract_feature function reads each audio file, computes the STFT for chroma features, and then calculates the mean of MFCCs, chroma, and mel-spectrogram features. These features are concatenated into a single feature vector for each audio file.

ii. Feature Extraction

Feature extraction is a crucial step to transform the raw audio signals into a set of numerical features that can be used to train the ANN. The librosa library is employed to extract the following features:

iii. Splitting the Dataset

The extracted features and corresponding labels are split into training and testing sets using the train_test_split function from sklearn.model_selection. This ensures that the model is evaluated on unseen data to assess its generalization performance.

iv. Model Training

The core of the sentiment analysis system is an Artificial Neural Network implemented using the Multi-layer Perceptron (MLP) classifier from sklearn.neural_network. The model is configured as follows:

- **Input Layer**: Receives the extracted features.

- **Hidden Layer**: Contains 300 neurons, specified by hidden_layer_sizes=(300,).

- **Output Layer**: Produces the final predictions for the emotional state.

The model is trained on the training dataset using the `fit` method, which adjusts the weights of the network to minimize the error between predicted and actual labels.

v. Prediction

For a new voice recording, features are extracted using the same process. The feature vector is reshaped and passed to the loaded model to predict the emotional state. The predicted emotion is then used to generate a mood indicator accessible through the dashboard.

By following these steps, the ANN effectively learns to analyze the sentiment of voice recordings, providing valuable insights into the emotional states of aged individuals in retirement homes.

3.4.2.6 Soundfile

Soundfile is a Python library that allows for reading and writing audio files. It will be utilized to handle the input and output of voice recordings in .wav formats. Soundfile provides convenient functions for manipulating audio data during the analysis process.

3.5 System Requirement Analysis

This section will be discussing the requirements of hardware and software that are needed during the development of this project for the system and web application.

3.5.1 Software Requirement

This section explains the software requirement that used in the proposed system. Table 3.3 shows the software requirement and its functionalities that will use along in developing the proposed system.

Table 3.1 Software Requirements

Requirement	Function
Twillio.com	• An SMS API to update the patient relatives on the proposed system
Pusher.com	• A real-time messaging API to handle the two way messages for proposed system
Visual Studio Code	• A platform to write, debug and run a code and develop web application
Django	• Include the packages and command line todevelop django app
Django builder	• Django modeling to store a data from the proposed AI trained model

3.5.2 Hardware Requirement

This section explains the software requirement that used in the proposed system. Table 3.3 shows the software requirement and its functionalities that will use along in developing the proposed system.

Table 3.2 Hardware Requirements

Hardware	Function
PC or laptop i7++ with RAMS 16++	• To be able to run virtual machines
VMWare	• to run the website and edit it on linux
Monitor	• For better visibility and comfort while programming

3.6 Chapter Summary

This chapter provided a comprehensive understanding of the system development methodology, technology stack, and system requirement analysis, setting the foundation for the subsequent stages of system design, development, testing, and deployment. These aspects ensure that the emotion detection and alerting system can effectively enhance the emotional well-being of aged individuals, facilitate targeted interventions by caregivers, and provide peace of mind to family members.

CHAPTER 4

REQUIREMENT ANALYSIS AND DESIGN

4.1 Introduction

In this chapter, based on the system function discussion in the previous chapter will be explained in more details into use case diagram, sequence diagram and activity diagram. Moreover, the interface of web app for the proposed system and also database proposedsystem design will be discussed in this chapter. Unified Modelling Language (UML) diagram is used as a guidance to design a complete proposed system based on the collective information andrequirements in the previous chapters.

4.2 Requirement Analysis

The development of the project consists the analysis of the requirement of the proposed system that involving caregiver. User requirements is the overview of the system functionalities and features from the user viewpoint in order to ensures the proposed system meetsthe user requirements.

The expected requirements for the users:

1. Caregiver able to log into the website
2. Caregiver can upload the recording and track emotions of his patient
3. Family member get notified daily about their relative status

4. Relatives can have direct chatting with the caregiver responsible of taking care of their patient relative

System admin is an important role in every created system to make sure the system running insmoothly for users. Hence, system admin is required to accomplish any activities according to expected requirements for users including analysing system logs, identifying potential issues withcomputer systems and other reliable operation of computer system. therefore, system admin can perform various of specific task as caregiver according to module and other specific activity task caregiver cannot do.

The expected requirements for system admin:

1. Admin able to enter and perform system admin site

2. Admin able to view the registered user database

3. Admin able to modify user database

4. Admin able to view user activities data

5. Admin can log out from system site

4.2.1 Use Case Diagram

Use case diagram consists several of actors that represent users in the proposed system. Use case diagram designated to show the exemplar of the roles, activities and the functions that user can execute within the system to fulfil the expectation needed for the actors. Figures 4.1 shows the overall use case diagram Aged People AI Recognition Web Application.

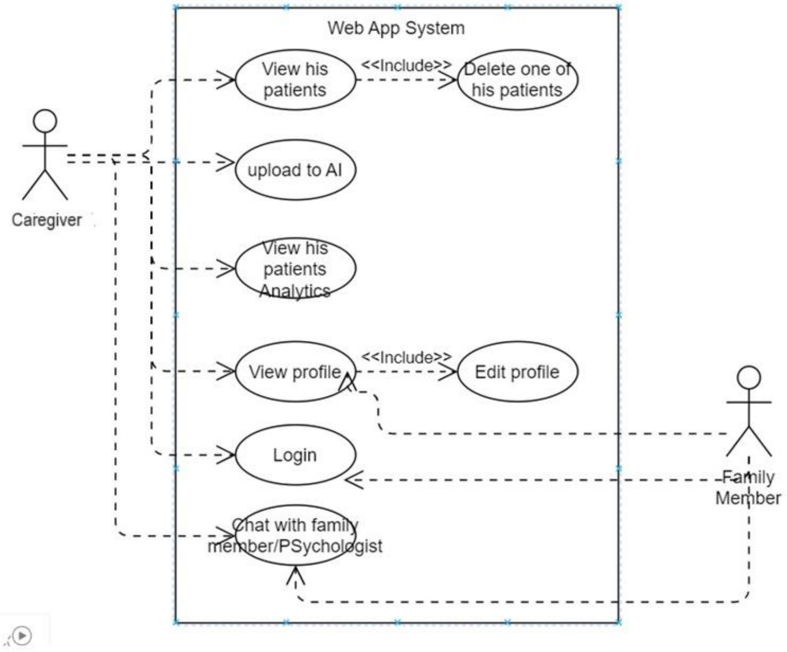


Figure 4.1 Overall use case for Aged People AI Recognition Web Application

Based on the Figure 4.1 show there are two types of actors for the website which are caregiver, patient relative. Both of the actors will perform specific activities according totheir particular roles. Next, the use of use case in each of the actors will be explained in more details.

4.2.1.1 Use Case of Caregiver

Based on the use case diagram in Table 4.1, caregiver able to log in to the website, view profile of patient under him only, upload voice to the AI for a specific patient to be analysed and added to the data, and see the general and individual analytics generated by the website. Caregiver also receive messages from the families for any questions, consultation arrangement, health or health update about their relative patient.

4.2.1.2 Activity Diagram for Relatives

Table 4.1 List of Caregiver Actions

User case	Description
Uploading voice to the AI	The caregiver can only upload .wav recordingfile to the AI to be analysed
Live chatting with family members	The caregiver can chat with the patientrelatives.
Add and delete patients	Caregiver can add and delete patients.
View analysis/statistics of the AI result	Caregiver can view his patient's profile.

4.2.1.1 Use Case of Relative (family member)

Based on Table 4.2 the overall use case for the family member of the patient in the proposed system, therelative can only log in and message the Caregiver responsible for his patient relative. The relative account and specific caregiver will be created automatically once the patient added and the relative information entered.

Table 4.2 List of Relatives Action

Use Case	Description
login	System admin can view and manage the user profile. For example, admin can delete the user profile if the staff no longer working in SC faculty.
Chat with caregiver	System admin can view user activities log that showing such as mail status of user

4.2.2 Sequence Diagram

Sequence diagram designated to represent the activities between roles from the use case diagram form. It also includes the depth interaction involving user and system admin between thesystem. Further explanation will be explained for every use case process that involves in the nextsection.

4.2.2.1 Sequence Diagram for Caregiver

In this section will be explaining about sequence diagram for the user and system admin activities within the system and web application. Figure 4.3 show the sequence diagram for user sign up to the application. Figure 4.2 show sequence diagram for Caregiver navigating the dashboard to view statistics generated by the application according to the database, Figure 4.4 show sequence diagram for user Caregiver and family member using the live chatting feature. Figure 4.5 show the Family SMS updates.

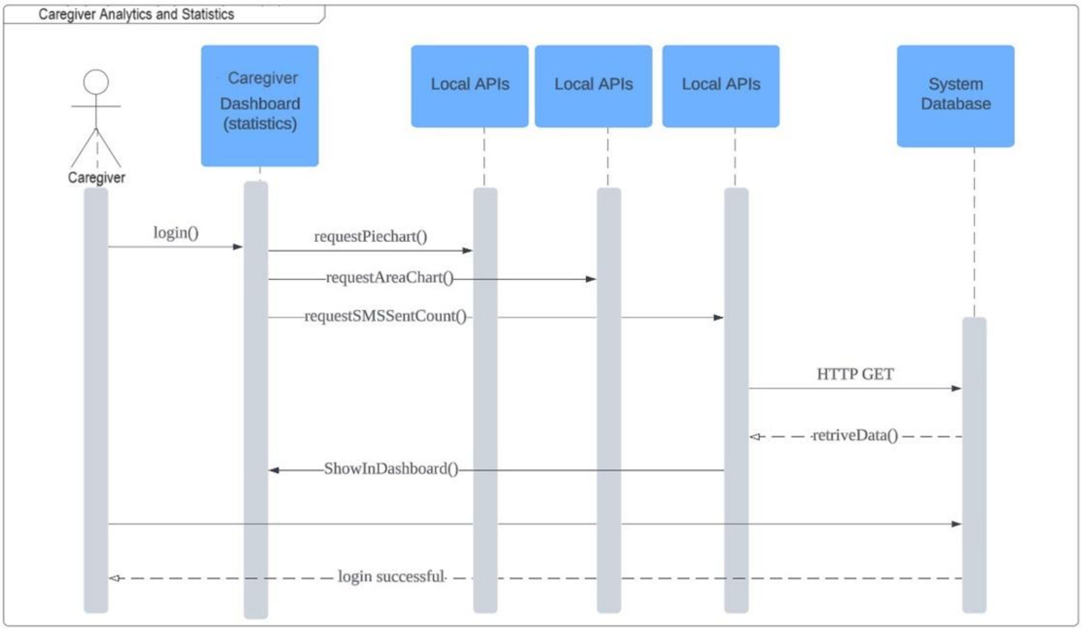


Figure 4.2 Sequence diagram for Caregiver viewing statistics

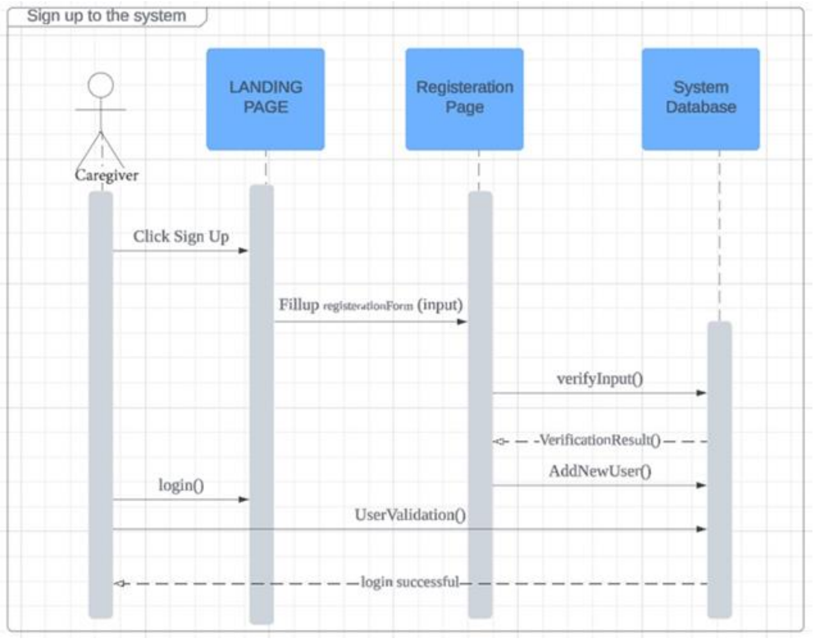


Figure 4.3 Sequence diagram for Caregiver singing up

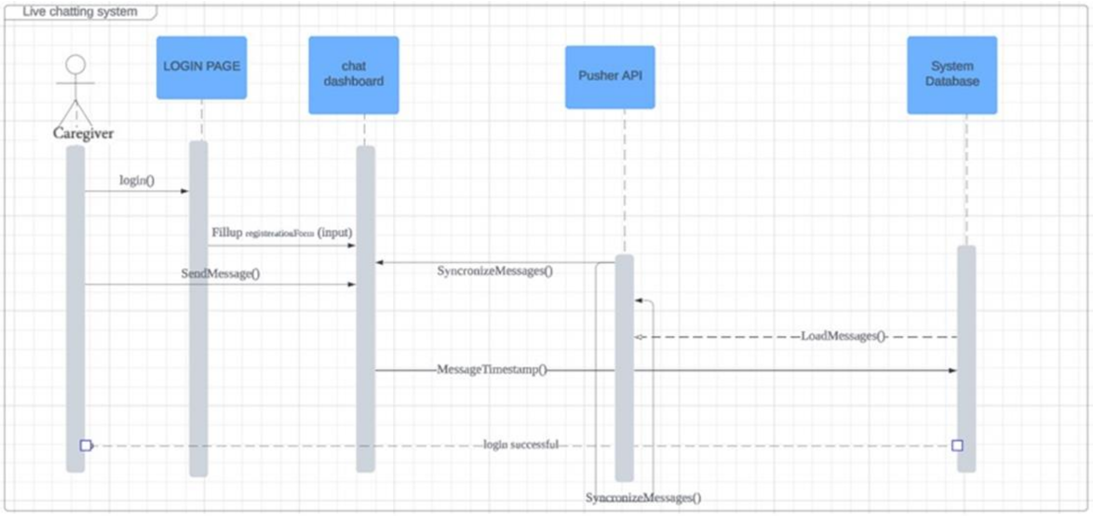


Figure 4.4 Sequence diagram for Caregiver live chatting system

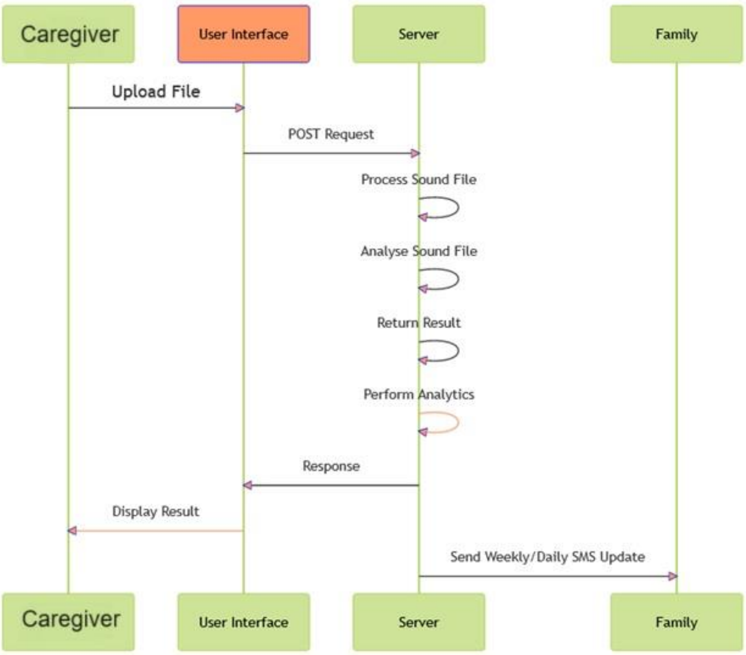


Figure 4.5 Sequence Diagram for Family updates

4.2.2.2 Sequence Diagram for Patient Relatives

In this section, further explanation about the sequence diagram for the patient relatives. They will automatically have an account and can log in, they will directly see the caregiver who is looking after their patient relative where they can chat with.

4.2.3 Activity Diagram

The purpose of the activity diagram to demonstrate the flow of action of the proposed system and in other hand to show the activity that required to perform for each user in the system.next, further explanation will be explained as regards the activity diagram for User and System Admin.

4.2.3.1 Activity Diagram for Caregiver

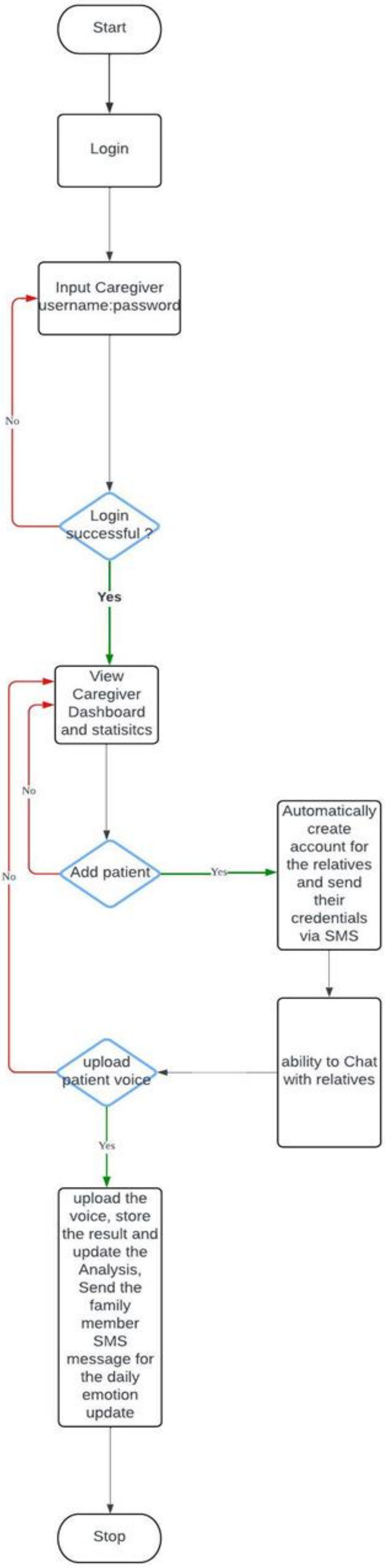

Start
Login
Input Caregiver username:password
No
Login successful ?
Yes
View Caregiver Dashboard and statisitcs
No
No
Add patient
Yes
Automatically create account for the relatives and send their credentials via SMS
ability to Chat with relatives
upload patient voice
Yes
upload the voice, store the result and update the Analysis, Send the family member SMS message for the daily emotion update
Stop

Figure 4.6 Activity Diagram for Caregiver

Based on the Figure 4.6, Caregiver is required to sign up to create the account in the AI sentiment website. After the registration, Caregiver need to log in to the account by using their login and password. Then, Caregiver can view the dashboard and able to start adding patients. At the same profile page, there will be two section which is the first section consists their profile information and the second section consist to change the password.

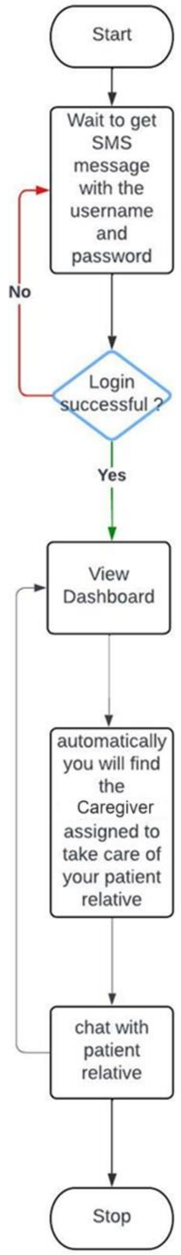

Start
Wait to get SMS message with the username and password
No
Login successful ?
Yes
View Dashboard
automatically you will find the Caregiver assigned to take care of your patient relative
chat with patient relative
Stop

Figure 4.7 Activity Diagram for Patient Relatives

Based on the Figure 4.7, Relatives only have a view action. Once they logged in they will see the chat profile of Caregiver responsible for their patient relative which will be loaded by the system automatically without the Caregiver or the relative intervention.

4.3 Project Design

In this section, the discussion on how the flow of the system work and its operation. Project design is an important element in by representing the whole system in understandable form and to know object class modelling.

4.3.1 Architecture Design

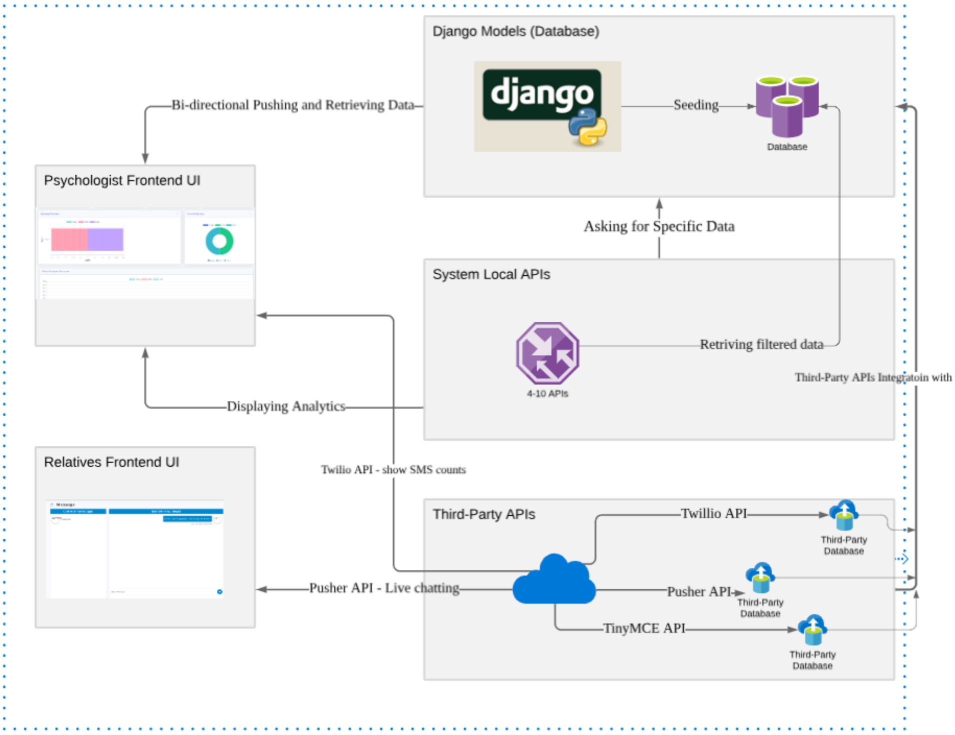


Figure 4.8 System Architecture Design for Web App

Based on the Figure 4.8 is an overall the architecture design of aged people AI Web Application that involves three layers which is Django models, System Local APIS Layer and API from the internet layer Django Models layer is the one responsible for upating the local and internet APIs and also responsible for seeing the application database in real-time database. It is also where all the application secure programming is happening.

Local and internet third party APIs are used to make the application smoother and doesn’t need to refresh the page every time. Features like SMS and live chatting can’t be implemented by one programmer, that is where the third-party APIs come into play in the purposed application.

4.3.2 Class Diagram

Class diagram is an illustration specification of system application that contains the relationship between objects, classes, attributes and operations. In other words, it is a model that convert the system application into programming language. Figure 4.9 shows the class diagram for the aged People AI Sentiment proposed System.

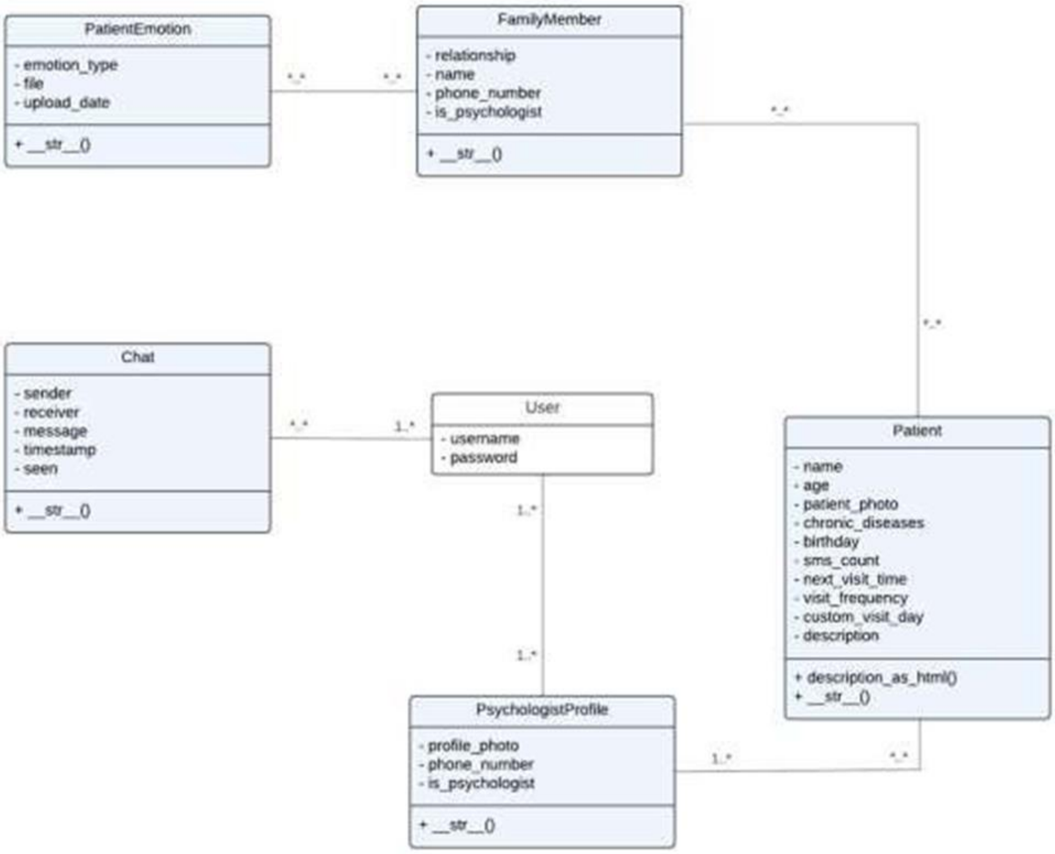
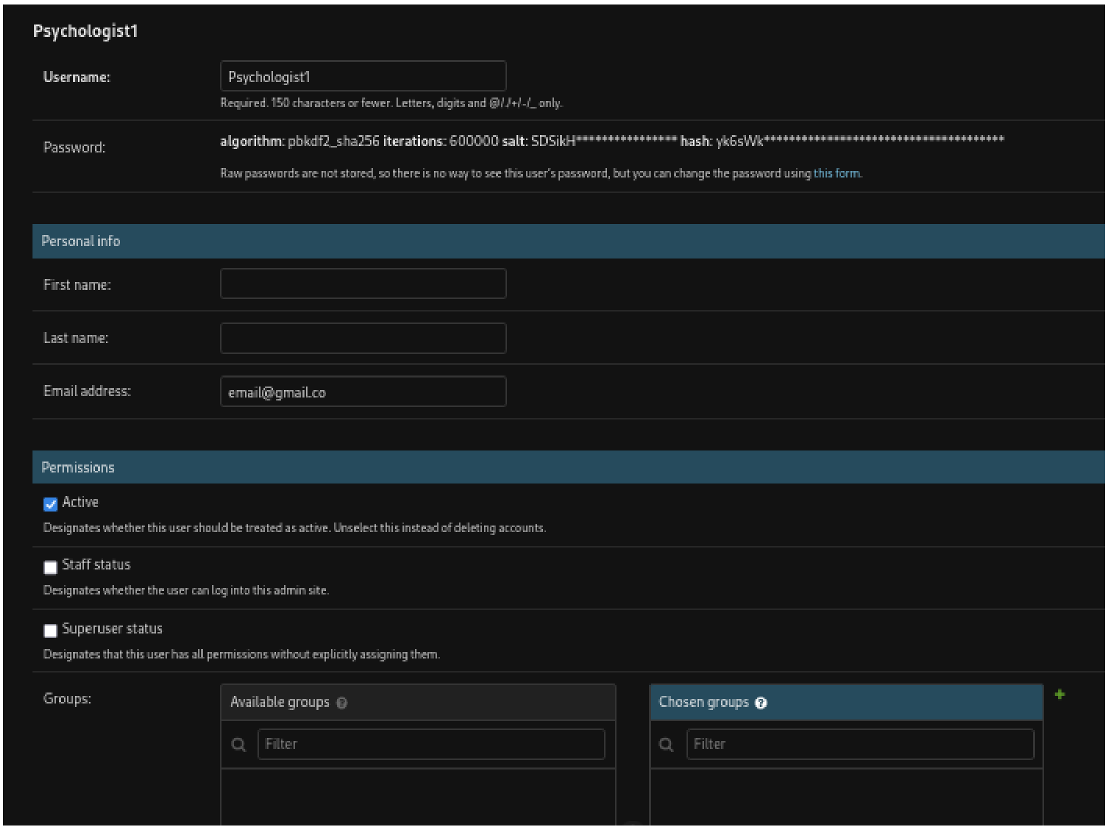


Figure 4.9 Class diagram for the Web App

4.4 Database Design

Database design is a group of data that represent the logical and physical process of Web Application. In order to store the data from users, the Django database is used to stored data and get real-time updated data from the web forms. The data that stored in Django database use unique key value to determine for each user where the key is taken from user authentication UID. Within the application database, each value key data can be a child or parents. Therefore, all the data within the system can be access and updated when all the components and user web application is linked to the internet. Thus, in system used APIs from the internet integrated with the local database to Storage and Authenticate users.

Figure 4.10 shows the key value method that used under Users Table. The child ɗparent used the same as authentication value key for each registered user.



Psychologist1

Username: Psychologist1

Required. 150 characters or fewer. Letters, digits and @/./+/-/_ only.

Password: **algorithm**: pbkdf2_sha256 **iterations**: 600000 **salt**: SDSikH**************** **hash**: yk6sWk**************************************

Raw passwords are not stored, so there is no way to see this user's password, but you can change the password using this form.

Personal info

First name:

Last name:

Email address: email@gmail.co

Permissions

☑ Active

Designates whether this user should be treated as active. Unselect this instead of deleting accounts.

□ Staff status

Designates whether the user can log into this admin site.

□ Superuser status

Designates that this user has all permissions without explicitly assigning them.

Groups:

Figure 4.10 Users Information in Django Database

Django database has an important role because all the related data to the system is stored in it. Data that stored in the firebase includename, email, patient relatives, relatives contact number.

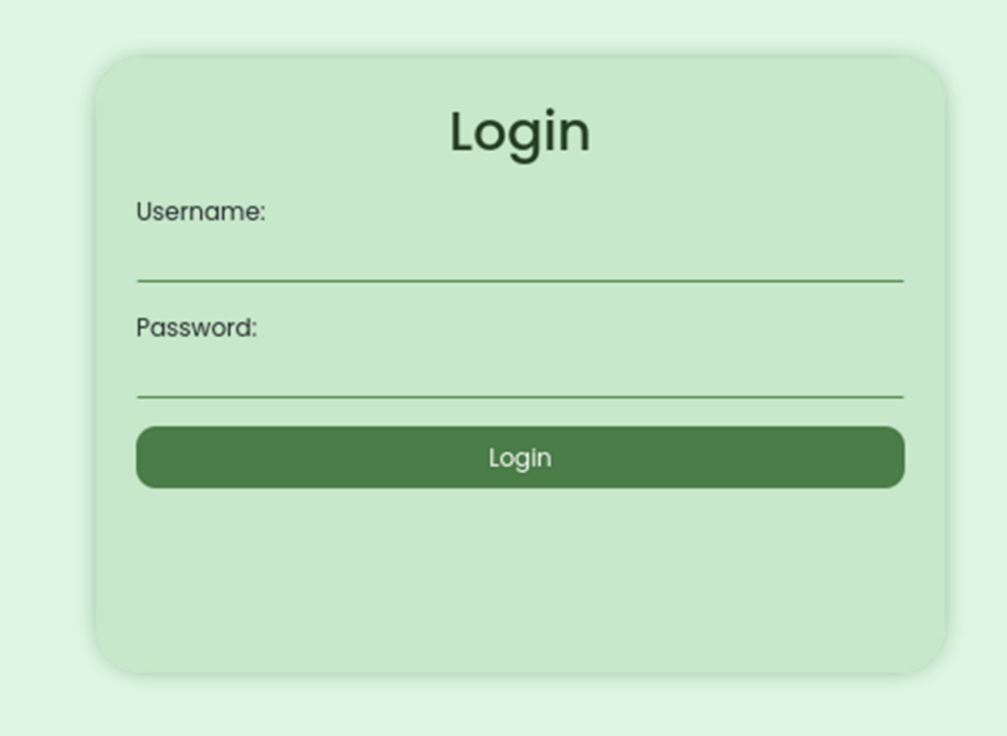
Relatives and Caregivers are able to update data such as User email and password that will be used to sign in to the application. Admincan manage all users; view user data log and profiles, also view chat activities as shown in the Table 4.3.

Table 4.3 List of database tables and description

Table	Name	Description	Type	Example
Admin	Admin_username	An ID for the admin	varchar	SuperHero
	password	A password for the admin	varchar	Test@123
	email	An email for the admin	varchar	admin@somecorp.com
User (caregiver/relative)	user_username	An ID for the user	varchar	Ahmed, maria_cathryn
	user_pass	A password for the user	varchar	Test@123
	user_email	An email for the user	varchar	Caregiver1@somecorp.com
	user_contact	A contact number for the user	int	0147990350

4.5 Interface Design

Interface design is an important element in every system development. Through the interface, it shows the interactive communication between user and an application. The interface design neither simple and complicated but surely, user could understand whenever exploring this application.



Login

Username:

Password:

Figure 4.11 Sign In interface for Caregiver/Relative

Figure 4.11 shows the Sign In interface for User/Staff. User need to insert their username and password to login to the application. The login interface only allowed authenticate and validate user to access to the application. “Register” button navigates to sign up interface to register into the system. Admin navigates to the path /admin where only web admin has the access to all user data.

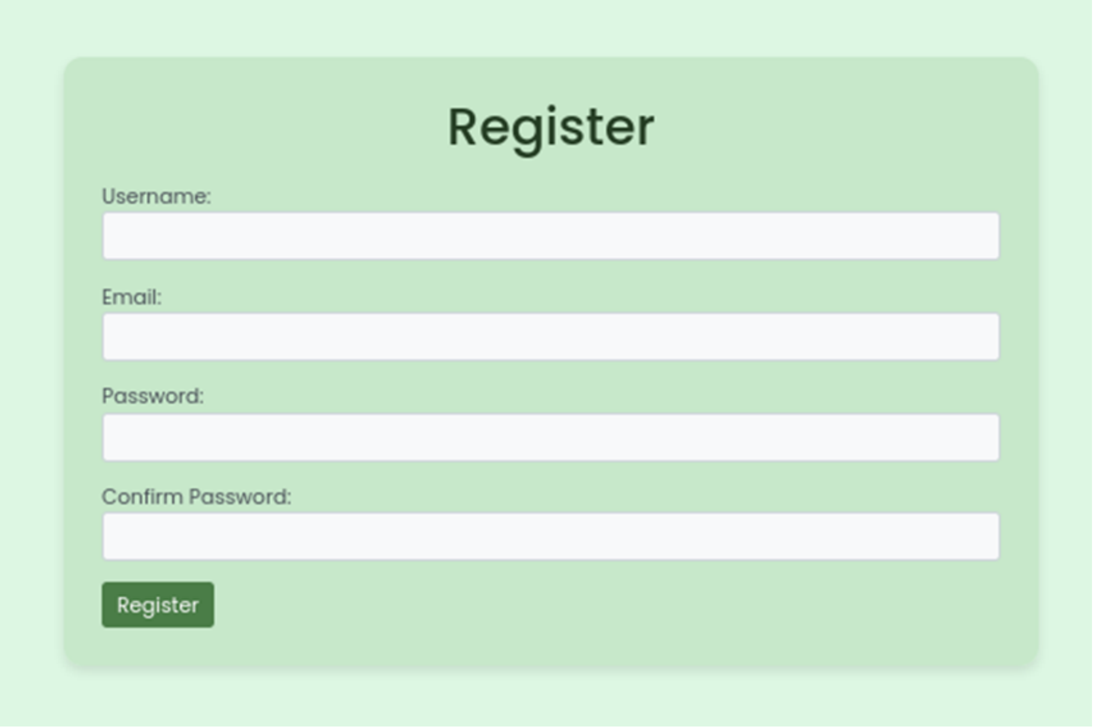
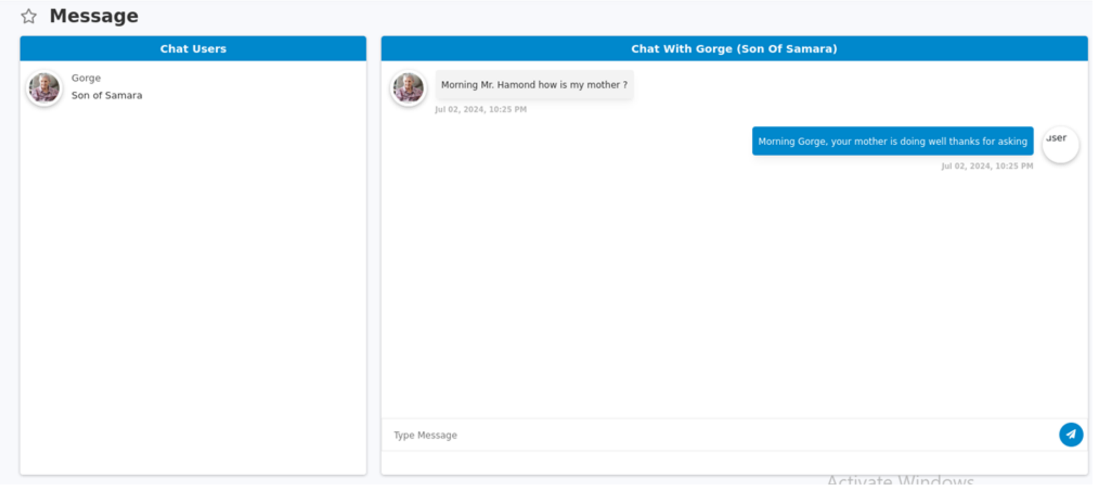


Figure 4.12 Sign Up interface

Figure 4.12 shows the Sign-Up interface for user and it is required for those users who do not have an account in the system. User must fill the form by insert their username, email, password, confirm password. After that, user can simply click the Sign-Up button.



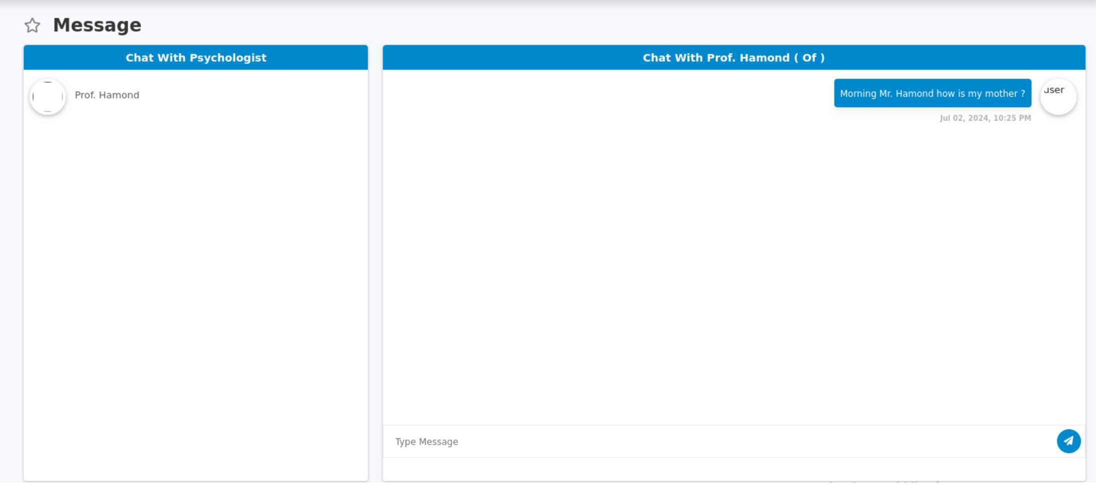
Morning Mr. Hamond how is my mother ?

Jul 02, 2024, 10:25 PM

Morning Gorge, your mother is doing well thanks for asking

Jul 02, 2024, 10:25 PM

Figure 4.13 Caregiver chat



Morning Mr. Hamond how is my mother ?

Jul 02, 2024, 10:25 PM

Figure 4.14 Family members dashboard

Figure 4.13 and 4.14 shows the dashboard interface for patient relatives and chat section in Caregiver Interface. Relatives can ask questions, check their patient relative status by contacting the Caregiver responsible for their parent health directly. The message will reach the Caregiver directly after it is sent by the relative.

Figure 4.15 shows the dashboard interface for Caregiver. The dashboard gives the Caregiver .an eagle eye view of his patients' overall emotions using variesgraphs to show different aspects of the data making the data useful information for the Caregiver.

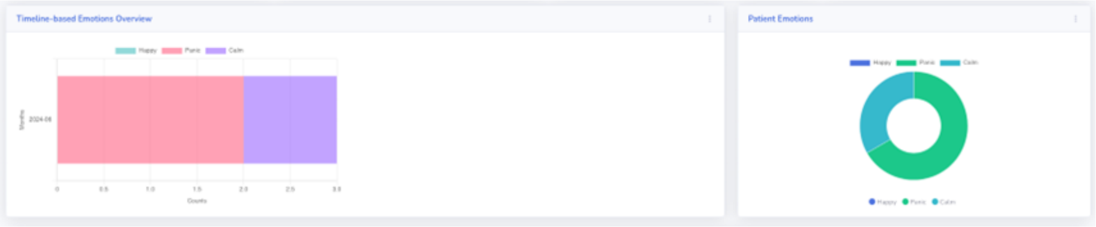
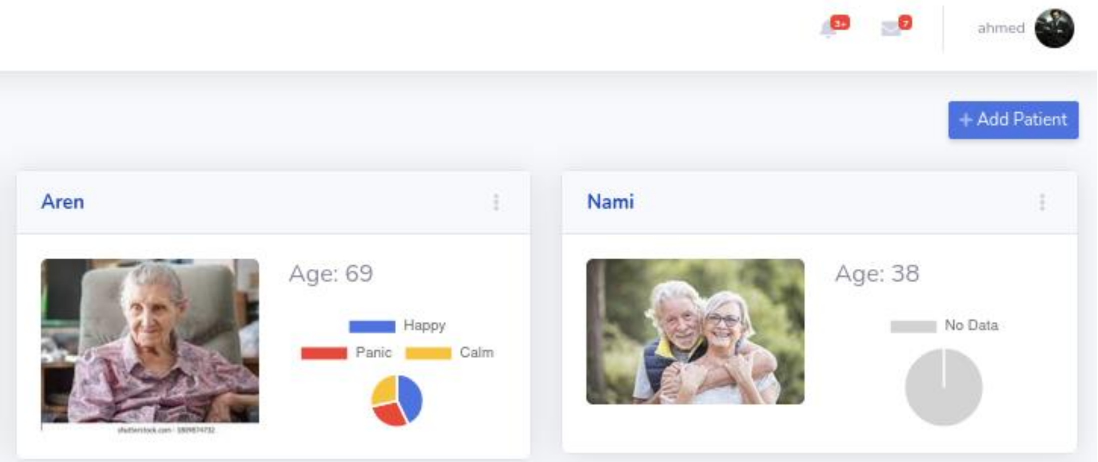


Figure 4.15 Caregiver Dashboard

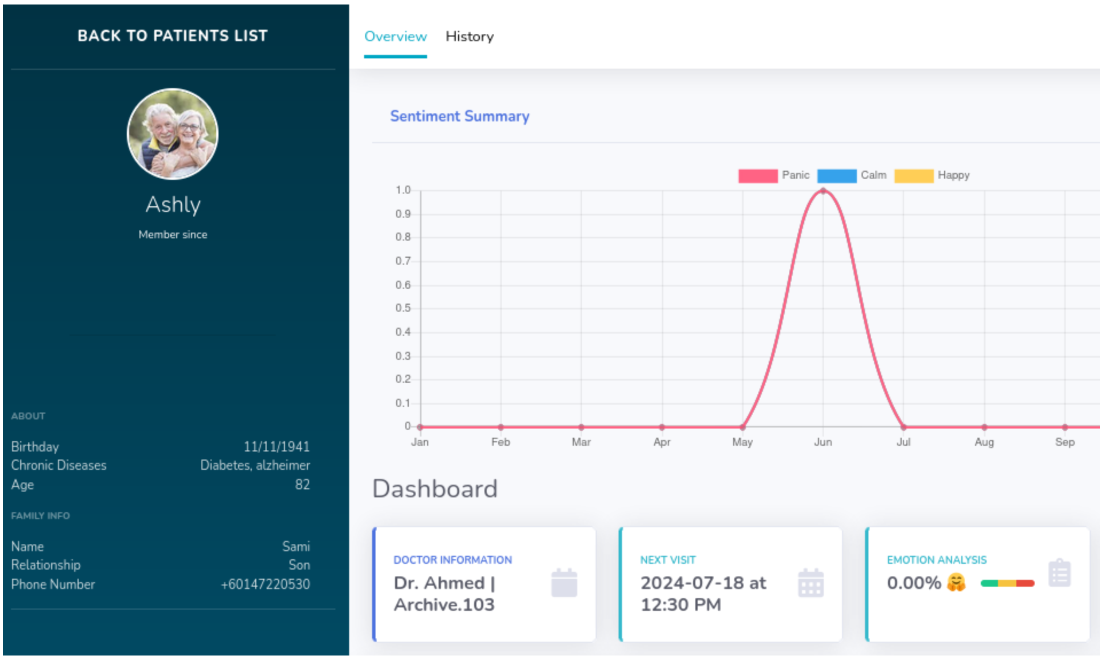


Age: 69

Age: 38

Figure 4.16 Caregiver "Patient under me" View

Figure 4.16 shows the Patients under the logged in Caregiver. Thehamburger menu or the three horizontal dots allow the Caregiver to directly upload voice or delete the patient. The pie chart next to each patient tries to give the Caregiver a zoom out overview for the Caregiver for that patient with some information about the patient like age and name.



Ashly

Member since

ABOUT

Birthday	11/11/1941
Chronic Diseases	Diabetes, alzheimer
Age	82

FAMILY INFO

Name	Sami
Relationship	Son
Phone Number	+60147220530

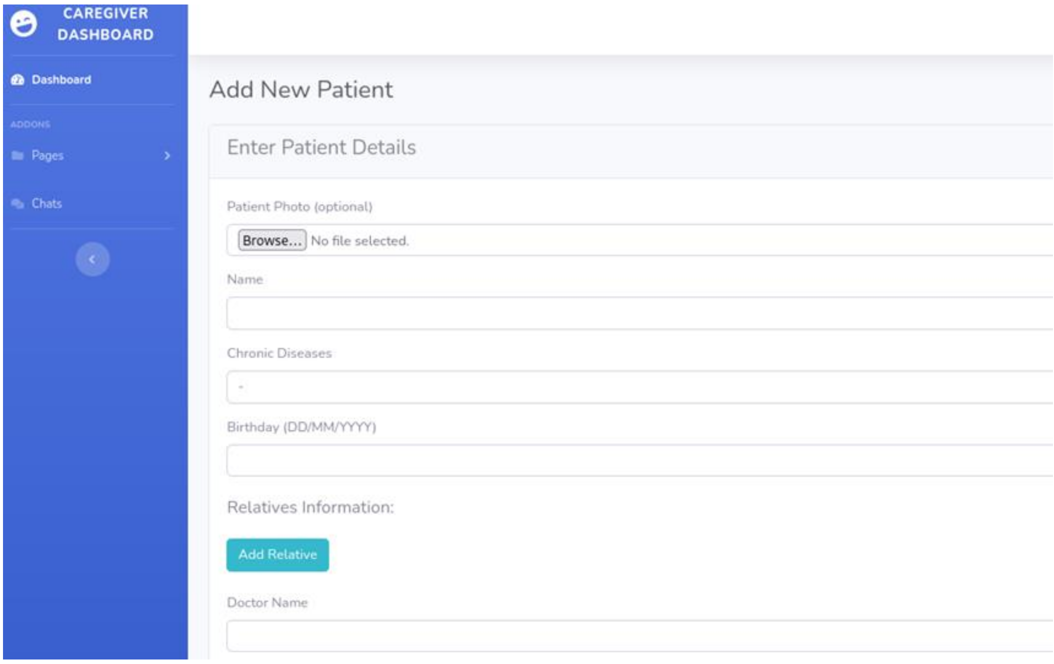
DOCTOR INFORMATION
Dr. Ahmed | Archive.103

NEXT VISIT
2024-07-18 at 12:30 PM

EMOTION ANALYSIS
0.00% 🤗

Figure 4.17 Patient Profile

Figure 4.17 shows the Profile of a specific patient using the patient ID. The profile gives the Caregiver a sharp view about the patient. Patient description is where the Caregiver put his notice and comments about the patient like the medicinethey take and when, how many dozes, general info like their nationality etc. the Emotion Analysis give the Caregiver the dominant mood of the patient from 100% and according to that the emoji will be reflecting the emotion. Next Visit shows the next date and time the Caregiver will visit the patient, the date and time placed according to the visit frequency the Caregiver put when adding the patient. The SMS family update show how many SMS message sent to the family. The graph showthe daily emotions history in a month. Under the patient's name is general information about the patient and his relatives. Also, in this page the Caregiver can upload the voice to add to the database and be shown in the Caregiver dashboards.



Add New Patient

Enter Patient Details

Patient Photo (optional)

Browse... No file selected.

Name

Chronic Diseases

Birthday (DD/MM/YYYY)

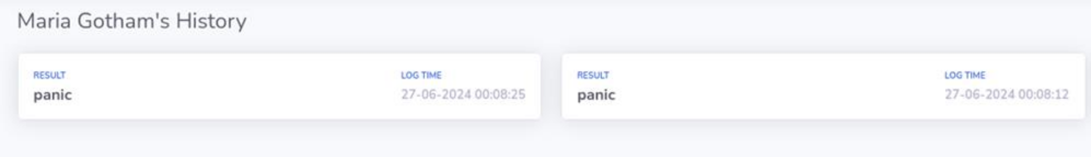
Relatives Information:

Add Relative

Doctor Name

Figure 4.18 Caregiver add patient page

Figure 4.18 show the add patient page. In order for the Caregiver to add a patient, he/she have to fill out the 4-section patient general info, patient's relatives' info, next visit appointment scheduling and patient description.



Maria Gotham's History

RESULT
panic

LOG TIME
27-06-2024 00:08:25

RESULT
panic

LOG TIME
27-06-2024 00:08:12

Figure 4.19 Patient history retrieved using patient ID

The history page shows the date and the results of the patient emotions for the Caregiver to be able to check on the patient history of emotions for any reason.

4.6 Implementation of AI model

Implementation of AI model will talk about the model used in the system to extract the features from the voice until the result of sending SMS message to the family with the patient relative mood indication.

4.6.1 How the AI will study on the mood of aged people

The AI in this system studies the mood of aged people by analysing voice recordings submitted by the Caregiver of the retirement home residents. The AI model uses machine learning techniques and a neural network to process and analyse these voice recordings. It extracts features such as MFCC (Mel-Frequency Cepstral Coefficients), chroma, and mel-spectrogram from the recordings.

4.6.2 How the voice data can be transformed into mood output

Voice data can be transformed into mood output by extracting relevant features from the voice recordings and using machine learning algorithms to analyse and classify the emotional state based on those features. In the provided code, the `extract_feature` function is used to extract features such as MFCC, chroma, and mel-spectrogram from the voice recordings.

These extracted features capture different aspects of the voice, such as pitch, intensity, and frequency distribution, which are indicative of emotional states.

4.6.3 What type of voice data can be used

The provided code accepts voice data in the .wav file format. It specifically looks for .wav files in the specified directory to extract features and perform mood classification. The code uses the `soundfile` library to read the .wav file, and then processes the audio data to extract features

4.6.4 How AI will test and train the data

The voice data, in the form of .wav files, is loaded and prepared. The data is then split into training and testing sets. The Multi-Layer Perceptron (MLP) classifier is initialized with specific parameters. The model is trained using the training set, where it learns to associate the extracted features with the corresponding emotions. Next, the model is tested using the testing set to predict emotions for unseen voice recordings. The accuracy of the model is calculated by comparing the predicted emotions with the actual emotions. The trained model is saved to a file for future use. The below figure shows the steps taken by the AI model to test and train:

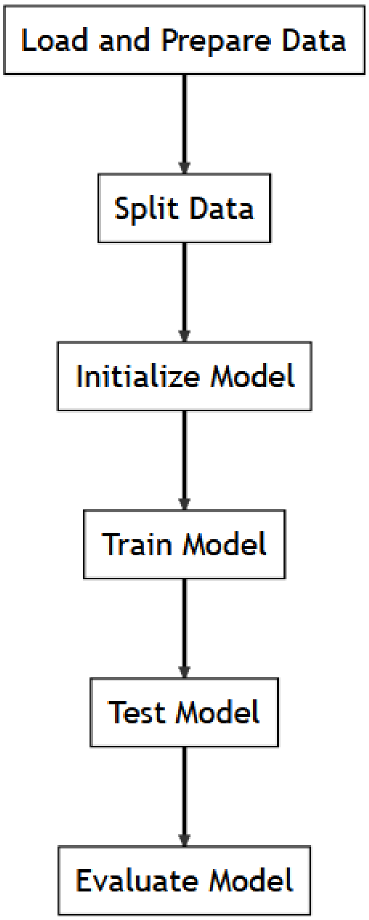


Figure 4.19 AI Model Test and Train Steps

Figure 4.19 is a flowchart of the previously mentioned idea above. For each of the above, to explain every step:

1. Loading and Preparing the Data:

2. The load_data function is responsible for loading the voice data and preparing it for training and testing. It reads the .wav files from the specified directory, extracts feature from the audio using the extract_feature function, and associates the extracted features with the corresponding emotions (labels).

3. Splitting the Data:

4. The loaded data is split into training and testing sets using the train_test_split function from the scikit-learn library. By default, 20% of the data is allocated for testing, but this can be adjusted by changing the test_size parameter in the load_data function.

5. Initializing the Model:

6. The Multi-Layer Perceptron (MLP) classifier is initialized using the MLPClassifier class from scikit-learn. The specific parameters for the MLP model, such as the learning rate, hidden layer sizes, and maximum iterations, are set during model initialization.

7. Training the Model:

8. The model is trained using the training set, which consists of the extracted features and corresponding emotion labels. The fit method is called on the model, with the training features (x_train) and labels (y_train) as inputs.

9. Testing the Model:

10. After training, the model is tested using the testing set, which contains unseen voice recordings. The predict method is used to predict the emotions for the testing features (x_test), and the predicted emotions are compared against the actual emotions (y_test) to evaluate the model's accuracy.

11. Model Evaluation:

12. The accuracy of the model is calculated using the accuracy_score function from scikit-learn. The accuracy represents the percentage of correctly predicted emotions in the testing set.

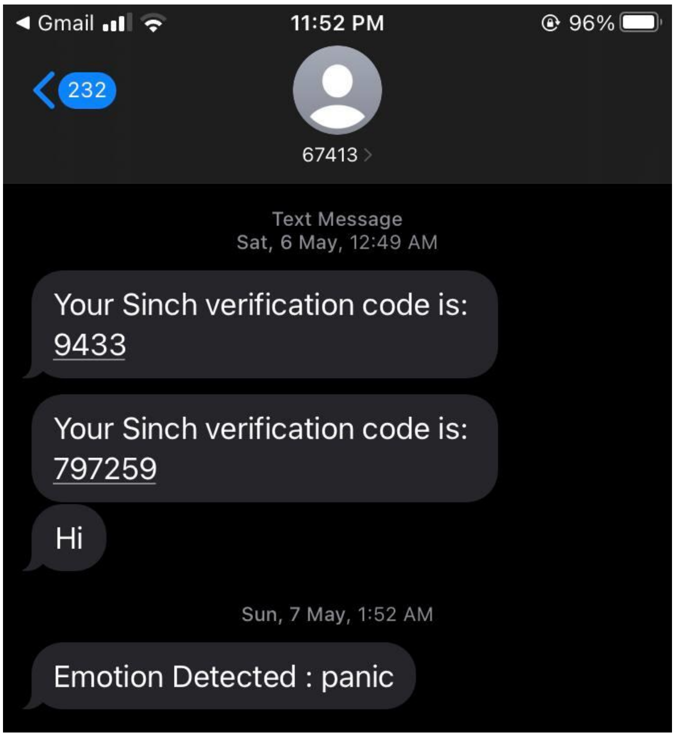
4.7 Users perspective

4.7.1 How frequently the Caregiver will collect the voice data

The submission of the recordings of all aged people in the retirement house depend on various factors, such as the needs and preferences of the Caregivers, and the specific goals of the emotional well-being interventions. Caregivers may choose to collect voice data in different times, or multiple times each a day, to monitor emotional trends and identify patterns. The system would provide them with up-to-date information to support their assessments and enable targeted interventions if necessary. However, the Caregiver has to submit voice for all aged people in the retirement house at least once daily to make sure updating the system and the families.

4.7.2 How frequently the family members will get the SMS notification

The system is designed to send these messages on a daily/weekly basis according to the family preference, ensuring that the family members receive regular updates without overwhelming them with frequent notifications. The mood indicator the family will be receiving will be very summarized and to the point, without any overwhelming details like the once that will be shown to the Professional Caregiver.



Text Message
Sat, 6 May, 12:49 AM

Your Sinch verification code is: 9433

Your Sinch verification code is: 797259

Hi

Sun, 7 May, 1:52 AM

Emotion Detected : panic

Figure 4.20 Family SMS emotion updates

Figure 4.21 example of the SMS message family members will get. (real test I've done) The above figure shows My results on the test I’ve done on the Sinch API SMS messaging service.

4.8 Chapter Summary

By considering the requirements, designing a comprehensive system, and establishing a suitable data model, the emotion detection and alerting system can be developed to improve the emotional well-being of aged individuals in retirement homes. The subsequent chapters will delve into the implementation, testing, and evaluation of the system, providing further insights into its functionality and impact..

CHAPTER 5

SYSTEM IMPLEMENTATION AND TESTING

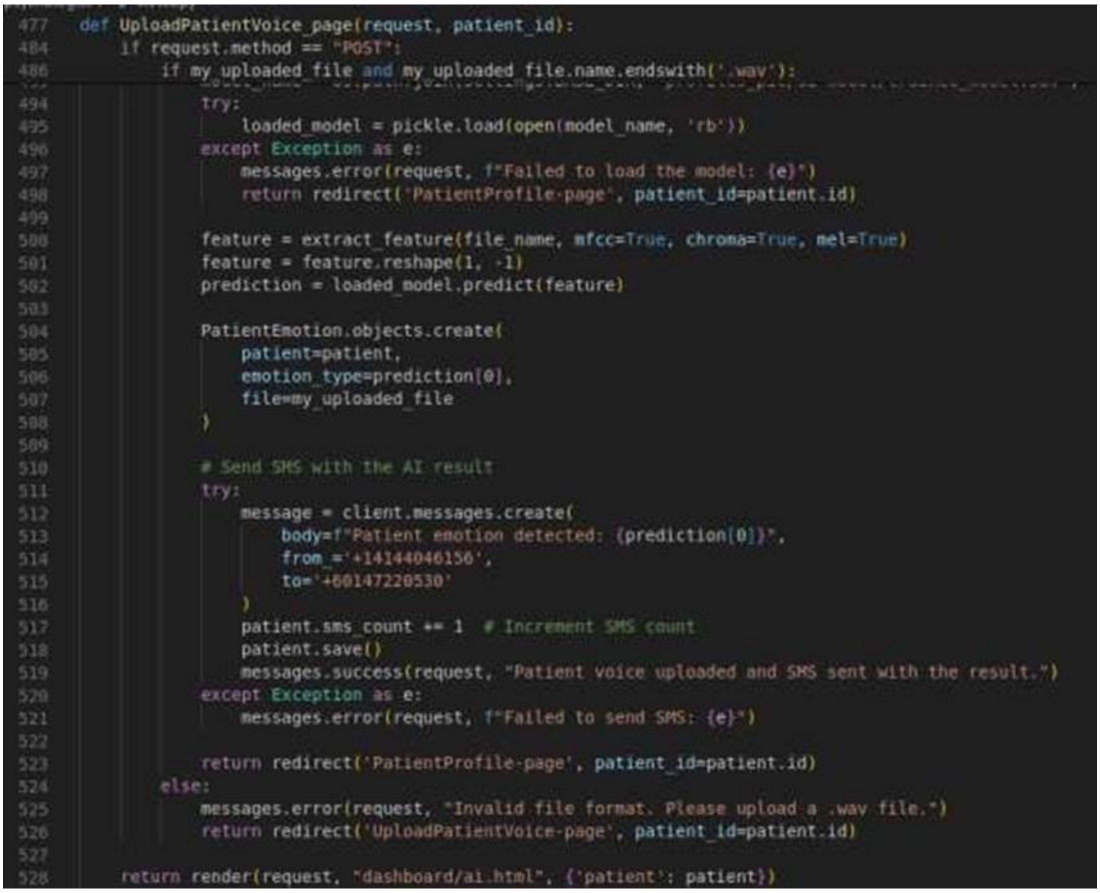
5.1 Introduction

The Web application implementation and system testing are discussed in this chapter. Several users have been tested the system capabilities and its functionality and the result during the testing are recorded for continuous improving and correcting any flaws and errors. Method used for the testing including Black Box testing, White Box testing and User testing.

5.2 System Functional Coding

The development of the system and combining its functionalities and components to become in one system in order to sending a notification regarding the family updates, live chatting, generating analytical graphs Web Application. This system helps Caregiver to have eagle eye view of their patients and me in close touch with their family.

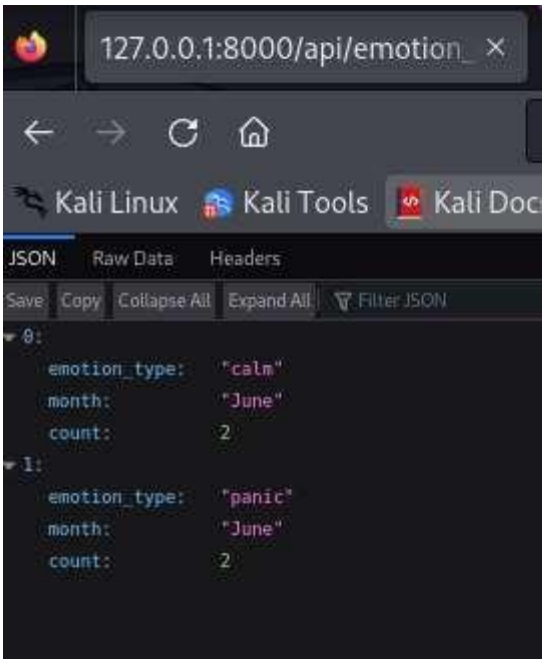
5.2.1 Application Coding



```python
def UploadPatientVoice_page(request, patient_id):
    if request.method == "POST":
        if my_uploaded_file and my_uploaded_file.name.endswith('.wav'):
            try:
                loaded_model = pickle.load(open(model_name, 'rb'))
            except Exception as e:
                messages.error(request, f"Failed to load the model: {e}")
                return redirect('PatientProfile-page', patient_id=patient.id)

            feature = extract_feature(file_name, mfcc=True, chroma=True, mel=True)
            feature = feature.reshape(1, -1)
            prediction = loaded_model.predict(feature)

            PatientEmotion.objects.create(
                patient=patient,
                emotion_type=prediction[0],
                file=my_uploaded_file
            )

            # Send SMS with the AI result
            try:
                message = client.messages.create(
                    body=f"Patient emotion detected: {prediction[0]}",
                    from_='+14144046156',
                    to='+60147220530'
                )
                patient.sms_count += 1  # Increment SMS count
                patient.save()
                messages.success(request, "Patient voice uploaded and SMS sent with the result.")
            except Exception as e:
                messages.error(request, f"Failed to send SMS: {e}")

            return redirect('PatientProfile-page', patient_id=patient.id)
        else:
            messages.error(request, "Invalid file format. Please upload a .wav file.")
            return redirect('UploadPatientVoice-page', patient_id=patient.id)

    return render(request, "dashboard/ai.html", {'patient': patient})
```

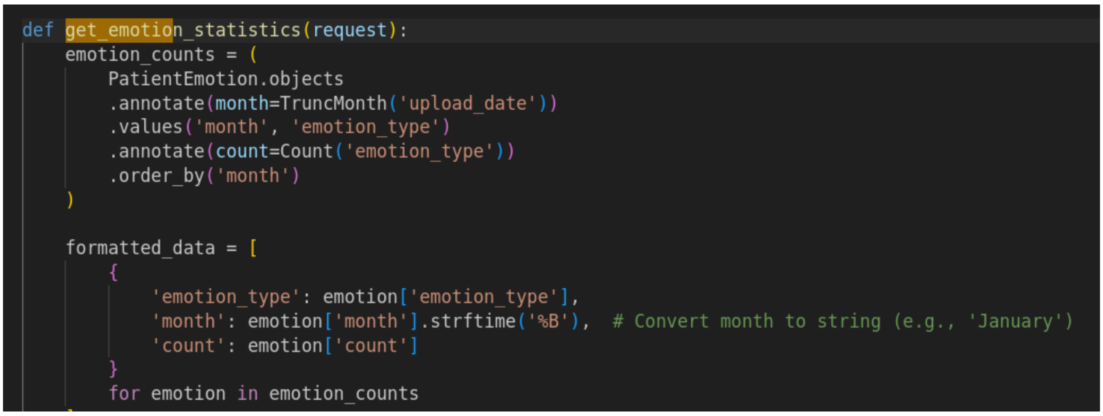
Figure 5.1 Send SMS message to relatives

Figure 5.1 show the code for SMS and upload the .wav file. The system only can accept .wav file, if the upload was correct the AI function will start extracting the features out of the file and use Twillio API to send SMS with the result.



```
0:
    emotion_type:   "calm"
    month:          "June"
    count:          2
1:
    emotion_type:   "panic"
    month:          "June"
    count:          2
```

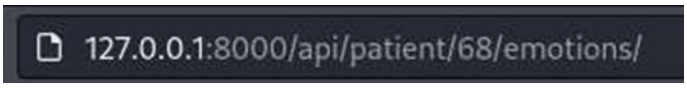
Figure 5.2 Emotion statistics local API



```python
def get_emotion_statistics(request):
    emotion_counts = (
        PatientEmotion.objects
        .annotate(month=TruncMonth('upload_date'))
        .values('month', 'emotion_type')
        .annotate(count=Count('emotion_type'))
        .order_by('month')
    )

    formatted_data = [
        {
            'emotion_type': emotion['emotion_type'],
            'month': emotion['month'].strftime('%B'),  # Convert month to string (e.g., 'January')
            'count': emotion['count']
        }
        for emotion in emotion_counts
```

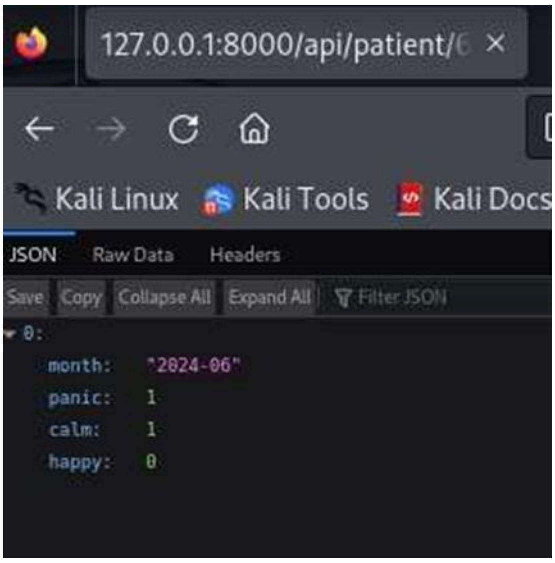
Figure 5.3 Caregiver Dashboard API for emotions

Figure 5.2 and 5.3 show the code for the API responsible for the Caregiver analytical Dashboard. The Pie chart, Area chart or whatever chat will be added to the Caregiver dashboard will need this API to show correct analytics of the patients under the logged in Caregiver.



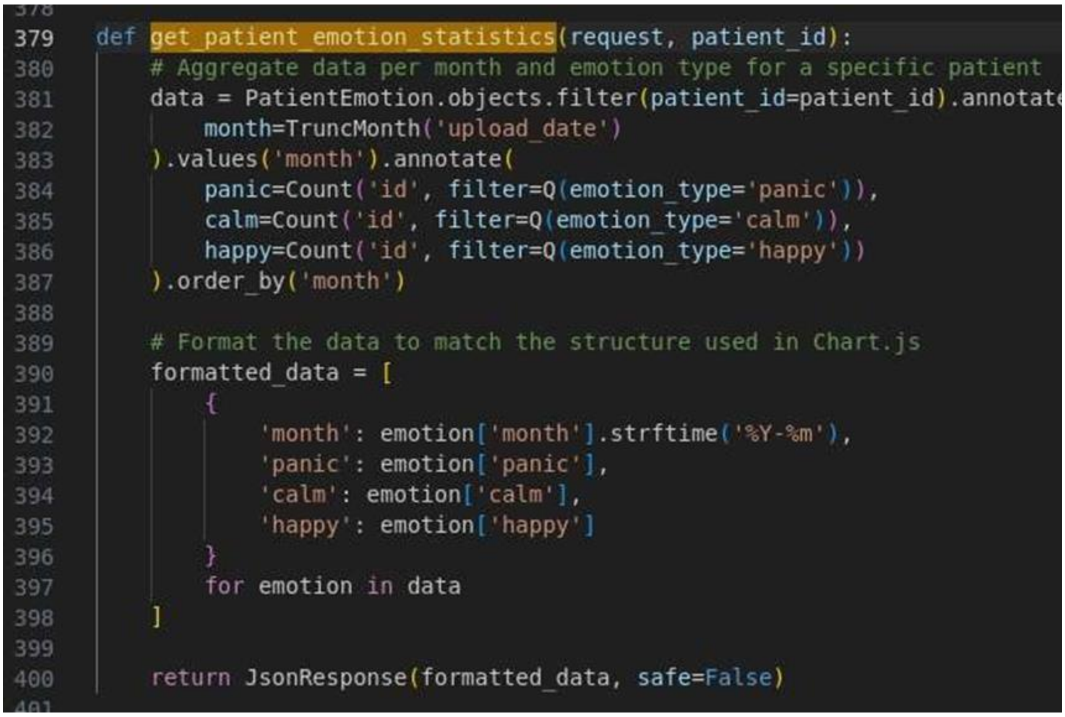
127.0.0.1:8000/api/patient/68/emotions/

Figure 5.4 API path using patient ID



```
0:
    month:  "2024-06"
    panic:  1
    calm:   1
    happy:  0
```

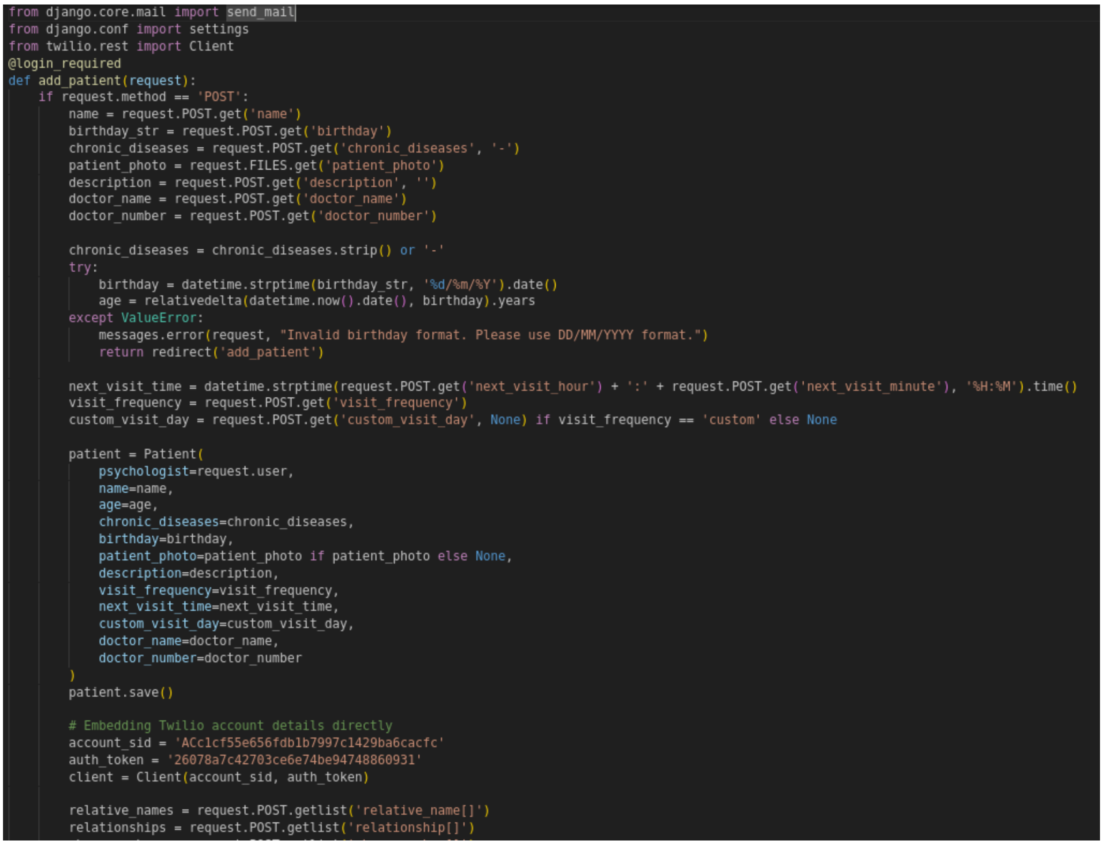
Figure 5.5 Patient Local API for Analytics



```python
def get_patient_emotion_statistics(request, patient_id):
    # Aggregate data per month and emotion type for a specific patient
    data = PatientEmotion.objects.filter(patient_id=patient_id).annotate
        month=TruncMonth('upload_date')
    ).values('month').annotate(
        panic=Count('id', filter=Q(emotion_type='panic')),
        calm=Count('id', filter=Q(emotion_type='calm')),
        happy=Count('id', filter=Q(emotion_type='happy'))
    ).order_by('month')

    # Format the data to match the structure used in Chart.js
    formatted_data = [
        {
            'month': emotion['month'].strftime('%Y-%m'),
            'panic': emotion['panic'],
            'calm': emotion['calm'],
            'happy': emotion['happy']
        }
        for emotion in data
    ]

    return JsonResponse(formatted_data, safe=False)
```

Figure 5.6 Patient API for emotions

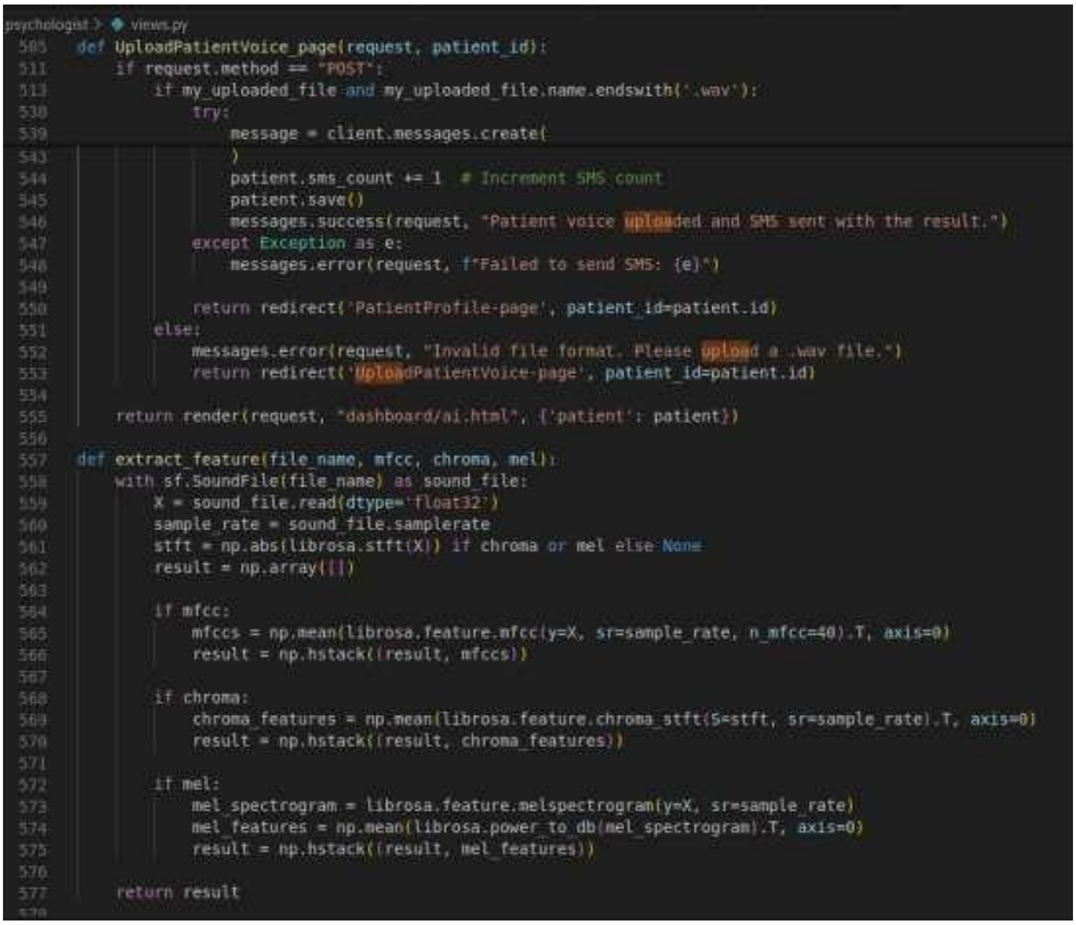
Figure 5.4, 5.5 and 5.6 show the code that create the local api that the graphs in the system relays on to draw the illustrative lines for the Caregiver. The API filters the data in the database and make it available in a separate page. The graphs are integrated with the local API to display the analysis correctly.



```python
from django.core.mail import send_mail
from django.conf import settings
from twilio.rest import Client
@login_required
def add_patient(request):
    if request.method == 'POST':
        name = request.POST.get('name')
        birthday_str = request.POST.get('birthday')
        chronic_diseases = request.POST.get('chronic_diseases', '-')
        patient_photo = request.FILES.get('patient_photo')
        description = request.POST.get('description', '')
        doctor_name = request.POST.get('doctor_name')
        doctor_number = request.POST.get('doctor_number')

        chronic_diseases = chronic_diseases.strip() or '-'
        try:
            birthday = datetime.strptime(birthday_str, '%d/%m/%Y').date()
            age = relativedelta(datetime.now().date(), birthday).years
        except ValueError:
            messages.error(request, "Invalid birthday format. Please use DD/MM/YYYY format.")
            return redirect('add_patient')

        next_visit_time = datetime.strptime(request.POST.get('next_visit_hour') + ':' + request.POST.get('next_visit_minute'), '%H:%M').time()
        visit_frequency = request.POST.get('visit_frequency')
        custom_visit_day = request.POST.get('custom_visit_day', None) if visit_frequency == 'custom' else None

        patient = Patient(
            psychologist=request.user,
            name=name,
            age=age,
            chronic_diseases=chronic_diseases,
            birthday=birthday,
            patient_photo=patient_photo if patient_photo else None,
            description=description,
            visit_frequency=visit_frequency,
            next_visit_time=next_visit_time,
            custom_visit_day=custom_visit_day,
            doctor_name=doctor_name,
            doctor_number=doctor_number
        )
        patient.save()

        # Embedding Twilio account details directly
        account_sid = 'ACc1cf55e656fdb1b7997c1429ba6cacfc'
        auth_token = '26078a7c42703ce6e74be94748860931'
        client = Client(account_sid, auth_token)

        relative_names = request.POST.getlist('relative_name[]')
        relationships = request.POST.getlist('relationship[]')
```

Figure 5.7 Send relative his credentials

Figure 5.7 show the code that is executed after the patient is added successfully to the database. The system will automatically send SMS update message to the patient relative with his/her username and password to be able to login and start contacting the Caregiver.



```
def UploadPatientVoice_page(request, patient_id):
    if request.method == "POST":
        if my_uploaded_file and my_uploaded_file.name.endswith('.wav'):
            try:
                message = client.messages.create(
                )
                patient.sms_count += 1  # Increment SMS count
                patient.save()
                messages.success(request, "Patient voice uploaded and SMS sent with the result.")
            except Exception as e:
                messages.error(request, f"Failed to send SMS: {e}")

            return redirect('PatientProfile-page', patient_id=patient.id)
        else:
            messages.error(request, "Invalid file format. Please upload a .wav file.")
            return redirect('UploadPatientVoice-page', patient_id=patient.id)

    return render(request, "dashboard/ai.html", {'patient': patient})

def extract_feature(file_name, mfcc, chroma, mel):
    with sf.SoundFile(file_name) as sound_file:
        X = sound_file.read(dtype='float32')
        sample_rate = sound_file.samplerate
        stft = np.abs(librosa.stft(X)) if chroma or mel else None
        result = np.array([])

        if mfcc:
            mfccs = np.mean(librosa.feature.mfcc(y=X, sr=sample_rate, n_mfcc=40).T, axis=0)
            result = np.hstack((result, mfccs))

        if chroma:
            chroma_features = np.mean(librosa.feature.chroma_stft(S=stft, sr=sample_rate).T, axis=0)
            result = np.hstack((result, chroma_features))

        if mel:
            mel_spectrogram = librosa.feature.melspectrogram(y=X, sr=sample_rate)
            mel_features = np.mean(librosa.power_to_db(mel_spectrogram).T, axis=0)
            result = np.hstack((result, mel_features))

    return result
```

Figure 5.8 AI feature extraction code

Figure 5.8 show the code used by the system to extract the features out of the uploaded the voice. The extract_feature function will use mathematical equation that is already pre-configured by librosa and soundfile python libraries and return the result to the UploadPatientVoice_page function.

5.3 System Functional Interface

Aged people AI sentiment web application contains eleven interfaces. The theme color of these interface consists of blue and white to make the interface becomes user friendly and preventing complexity. This application built with simple interface. Starter interface for this application begin with login page. The login page has a login form consist username and password form then, continuing with the Register label. Figure 5.10 show adding patient under the logged in Caregiver. Figure 5.12 shows the patient is added and the pie chart shows the patient has no data yet. Figure 5.9 shows the logo used for this application. the smiley twinks face in the logo is chosen to tell the Caregiver how cool his work will be from now on after using the system.

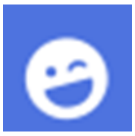
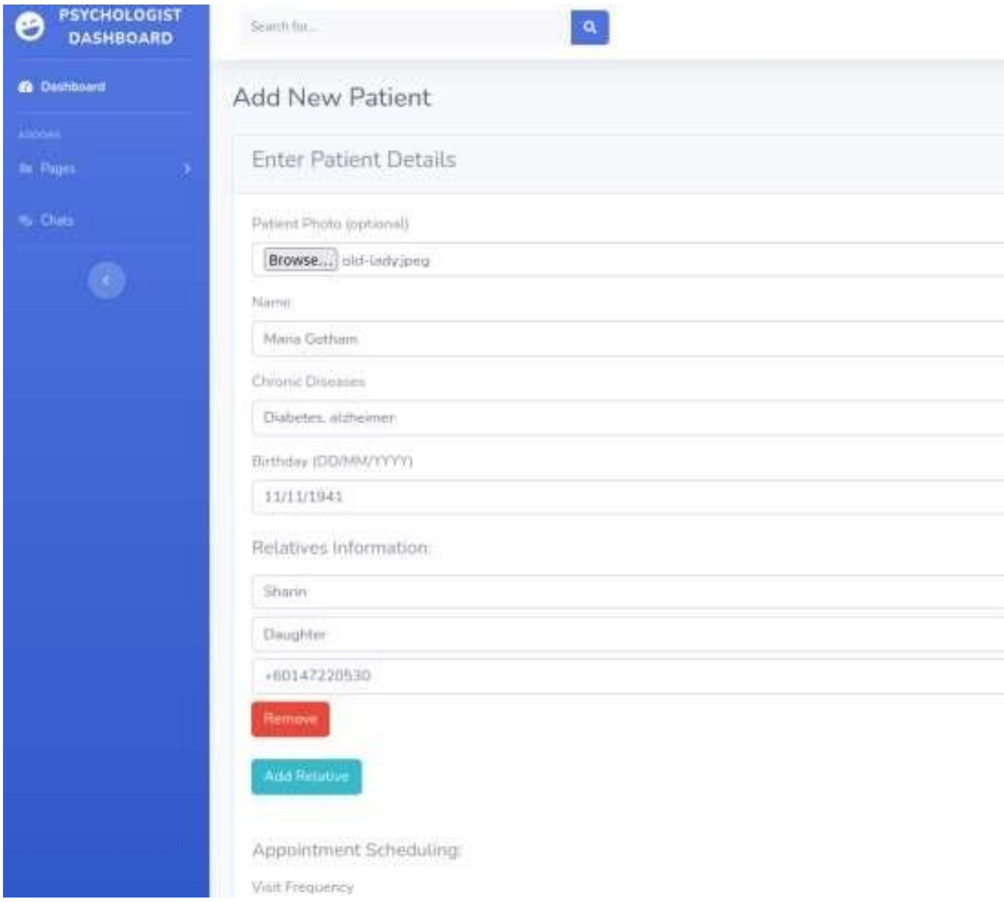


Figure 5.9 Logo for the Web Application



Add New Patient

Enter Patient Details

Patient Photo (optional)
Browse... old-lady.jpeg

Name
Maria Gotham

Chronic Diseases
Diabetes, alzheimer

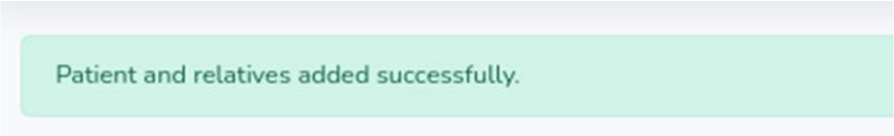
Birthday (DD/MM/YYYY)
11/11/1941

Relatives Information:
Sharin
Daughter
+60147220530

Appointment Scheduling:

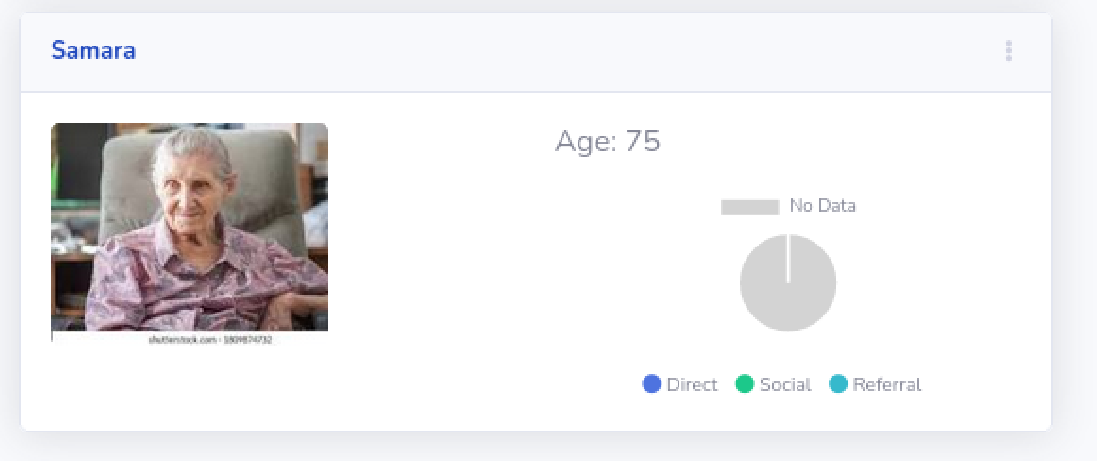
Visit Frequency

Figure 5.10 Caregiver adding patient to the system



Patient and relatives added successfully.

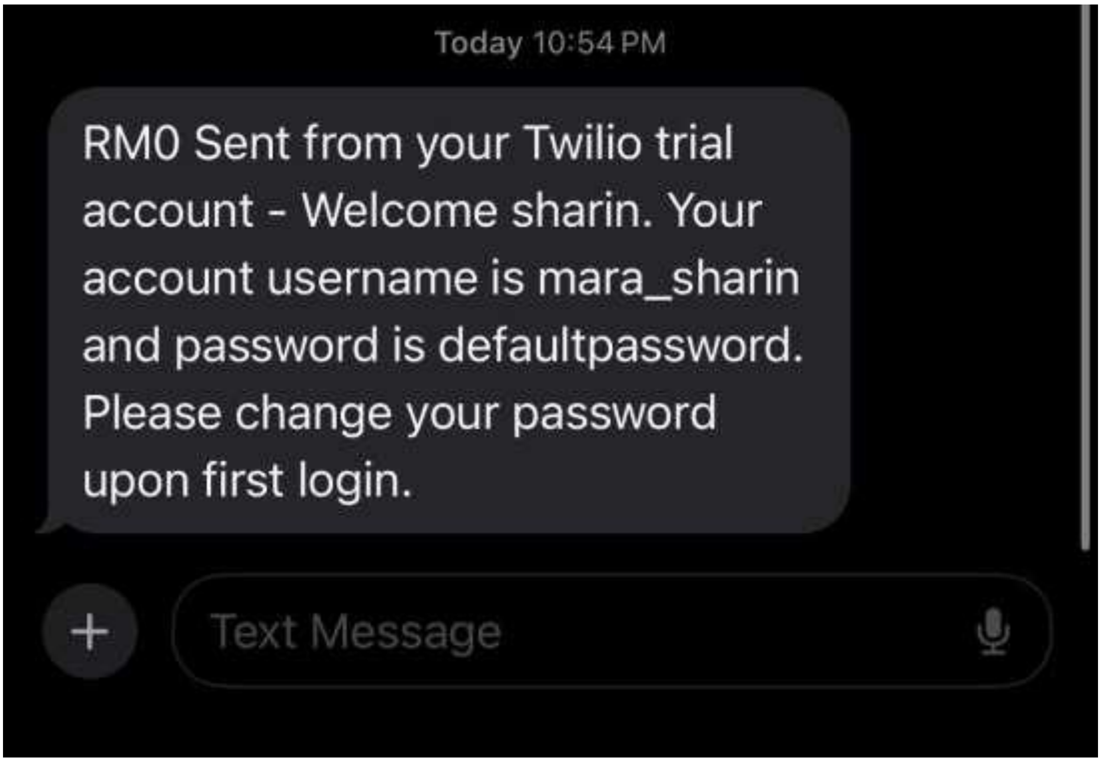
Figure 5.11 Success message of adding patient



Samara

Age: 75

Figure 5.12 Listing the patients under the Caregiver

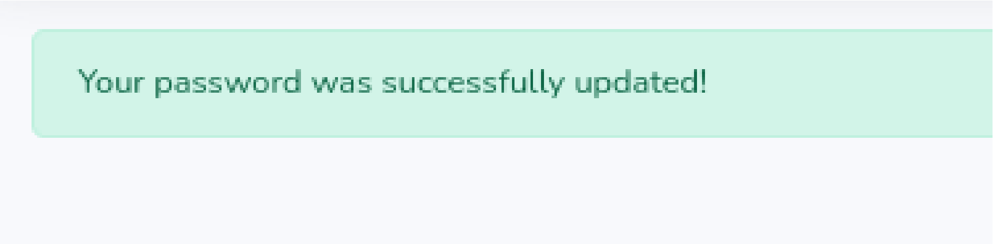


Today 10:54 PM

RM0 Sent from your Twilio trial account - Welcome sharin. Your account username is mara_sharin and password is defaultpassword. Please change your password upon first login.

Figure 5.13 SMS message with the credentials to the relative

Figure 5.13 show the SMS message automatically sent to the relative to notify him about logging in credential. The default login credential sent via SMS have to be changed after logging in to the system and clicking on the patient’s name or image a dropdown menu will appear there is going to be profile option which will show the patient profile information. Currently the pie chart is in light grey with “no Data” label.



Your password was successfully updated!

Figure 5.14 Patient relative changing default password

Figure 5.14 show the patient relative changing the default password for security reasons. If the new password is not short and contain complex characters and the confirm password identical to the new password field the message “Your password was successfully updated!” will be returned indicating the password changed.

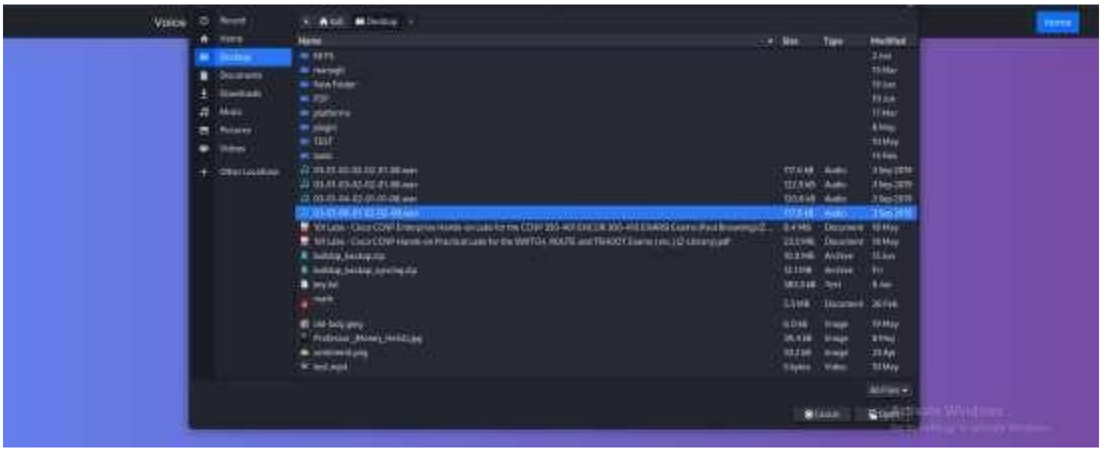


Figure 5.15 Caregiver uploading .wav file

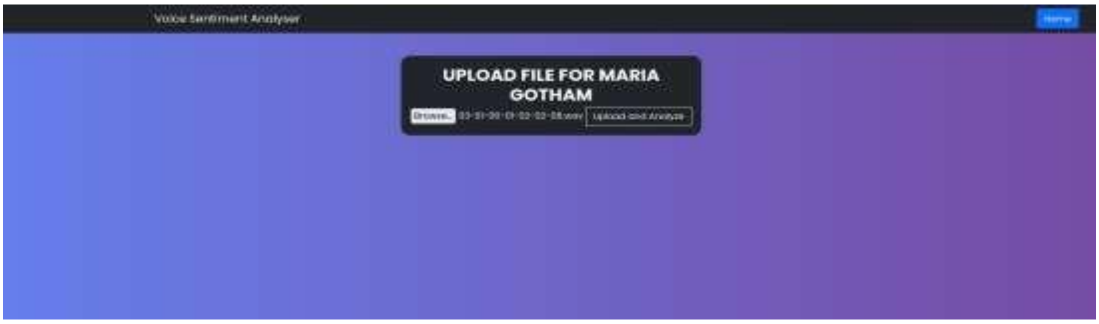
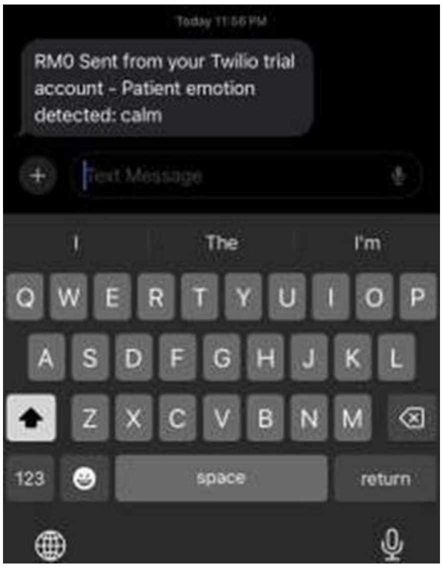


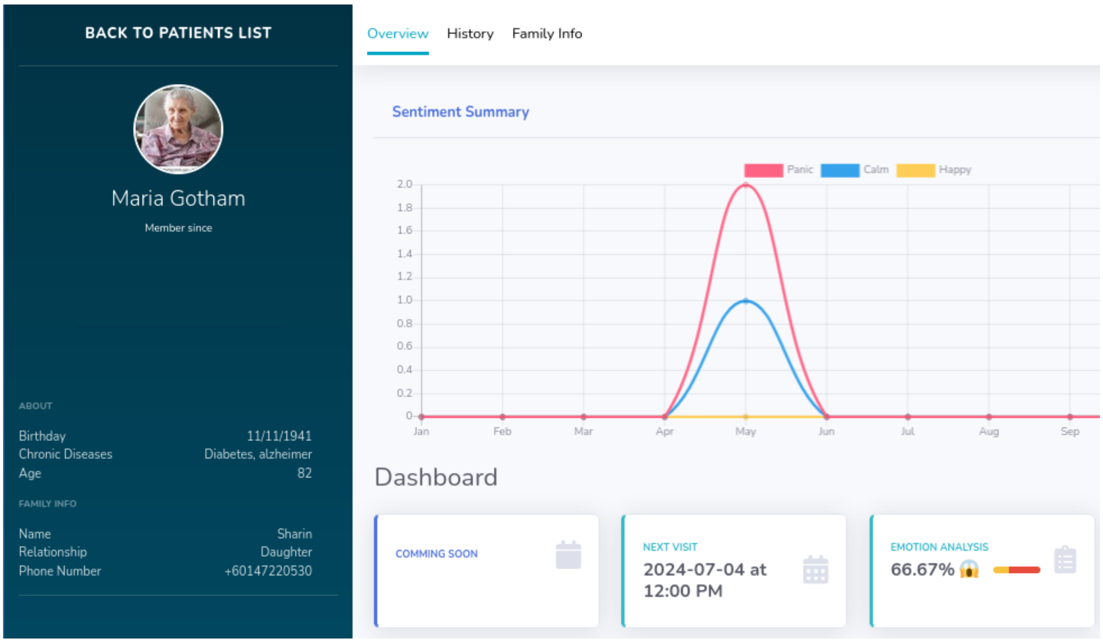
Figure 5.16 Caregiver uploaded the voice



RM0 Sent from your Twilio trial account - Patient emotion detected: calm

Figure 5.17 Relatives got SMS emotion update automatically

Figure 5.16 show the uploaded voice file to be analysed by the AI, using the extract_feature function. The upload takes around 20 seconds for the AI to digest the voice and return the result. Once success the Caregiver will be redirected the patient profile with the success message “Patient voice uploaded and SMS sent with the result.” Like in Figure 5.17. At the same time the SMS message in figure 5.18 will be sent to the relatives of the patient. The emotion analysis is updated directly according to the results of the AI.



Maria Gotham

Member since

ABOUT

Birthday	11/11/1941
Chronic Diseases	Diabetes, alzheimer
Age	82

FAMILY INFO

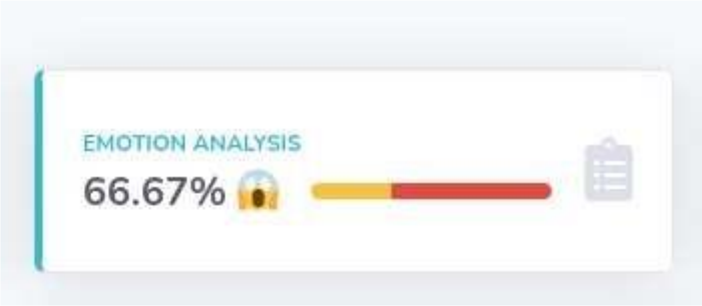
Name	Sharin
Relationship	Daughter
Phone Number	+60147220530

COMMING SOON

NEXT VISIT
2024-07-04 at 12:00 PM

EMOTION ANALYSIS
66.67% 😱

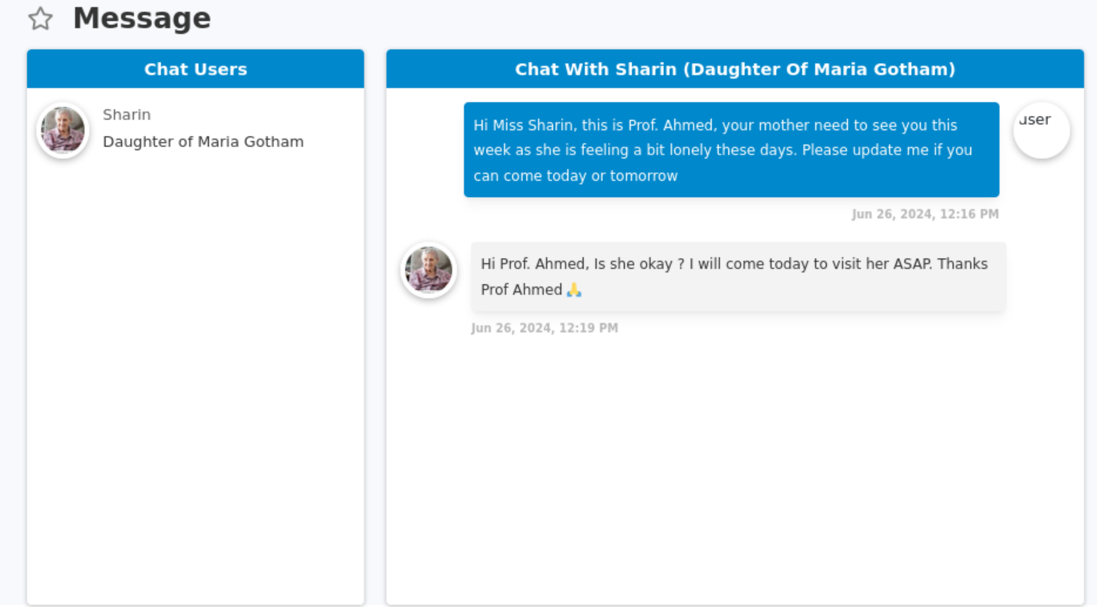
Figure 5.18 Scenario of not very well patient



EMOTION ANALYSIS
66.67% 😱

Figure 5.19 Emotion analysis showing red flag in this patient

Figure 5.20 show an example of a patient whose results is not very well. The red half of the progress bar indicate that the panic emotion is the dominant emotion in this patient, that is there is something with this patient.



Sharin
Daughter of Maria Gotham

Hi Miss Sharin, this is Prof. Ahmed, your mother need to see you this week as she is feeling a bit lonely these days. Please update me if you can come today or tomorrow

Jun 26, 2024, 12:16 PM

Hi Prof. Ahmed, Is she okay ? I will come today to visit her ASAP. Thanks Prof Ahmed 🙏

Jun 26, 2024, 12:19 PM

Figure 5.20 Caregiver talking with Sharin (Maria's Daughter)

Figure 5.21 show the Caregiver ability to reach out the relatives of any patient very fast using the live chatting feature with the Pusher API. Here Prof. Ahmedasking Sharin to come visit her relative.

5.4 Testing

In this section, the method used for testing the system is discussed in this part. In order to complete theuser usability, the system flow must be tested to identify any faults or errors in the system. From the result achieved through this testing, error detection and fixability must be perform to prevent any future matters throughout the system development. Therefore, Black Box testing, White Box texting, input output validationand user testing some of the approaches utilized. Thus, each approach is discussed and shown in its own section.

5.4.1 Black Box Testing

Black box testing focuses on application testing involves application's input and output based on software requirements and specifications with no prior knowledge of its internal code structure, implementationof details and internal path. With this testing approach, it can identify the faults and error in the system based on the responds on user expected and unexpected actions such as application response time, usability and reliability flaws, faults in data structures and external database access.

Table 5.1 shows the black box testing including hardware components and its functionality to ensure the components works as expected in the circuit. The backend scripts is completely done, its able to pass all ofthe result to each component to run smoothly and all the request and responses working. During the testing, AImodel, dashboard charts and APIs, live chatting and other component are tested.

Table 5.1 Software Functions

Software Functions			
No.	Tested Components	Expected Output Result	Pass/Failed
1	Accessing 127.0.0.1:8000 to connect to the system landingpage	The application show up the landing page where a user can start login or signup	Pass
2	Check if Caregiver addpatient to the system.	The Patient added successfully and all the relatives of the patient got SMS message of theircredentials to login to the system	Pass

Software Functions			
No.	Tested Components	Expected Output Result	Pass/Failed
3	Check if Caregiver go to chat page and relative login totheir account	Caregiver can see the relative added automatically to the chat list and patient relative see the Caregiver taking care of their relative automatically and live chatting messages sent/received.	Pass
4	Check all the graphs in thesystem	All graphs can smoothly pick al its needs from the API having no issue with the APIformat and display it correctly.	Pass
5	Check the power supple	The microcontroller able to connect to the power supply via USB	Pass
6	Run the system more than 30 minutes	The system is stable and able to run more than 30 minutes	Pass

5.4.2 Input and Output Validation

Input and output validation testing is an important element in system testing to ensure the user submit the correct information and the system satisfies the user needs. It is quality assurance that examines the data input by the user whenever the user inserts incorrect information, an input error is prompt. Table 5.1 shows theinput and output validation for the web app where the login page and sign-up page is tested. Table 5.1

shows the message if the user enters invalid username and password. Email must in correct format and password but atleast 8 characters.

Table 5.2 Black box testing for input and output validation

Input and Output Validation			
No.	Tested Input	Input	Result
1	Login Page Enter valid and correct username and password	Email: Username: maria_gotham_sharin password: Test@123	Valid and head to theDashboard page
2	Login Page Enter invalid email and password < 8	Email: maria_gotham_sharin Password: defaultpassword	error message: Please enter a correct username and password. Note that both fieldsmay be case-sensitive.
3	Sign Up Page Enter an email that already registered to the system	Email: Caregiver1@somecorp.com	Prompt error message: This email is already registered.Please use another email.

Table 5.2 shows the input and output validation for the web app where Caregiver try to upload any voice record format other than .wav . It is not possible because the AI model is trained to only handle .wav filefeatures and will cause crash in the system if not sanitized.

Table 5.3 Black box testing for input and output validation for uploading voice

Input and Output Validation			
No.	Tested Input	Input	Result
1	Uploading .jpg .txt .mp4	Upload .mp4 file	Error message: Invalid file format. Please upload a .wav file.

5.4.3 White Box Testing

Other than black box testing, white box testing is another approach to test and evaluate the system. Whitebox testing is a technique where the internal structure, design and coding of application are tested to verify theflow of input-output in order to ensure there are no errors. The purpose of white box testing including internal security holes in application. imperfect structured path during coding process, the conditional loops function incoding and also the testing of each statement, function, objects and individual basis. Table 5.4 shows a list of py files that contains application code to run the system.

Table 5.4 List of py file code for application

No	Filename	File Type	Result
1	manage.py	Py	No Error
2	Views.py	Py	No Error
3	Forms.py	Py	No Error
4	Admin.py	Py	No Error
5	Apps.py	Py	No Error
6	Urls.py	Py	No Error
7	__init__.py	Py	No Error
8	Setting.py	Py	No Error
9	Models.py	Py	No Error
10	Wsgi.py	Py	No Error
11	Asgi.py	Py	No Error

5.5 Chapter Summary

This section described the overall of execution and testing for the system throughout black box testing, white box testing and user acceptance testing. The process of these testing performs to ensure the system can operate smoothly and detects any flaw during the testing process. Based on the result and critics from user testing, error and flaws that occurs during the testing is successfully corrected during the development of the system.

CHAPTER 6

CONCLUSION

6.1 Introduction

The Conclusion chapter provides a comprehensive summary of the Sentiment Voice Analysis Alert System for Aged People using AI, highlighting its significance, accomplishments, and potential future developments. This chapter reflects on the project's objectives, implementation process, and outcomes, while also discussing the implications and impact of the system.

6.2 Achievement of Project Objectives

The project achieved its set objectives by developing a voice-based sentiment analysis system for elderly care, incorporating essential features like live chatting to enhance communication between caregivers and patients' relatives. The system, based on user requirements, effectively aids in monitoring and alerting caregivers about the emotional states of the elderly. A sophisticated machine learning model using neural networks and MLP classifiers was developed and tested, accurately classifying emotions such as panic, calm, and happy from voice samples. The robustness of the sentiment analysis model and the SMS alerting mechanism was confirmed through extensive testing with a large dataset. The addition of a live chat feature further enhances real-time interaction, allowing for immediate response and support, thereby significantly improving the system's utility and the quality of care provided to elderly individuals. system has successfully fulfilled the project objectives by improving the emotional well-being of aged individuals, facilitating targeted interventions by Caregivers, and providing family members with vital information about theirparent's emotional state. By leveraging AI and sentiment analysis techniques, the system has brought forth an innovative solution to combat the challenges faced by aged individuals in retirement homes. The achievements of the project objectives highlight the potential of the system to make a positive impact on the lives of the aged people, addressing their emotional needs and fostering a sense of well-being, support, and connection.

6.3 Suggestions for Future Improvement

One potential area for improvement lies in the refinement of the sentiment analysis model. As the system evolves, incorporating a larger and more diverse dataset can enhance the accuracy and robustness of emotion detection. By training the model on a broader range of voice recordings and emotions, the system can better capture subtle nuances and variations in emotional states. Additionally, exploring advanced machine learning techniques or alternative sentiment analysis algorithms can provide further insights into emotional patterns and improve the system's performance

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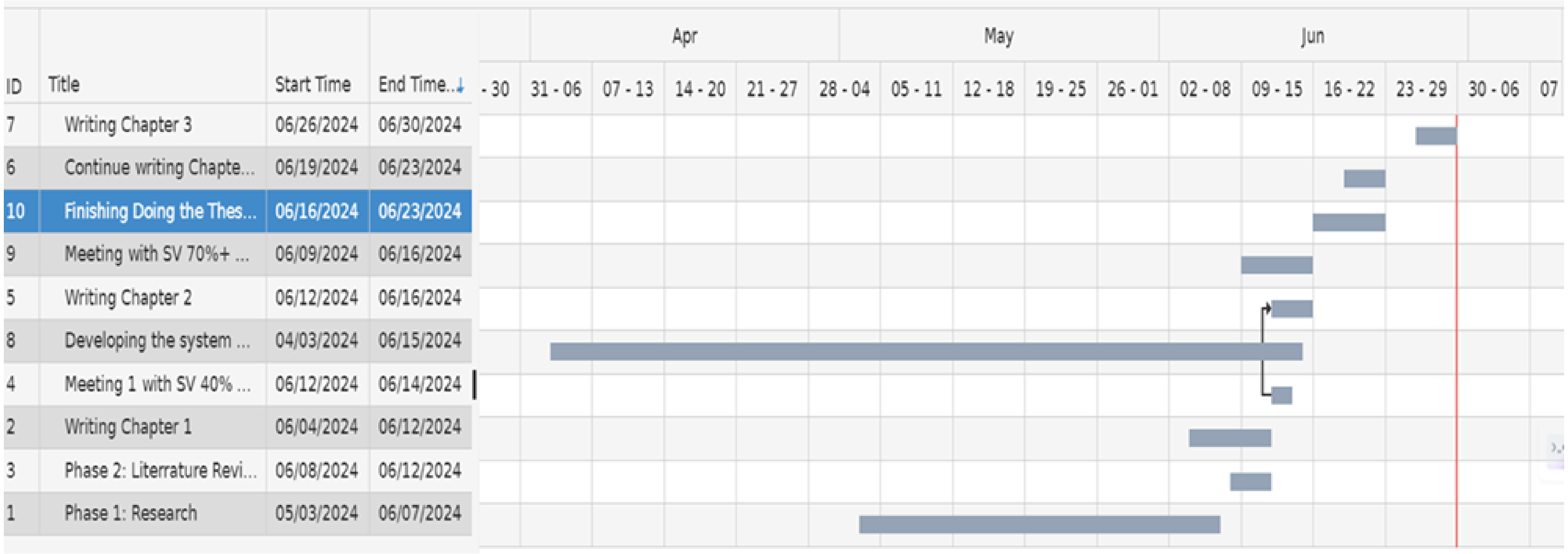
APPENDIX A



ID	Title	Start Time	End Time..
7	Writing Chapter 3	06/26/2024	06/30/2024
6	Continue writing Chapte...	06/19/2024	06/23/2024
10	Finishing Doing the Thes...	06/16/2024	06/23/2024
9	Meeting with SV 70%+ ...	06/09/2024	06/16/2024
5	Writing Chapter 2	06/12/2024	06/16/2024
8	Developing the system ...	04/03/2024	06/15/2024
4	Meeting 1 with SV 40% ...	06/12/2024	06/14/2024
2	Writing Chapter 1	06/04/2024	06/12/2024
3	Phase 2: Literrature Revi...	06/08/2024	06/12/2024
1	Phase 1: Research	05/03/2024	06/07/2024

Gantt Chart