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**ZOIE : Human sentiment analyzer mobile  
application using machine learning with an AI  
chatbot**

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## **Abstract**

Psycho-social well-being is the ability to use talents and abilities to cope with stressful situations, work effectively and contribute positively to the society. Hence, it is critical to maintain a really excellent mental state. Depression, anxiety, and stress all have a negative impact on an individual's mental health. Loneliness and depression are correlated but different constructs. Having someone who understands emotions, feelings, and sentiments is a great strategy to minimize the aforementioned issues. Some early attempts have been made to develop mood tracking and mental health supportive applications for mobile platforms. Almost all of these applications rely on their own chatbot for both inputs and outputs. Due to that deficiency majority of users don't reap the benefits as they are reluctant to use these on daily basis for a period of time. This research attempts to develop a mobile application which is able to understand individual's feelings and analyse the sentiment behind the individuals using Natural Language Processing techniques without user's direct involvement to the application itself. In addition, this consists of an automatic conversational agent extended up to detect an individual's mood purely from capturing data through the smart phone and to react accordingly to the current mood of the individual as a virtual companion. The report explains the methodology, features and functionalities of the system in depth, while highlighting the testing and evaluation the system has undergone.

**Keywords:** Natural Language Processing, Mobile Application

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## **Dedication**

This dissertation is dedicated to my dear family for their continuous encouragement and support during the research as well as the entire study process. Specially, my mother who inspired me and given her fullest cooperation to make my research success.

## Acronyms/Abbreviation

Table 1: Acronyms/Abbreviation

Term	Definition
AI	Artificial Intelligence
API	Application Programming Interface
APK	Android Package Kit
ASCII	American Standard Code For Information Interchange
HTTP	Hypertext Transfer Protocol
IDE	Integrated Development Environment
NPS	Net Promoter Score
QOL	Quality of life
SDK	Software Development Kit
SDLC	Software Development Life Cycle
UI	User Interface
UML	Unified Modelling Language
UX	User Experience
WBS	Work Breakdown Structure
WHO	World Health Organization

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# **1. Introduction**

This chapter introduces the project. Background of the project emphasis with problem identification, the system and the scope of the project. Next, project aims and objectives are stated. Project framework and Description of the artefact are mentioned. Finally, structure of the report is described.

## **1.1. Background of the project**

The world mental health disease – stress is the epidemic of the 21st Century, leads to depression which is a disorder with symptoms as loose interest, feeling of sadness and worthlessness ultimately causes suicide if it is not treated properly (Fink, 2021). Unfortunately, the World Health Organization (WHO) reported in 2017 that over 5% of the worldwide human population suffers from depression. Furthermore, the WHO reports that suicide is the second leading cause of mortality in the 15-29 age group, accounting for more than 800,000 deaths per year (Suicide, 2021). This epidemic must be brought under control to some extent in order to protect even children.

The above mental diseases are treatable with various medical therapies such as psychotherapy, pharmacotherapy and meditation (Deadly et al., 2018). The main issues with these treatments include a lack of professionals in the mental health area, which results in long waiting lists for treatments and high treatment costs. In order to conduct this matter, mental health related software and mobile applications are dramatically developed. According to a research conducted in 2015, supportive health applications were downloaded by 58% of global mobile phone users (Krebs and Duncan, 2015). Furthermore, people mostly prefer automated conversational bots with Artificial Intelligence (AI) over human assistance, allowing them to reveal personal information without hesitation (Lucas et al., 2014).

On average, 10,000 depression and anxiety applications are downloaded in a single month. However, when it comes to usage, it is not really satisfied as 56% to 63% of these applications reports there are no monthly users (Psychiatry, 2020). The problem raises with users rarely open the application after installing it and using it for a few days before becoming bored with it (Ellis et al., 2014).

### **1.1.1. Problem Identification**

While hundreds of mobile applications have been developed to address the above - mentioned issue, it is evident that the majority of the users are not receiving the benefits out of this because the users reluctant to use these on daily basis for a period of time. The problem was to build a mental health supportive application which can use effectively without any reluctance in an innovative way.

### ***1.1.2. Proposed System***

The proposed system was to develop a mobile application which is able to help user to manage mental health in a good condition without user regular involvement to the application. Unlike other applications, the proposed application can identify user sentiments. Even the user doesn't open this, it is able to analyse and help user to keep their mental health in good condition throughout the day. The application also consists with a Chatbot which acts as a digital companion for the user.

### ***1.1.3. Scope of the Project***

This application's Sentiment analysis process was designed solely to do textual sentiment analysis. It does not contain emotion detection on the face. Furthermore, the sentiment analyser only detects positive, negative, or neutral sentiment.

## **1.2. Project aims and objectives**

### ***1.2.1. Project Aim***

- The aim of the proposed project is to develop a mobile application which enables the user to collaborate with a digital companion towards a better mental health.

### ***1.2.1.2. Project Objectives***

- To identify the existing AI related chatbots/ mood tracking mobile applications, analyze and study their behavior.
- To get hands on experience about AI, ML and natural language applications on a project
- To train a machine learning model and develop an AI based chatbot using natural language processing
- To develop a user friendly – interesting platform to users to interact with.

## **1.3. Project framework**

The project began with a thorough feasibility study. The requirement gathering and analysis phase was then divided into two stages. In the first stage, a literature review was carried out in order to learn about previous studies on this subject. The second stage entailed conducting a market research.

The Agile methodology was chosen to address the project. There were four sprints, with each sprint consisting of planning, designing, developing, testing, and deploying a release. Finally, evaluation is conducted in a form of a survey.

## **1.4. Description of Artefact**

The artefact which ZOIE mobile application is implemented using client - server architecture. The sentiment analyser of the application is hosted in the cloud and acts as the server itself. The mobile application, which is the client of the system is capable of recording textual inputs of the user. It continuously sends raw data to its server and obtains the sentiment status that has been analysed.

## 1.5.Structure of the report

*Table 2: Structure of the report*

Chapter No.	Chapter Name	Description
1	Introduction	The introduction chapter describes the project background including the research problem, proposed system and the scope of the project. Project aims and objectives are defined. Project framework is described and description about the artefact is also stated. Following, structure of the report is described.
2	Literature Review & Market Research	Second chapter consists of two main sections, Literature review and Market research. The literature review segment is mainly based on the previous attempts which conducted related to the developed system. Findings from previous research papers and journal articles are briefly discussed. Further, several existing systems are discussed and finally functionalities are compared with the developed system and research gap is stated.  In the second part of the chapter, results of the conducted market research are discussed. The primary subject of discussion was the need for this type of system and how the developed system serves the need of users that is currently not being met and finally expected demand for the proposed system is stated.
3	Methodology	In the third chapter, the developed artefact is described. Research methodology, Project Planning, Requirement gathering & Analysis, design, development and testing phases are covered in depth.
4	Implementation	The implementation chapter describes the entire development process of the artefact using the source code.
5	Results & Discussion	This section discusses in detail, the functionalities of the system, how they were developed, the user interfaces designed for each function and testing process conducted. Furthermore, this section explains about the reliability and accuracy of the system and technical issues faced by the developer. Finally, the evaluation section provides a detailed review of how the system evaluated
6	Conclusion and Future work	The final section gives an overall overview of this project, limitations and further work that can be done to develop and improve the artefact are discussed.

## **2. Literature review and Market research**

This chapter includes the conducted literature review of the proposed system and follows findings of the conducted market research regarding the project is discussed.

### **2.1.Literature review**

The literature review consists of a background research about research papers and similar systems. Conducted research results are discussed under the literature review section. It describes an overview about sentiment analysis, AI chatbots and Natural Language Processing which is a subset of Machine Learning. This literature review is mainly based on journals such as research papers, case studies and survey papers which were published during 2013 to 2020. The arrangement of the literature review as follows, first it has been discussed about the subtopics which are related to the theme of the proposed system. Then some of the existing systems related to the developed system are discussed. Following, the research gap is stated.

#### ***2.1.1. Stress, anxiety, depression and loneliness towards suicide***

Studies have shown that individuals with depressive disorders showed anxiety symptoms in more than 70% of the cases and met criteria concurrently for at least one suicidal ideation. (9a) Khansa, W et al. in 2017 to 2018 have conducted a study that was aimed to assess the impact of the interaction between anxiety and depression on suicidal ideation, QOL, and work productivity. There, they have conducted a survey using 1487 participants consisting of 20 questions that test trait anxiety or anxiety level as a personal attribute and another 20 questions that assess state anxiety (STAIA). This was a cross-sectional study that took place between November 2017 and March 2018. As a result of the study, Khansa et al. have stated that anxiety and depression were significantly linked to an increase in suicide thoughts, while each component had a significant negative impact on job productivity and lowered people's quality of life. And also anxiety and depression were associated with a rise in suicidal ideation. But anxiety alone, without depression, was correlated with lower work productivity and quality of life. Depression on its own was also associated with higher suicidal ideations. (Khansa et al., 2020)

Debowska et al. in 2020 conducted a study to determine the prevalence of stress, sadness, anxiety, and suicidality among university students in various groups. For the study, 7228 university students have participated. The mean age of the participants was 22.78. The study was conducted during the first two months of the COVID-19 outbreak in Europe, information was gathered in five waves (March and April 2020). As a result of this study, researchers stated that, as the outbreak progressed, the findings show a considerable increase in levels of depression. Also, researchers have stated that, on depression, anxiety, stress and suicidality, female students scored considerably higher than undergraduate male students. (Debowska, Horeczy, Boduszek and Dolinski, 2020).

In addition to the previous study, Fountoulakis et al. have also conducted a study regarding depression in adult population in Greece between COVID-19 outbreak. 3997 participants between age 18 to 69 were participated and as a result of the study, Fountoulakis et al. stated that, more over 45% participants expressed increased anxiety as a result of the lockout, and nearly 40% reported increased depressed symptoms. Suicidal ideation improved in 10.4% of

participants and reduced in 4.4%. Major depression was prevalent in 9.31% of the participants, with another 8.5% feeling unpleasant sensations. (Fountoulakis et al., 2021)

Negative emotions with a common, chronic, and recurring pattern are crucial in the development and maintenance of psychopathology. Erzen and Çikrikci in 2018 have investigated the effect of loneliness on depression by conducting a meta-analysis. Loneliness, as a negative feeling, was thought to be a risk factor for depression as considered in that study. A total of 40,068 people were surveyed for this study and as a result of the study, researchers have stated that, loneliness had a moderately significant effect on depression . (Erzen and Çikrikci, 2018) Domènech-Abella et al. in 2017 conducted a study regarding the connection between loneliness and depression in Spain's elderly population. A total of 3535 participants who above 50 years were participated in this study. As a result of this study, Domènech-Abella et al. pointed out the importance of investigating the impact of social networks in feelings of loneliness in older persons with depression, taking into consideration their social and demographic features, as well as their health condition (Domènech-Abella et al., 2017)

### ***2.1.2. Artificial Intelligent Chatbots***

Dharwadkar and Deshpande in 2018 have stated that People today are more likely to be hooked on the Internet, but they don't care about their own health. And also mentioned that people avoid to meet doctors for minor issues and those will become major disease in future. Researchers have given a solution to the problem which people have to consult medical officers even for a small problem. There, Rashmi Dharwadkar and Deshpande have stated that, it is much more time-consuming process and also handling the telephone calls for the inquiries is quite hard. They have reached the solution by an idea of using a medical chatbot to aware people about the treatments or symptoms concerning the specific disease. The system has used Natural Language Processing to make the conversational interface. SVM algorithm and disease symptoms system can predict disease. The system also used Google API for voice-text and text-voice conversion. The system analyzes inputs, generated answers and displays to the user. With the use of this system people could have get an idea about preliminary treatments and the topmost benefit of this system is people could have get pretreatments immediately and reduce the disposition of victimization to the major mental health issues (Dharwadkar and Deshpande, 2018).

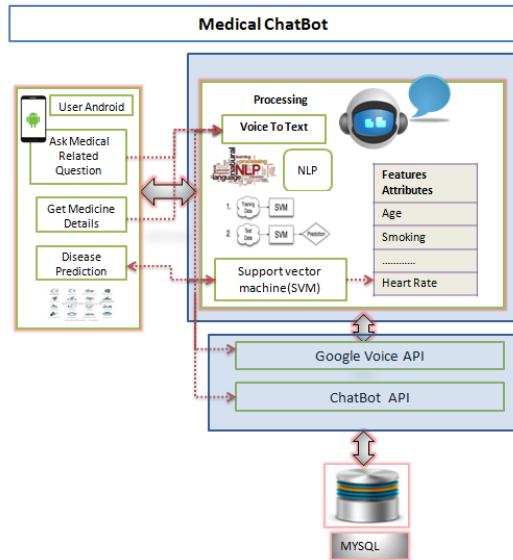


Figure 2-1: System Design of Medical Chatbot (Dharwadkar and Deshpande, 2018)

Patel et al. in 2019 has stated that Chatbots are special agents that respond with the user in natural language just as a human would reply. Patel et al have made an intelligent social therapeutic chatbot for students who undergo different levels of stress to provide a mental relief to them. They have developed three deep learning classifiers which are, Convolutional Neural Network (CNN), Recurrent Neural Network (CNN), and Hierarchical Attention Network (HAN) for the process. People have to chat with the chatbot for a while. Bot will ask questions and identify emotions based on the inputs. The classifiers of the system are capable of identifying the mental state of the user and tag the user to several categories such as zero depression, Slightly stressed, Highly stressed or Slightly depressed. Benefit of this system is, this could mention the required treatment according to the identified state. Cons of this developed system can be identified as, the research mainly focused only on students, hence the system has developed using limited classification methods and focused on minor details thus, accuracy is decreased (Patel et al., 2019).

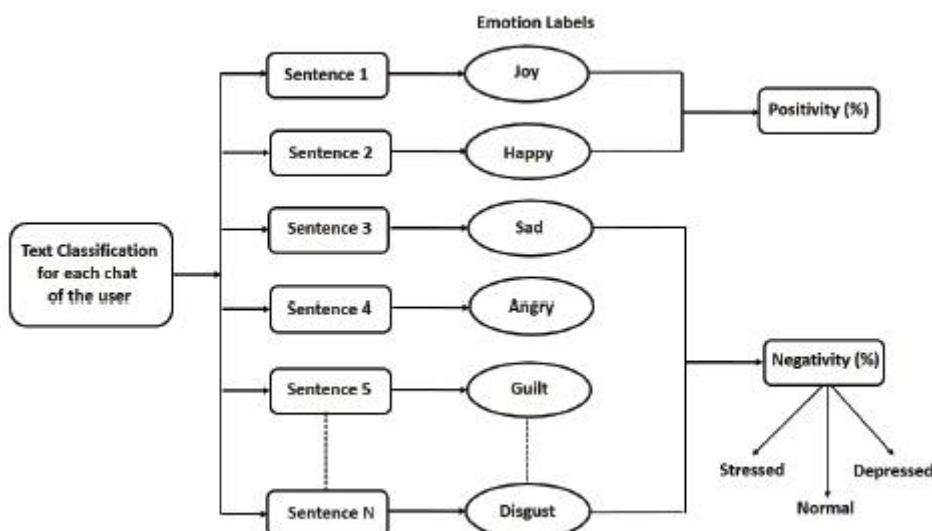
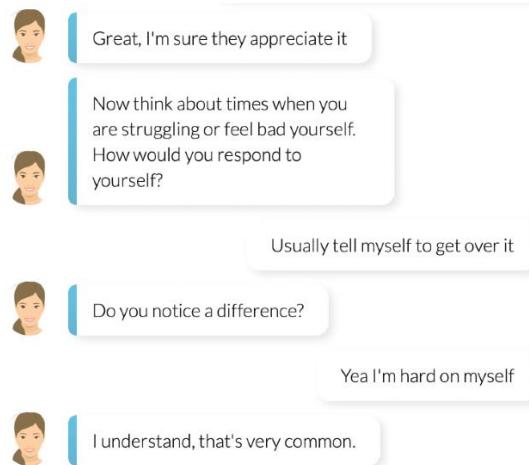


Figure 2-2: System model for mental state identification using (Patel et al., 2019)

Dosovitsky et al. in 2020 stated that chatbots are a scalable solution that provides an interactive means for engaging users in behavior health interventions carried out by the artificial intelligence. Dosovitsky and team have done a study about how users engage with a particular chatbot that made for reduce depression. They have made 354 users interact with a chatbot called “Tess” which is a mental health chatbot designed by “X2AI” between July 27, 2017, and September 15, 2018 and analyzed. In average, users have interacted with the chatbot for 46 days with total 6220 messages. In conclusion, they have noticed an average usage from users. When considering findings of the research, Dosovitsky et al. have stated that many individuals used the chatbot and chatbot can be an effective way to handle this issue (Dosovitsky et al., 2020).

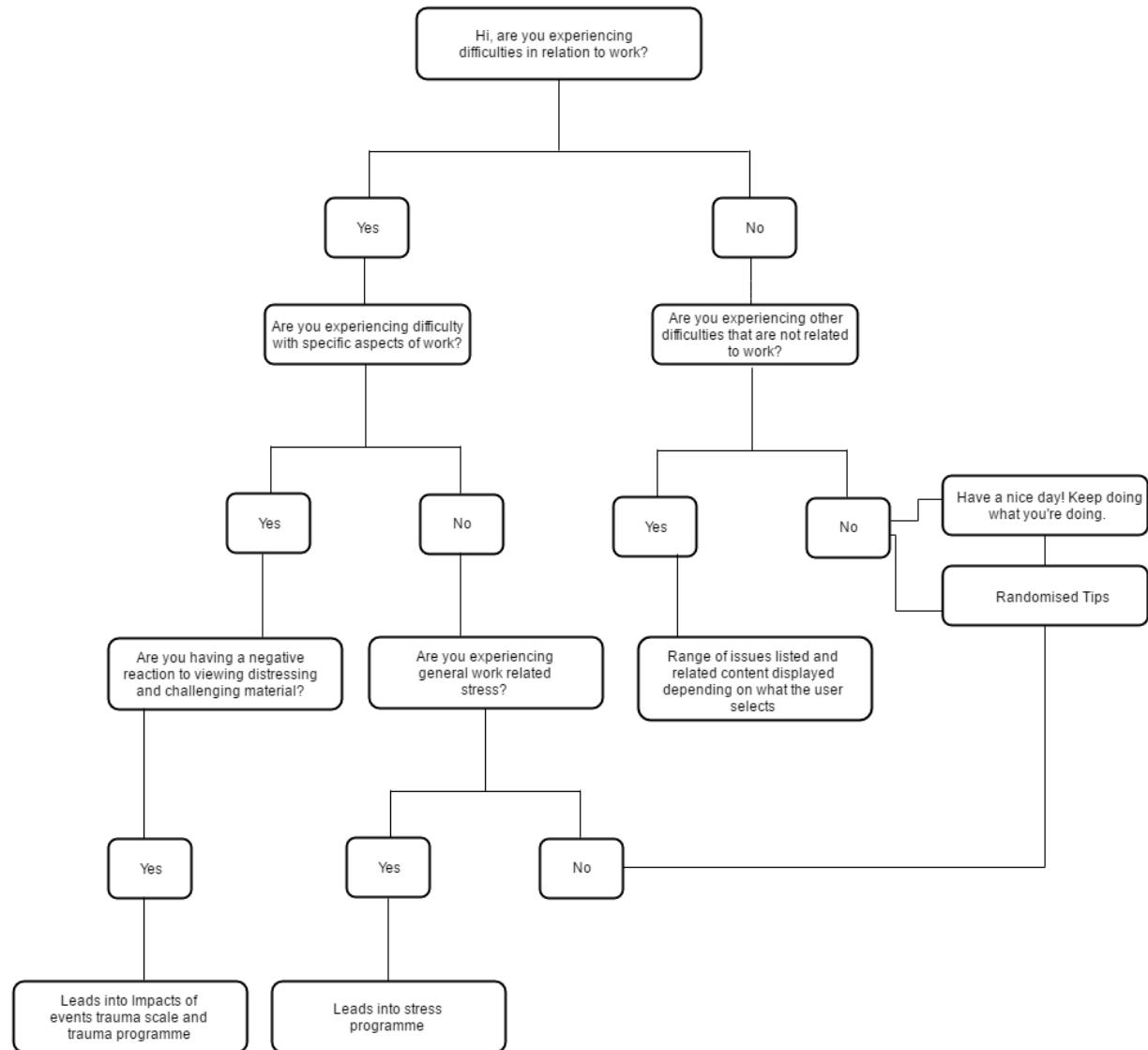


*Figure 2-3: Sample conversation with "Tess" Chatbot (Dosovitsky et al., 2020)*

Osorio, Zepeda and Carballido in 2020 have stated that Stress is the 21st century global mental illness which triggers depression or even suicide at the end. Osorio, Zepeda and Carballido have proposed a design of an architectural framework, logic based intelligent chatbot called MyUBot. MyUBot was mainly focused in poetry and silence mild therapies. In the initial stage MyUBot was introduced to first-year university students with the expectation of uplifting students' mental health. MyUBot is an intelligent agent system which is logic based for dialogue composition. The application does not serve for the detected cases of anxiety and depression. Instead, it will guide the student to a human expert therapist. In addition, the system consists with an emergency button which can be used for immediate experts' help. The system has used master-slave conceptual AI design. MyUBot could learn about each and every individual in each conversation sessions. The research team proposed to use machine learning algorithms to expand the system in future works (Osorio, Zepeda and Carballido, 2020).

Cameron et al. have stated that, for mental health counselling, using a chatbot will provide many benefits for the user. Cameron et al. have proposed a design of a chatbot that can be used to mental health counselling. The application consists with a self-help library. In that library, solutions for various mental health problems are categorized and stored. The solutions are stored in a form of a Portable Document Format (PDF). Users have to select the relevant

category on the preference of individual and then the information in the PDF content will be received. When considering this research work, it is consisted with an interesting emoji selection feature which allows users to easily input their current mood to the application. It leads to generate responses from the chatbot. When discussing about flaws of the system, it can be stated that this system is a very basic level application and even it does not consist with an interactive chatbot. In the future work, the researchers are planning to improve the functionalites (Cameron et al., 2017).



*Figure 2-4: Script of the digital counselling chatbot (Cameron et al.,2017)*

In conclusion, researchers stated that chatbots provide a great opportunity towards people who do not willing to take face to face treatments yet they can have a user friendly and interactive experience.

### **2.1.3. *Sentiment Analysis***

Neethu and Rajasree in 2013 have stated that sentiment analysis deals with identifying and classifying opinions or sentiments expressed in source text. They have tried to analyze the twitter posts which has maximum of 140 characters limit using machine learning approach. They used their own data set which they have collected tweets over a period of time ranging from April 2013 to May 2013 through Twitter API. The data set was consisted of 1200 words, 600 of positive and 600 of negative which they have manually annotated. The preprocessing step was conducted by removing URL, avoiding misspellings and slang words. Creation of feature vector process was conducted by extracting twitter specific features in the first step and following using a unigram approach. In the sentiment classification process was done using Naive Bayes, Support Vector Machine, Maximum Entropy and Ensemble classifiers and then performances are compared of each other (Neethu and Rajasree, 2013).

Vivek Narayanan et al. in 2013 have explored several methods to improve the accuracy of Naive Bayes classifier to sentiment analysis process. There, they have used dataset from Internet Movie Database(IMDb) which consists of 25,000 reviews for training. To store the count of words they have implemented a classifier in Python using hash tables. Training is conducted on Intel Core 2 Duo processor at 2.1 GHz. The preprocessing and applying negation handling before counting the words has done in that step. They could have achieved 88.80% accuracy on the 25,000 test data set. The research has significantly shown that high accuracy can be achieved on Naive Bayes classifier by choosing the right type of features and removing noise by appropriate feature selection. Also they have indicated that ease of implementation is another key benefit of Naive Bayes (Narayanan, Arora and Bhatia, 2013).

Messias et al. in 2016 have compared the performance of 17 different sentence level sentiment analysis methods made for mobile platform. Adapted those sentence level methods to work on LG G3 mobile device powered by Android OS and measured their performance by CPU usage, memory usage and battery consumption. The mentioned 17 methods include AFINN, Emoticons, Emolex, Happiness Index, NRC Hashtag Sentiment Lexicon, OpinionLexicon, OpinionFinder (MPQA), Panas-t, USent, SASA, Sentiment140 Lexicon, SentiStrength, SentiWordNet, Stanford Recursive Deep Model, Umigon, SenticNet, and Vader. The testing has implemented from 10 to 10000 input text range. In the first case, considering battery consumption, USent & Stanford didn't perform in a good manner. Except USent and Stanford which drained 6& 11.5% respectively all other methods were satisfied. In the second case, considering memory usage some of the methods shown less amount of memory usage while some methods such as USent, OpinionFinder and SASA consuming considerable amount of memory. The last case, in terms of CPU usage during the execution to run 1000 instances USent took around 713 seconds while Stanford took around 1225 seconds. The result shows that some of the methods consume more resources thus NRCHashtag, Opinion-Finder, USent, SASA, Stanford cannot recommended for mobile devices (Messias et al., 2016).

Zhang et al. in 2019 have developed a system called MoSa (Mobile Sentiment analysis) which is able to analyze human behavior and trends in public sentiments in a machine learning based

method. Their experimental results shows that, the classification of short text, the most effective approach is a mixed sentiment dictionary while the average word length is less than 2.3. Also researchers have stated that by analyzing the texts in mobile applications, public opinion can be more accurately assessed (Zhang et al., 2019).

Nemes and Kiss in 2020 have done a social media sentiment analysis based on COVID-19. The main goal was to develop and train a machine learning model to analyze words and tag it as whether positive or negative. Researchers have used the most up-to-date tweets as the test data set. The analysis was done in a Recurrent Neural Network (RNN) which is built by them using tools provided by Keras and Tensorflow. The researchers have founded that It can be seen that recurrent neural network provides good performance and prediction in text classification (Nemes and Kiss, 2020).

#### **2.1.4. Natural Language Processing**

‘Natural Language Processing is a theoretically motivated range of computational techniques for analyzing and representing naturally occurring texts at one or more levels of linguistic analysis for the purpose of achieving human-like language processing for a range of tasks or applications’(Liddy, 2001, p. 2). It is the definition given by Elizabeth D. Liddy for Natural Language Processing(NLP). Human-like language processing which is the Natural language Processing (NLP) is a subset of Artificial Intelligence(AI). The NLP history goes several decades back. Machine Translation (MT) was the very first natural language related computer based application. In 1946 one of the earliest Machine Translation projects were conducted In order to break the enemy codes during the 2<sup>nd</sup> world war. In the last decade this field was growing rapidly. Oyebode et al. in 2020 have analyzed comments related to Covid-19 from six different social media platforms using Natural Language Processing techniques. They have categorized opinions themes wise according to the respective sentiment polarity whether negative or positive. They have successfully figured out 34 negative themes and 20 positive from over one million of randomly selected comments. The methodology consisted of Data collection, data preprocessing, Key phrase extraction and Categorizing Key phrases (Oyebode et al., 2020).

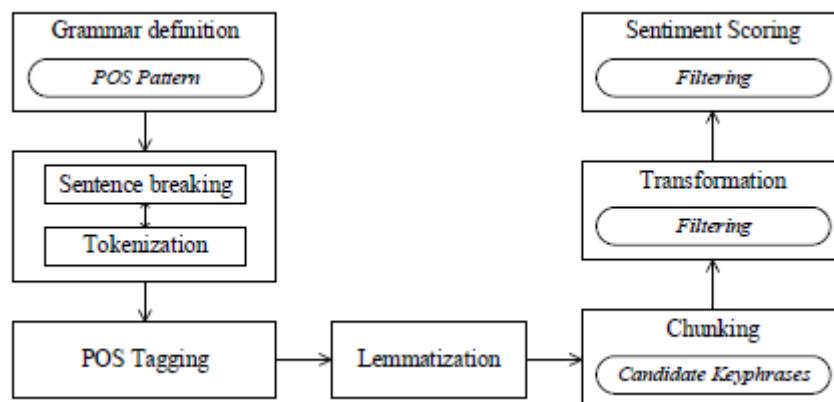


Figure 2-5: Extracting keyphrases in NLP (Oyebode et al.,2020)



*Figure 2-6: Sample keyphrases and their frequency of occurrence (Oyebode et al., 2020)*

The 2.5 -1 figure illustrates the steps of the process. These are a graphical representation of the scenario, key phrase categorization. It illustrates sample key phrases and the frequency of occurrence. A larger bubble size is representing higher dominance while the right bubble of figure 2.5 -1 represents negative key phrases and left bubble represents positive key phrases. When concluding the effort which Oladapo Oyebode et al. have taken, the implemented context-based method to identify themes / key phrases from different social media platforms related to covid19 pandemic. Researchers have illustrated the finding and suggested inventions to tackle the negative issues. The advantage out of the research is these interventions will help governments and individuals to reduce the spread and impact of COVID-19 and to respond to future pandemics in more effective manner.

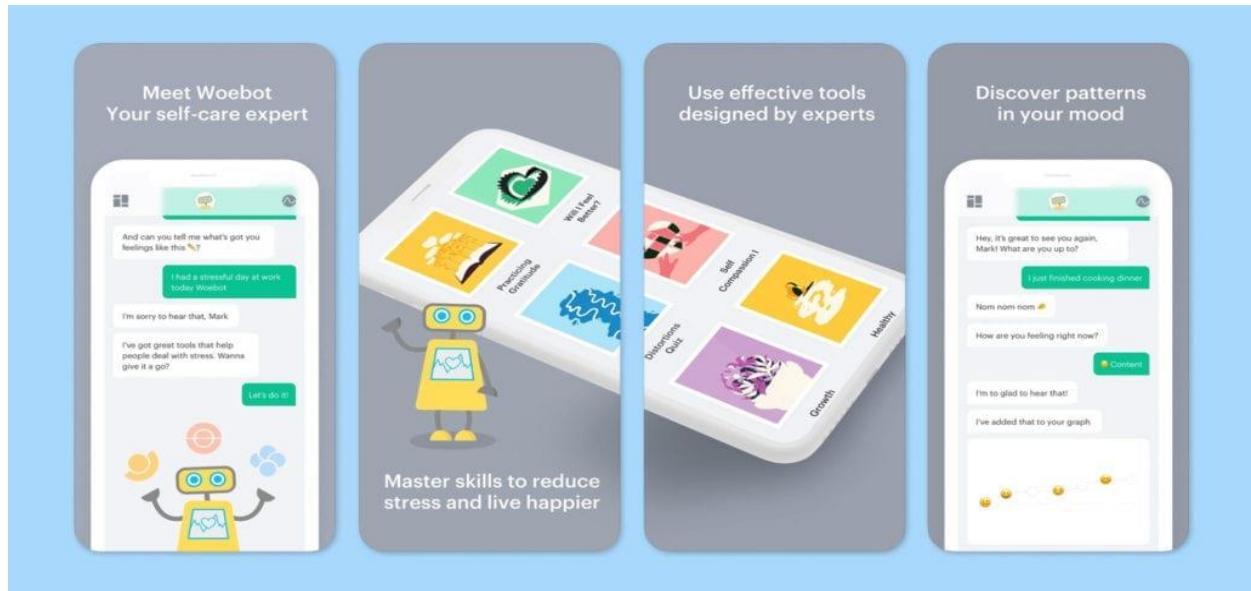
#### **2.1.5. Similar Systems**

There are number of mobile applications available regarding meditation/mental health and depression. Most similar three applications regarding the developed system are discussed in this section. These applications have shown a higher number of download count and the received ratings are 4.7, 4.8 and 4.4 respectively. Applications are selected by searching for “Mental health”, “AI Chatbot”, “Stress and depression”, “Self-care” keywords in the google play store.

##### *Woebot: Your Self-Care Expert*

Woebot is an automated conversational agent / chatbot founded by Dr Alison Darcy and team, Woebot Labs Inc. (Zaidi, 2018). Woebot is a mobile application which is available for both iOS and Android platforms. Woebot was introduced in 2018. Woebot is able to monitor the mood of the user and build up a platform which user can express their feelings, thoughts and emotions in a form of a conversation. Woebot is built on a platform of Cognitive Behavioral Therapy (CBT) which also referred to talking therapy. It makes patients changing the way of thinking and behave by enabling patients to reframe negative thoughts into positive towards a better mental health. When Woebot’s initial launch it was only available to iOS and later

Android version is released. First, Woebot asks for user how user feels and what's going on life. Make conversations regarding mental health and wellness. Sends footages and other relevant resources regarding that. Woebot can think through situations and guide the user using woebot tools from CBT, Learn about user with the use of its intelligent mood tracking and woebot is able to reduce stress and make the user happy.



*Figure 2-7: Interface of Woebot (Woebot / One Mind PsyberGuide, 2021)*

#### *Wysa: stress, depression & anxiety therapy chatbot*

Wysa: stress, depression & anxiety therapy chatbot is an Artificial intelligent based mobile chat bot developed by Touchkin. The goal of the wysa is aimed at improve the social well being via mental resilience. The Wysa is based on a text – based conversational agent. Wysa is available for both iOS and Android platforms. Wysa is able to provide mental health support by giving self heath practices in several ways. Machine learning algorithms to learn user emotions an provide mental health support such it can give kind of therapies, motivational support and behavioral reinforcement ("The wisdom of Wysa – Mental health apps, the (AI) friend who is always there", 2019). Today, there are about more than 500,000 users for Wysa from more than 30 countries worldwide. Wysa is more recognized as mindfulness coach, anxiety helper and as a mood tracker (Wysa: anxiety, depression & sleep therapy chatbot, 2021). Also Wysa consists with an emergency option where users can reach helplines immediately (Wysa | One Mind PsyberGuide, 2021).

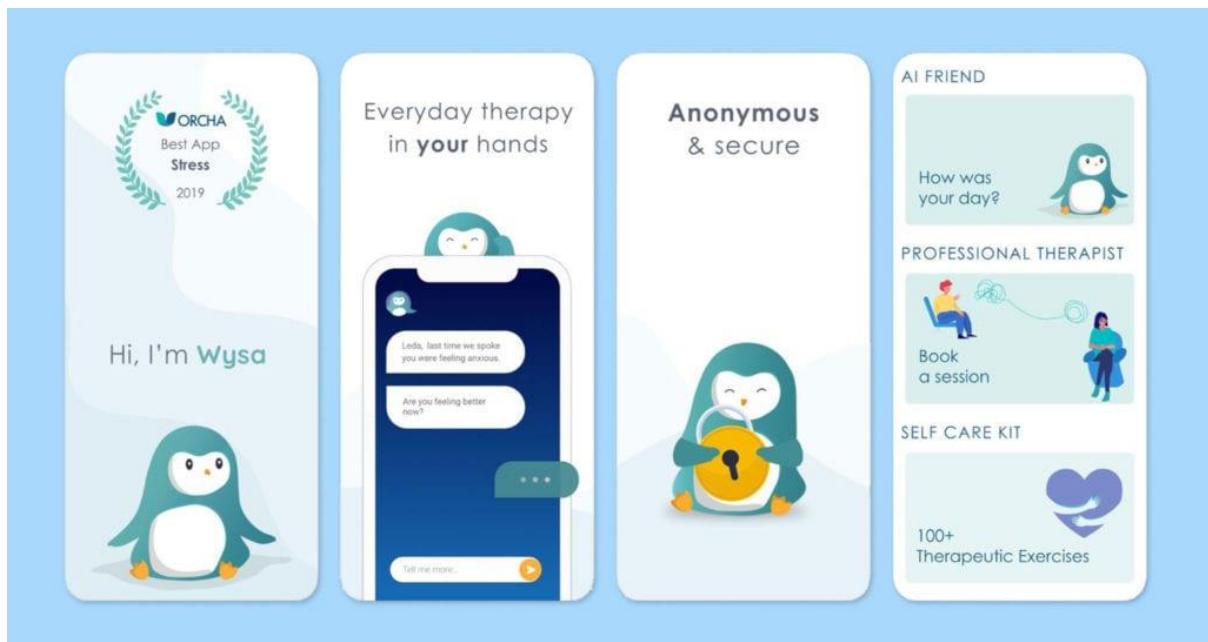


Figure 2-8: Interface of Wysa (Wysa / One Mind PsyberGuide, 2021)

### Replika: My AI Friend

Team Luka in 2017 have developed the Replica : My AI Friend mobile application. It was introduced to both iOS and Android platforms. Replica can be introduced as the first 100% Artificial Intelligent chatbot (Yerega and Muñoz, 2021). Replica mostly acts as a friend other than another meditation app. Replica can help user in such situations like, if user is feeling overwhelmed, anxious, or either if user feels alone Replica can talks with the user and make the feeling that, always user is having someone there to talk. Replica will be always there for user (Discover 20 Best AI-Powered Chatbot Apps (UPDATED 2021) - Verloop.io, 2021). In the basic plan, First the application allows the user to design and name the virtual character as user wants. Then the created character will act as the companion within the mobile phone. It will ask questions about the user and learns about the user. It will keep a diary regarding the important information about the user. The more conversations with replica, the more replica learns about the user. Replica will able to track user's personal preferences the personality too. The goal behind developing Replica is to enable users to build friendships with non-human involvement. In the premium versions of Replica application, also provides facilities to upgrade the relationship with the character which made by the user.

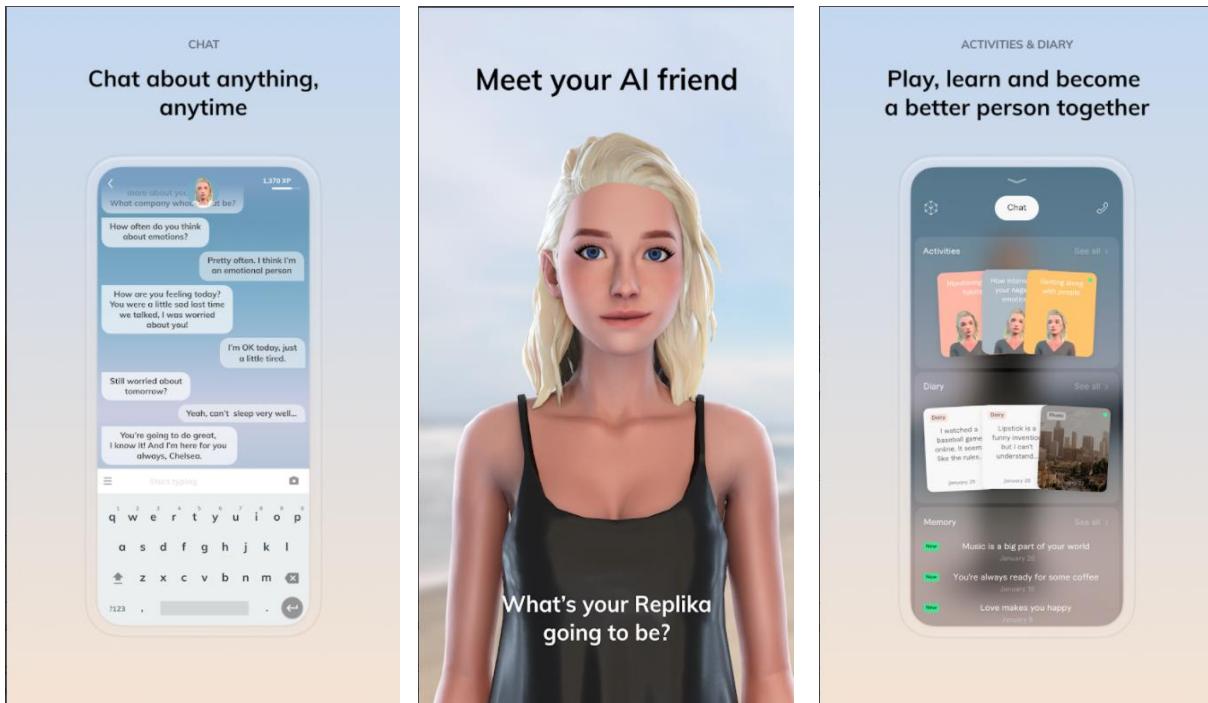


Figure 2-9: Interface of Replica (Replika: My AI Friend, 2021)

### 2.1.6. Research Gap

According to the conducted literature review, it shows that, sentiment analysis and AI chatbots can provide a more effective, updated solution. Natural Language Processing is the mechanism behind making this conversational chatbots. These chatbots can act as human and build conversations with the user in a way that user almost feels that it is real companion. Hence according to the conducted literature review it can be concluded that, A medical health app, which is able to analyze human sentiments without involvement of the user is not yet exists and such kind of application is needed to implement in order to improve the mental health of the public.

In the 2.1.4 section, three similar systems regarding the developed system topic is discussed. When considering that systems, these systems offer different functionalities. Woebot application and Wysa application shows similarities to some extent. When considering about Replica application it consists with a very successful AI powered conversational agent. When these applications are compared from the Woebot and Wysa we can see wonderful performances towards improving mental health and meditation. Woebot and Wysa offers almost all the facilities that a mental health improvement app should consist of. When it comes to the Replica application it provides the best AI conversational agent. Such the users will not feel interacting with a non-human component. But as mentioned in the Introduction and literature review, the problem is, even the top-level meditation and mental health care apps are developed, people won't reach the benefits of that systems because of the less of usage. Even the download count is shown in millions in the records, very few number of people gets the advantages out of that applications. Most of the people rarely opens the application after

downloading it and use for few days unless they get bored of it. So, it is obvious that there should be more effective way to address this issue.

To address that issue ZOIE is introduced. ZOIE consists with a sentiment analyzing mechanism, which monitors user's mood through all the text inputs given to the mobile phone in selected applications by user himself. So, user could not spend time on the application to get treatments or solutions. User should not waste their time to make the conversational agent learn. Basically, ZOIE is able to understand user's actual feelings without engaging the user in to the application. Also, ZOIE consists with an AI chatbot. Yet ZOIE is always there if user need someone to talk. In addition, ZOIE consists with several features that doesn't exist in the mentioned systems. ZOIE can also use as a personal assistant. It is able to plan the work and so on. ZOIE can also be a mood tracker, it will understand user's situation with the use of its sentiment analysis mechanisms and perform various tasks such as it asks to play videos, play music, let the user know about new updates of movies and games based on which ZOIE learnt about user. More functionalities ZOIE provides are explained in chapter one. So, it can be concluded that ZOIE will fill the usability gap between mental health apps and users with adding many interesting functions on it.

*Table 3: Research Gap*

Feature	Woebot	Wysa	Replica	Developed System (ZOIE)
AI Chatbot	✓	✓	✓	✓
Meditation	✓	✓	✗	✓
Mood Tracking	✓	✓	✓	✓
Habit Tracking	✗	✗	✗	✓
Provide entertainment facilities based on users likes and dislikes	✗	✗	✓	✓
Monitors the mood all time	✗	✗	✗	✓
Analyze mood day/week/month wise.	✓	✓	✗	✓
Provide the feeling of a real companion	✗	✗	✓	✓
Consist with a virtual digital character	✗	✗	✓	✗

## 2.2.Market Research

A market research was conducted in a form of an online survey to gather the opinions of public towards the developed system. The survey was conducted through Microsoft Forms. The questionnaire was regarding day today mental health, usage of mental health applications, impact of a digital companion towards uplifting the mental health and opinions about the developed system. The survey questionnaire is listed below. The selected sample taken from the different categories as students, undergraduates, Employees, Businessmen and unemployed people. The selected sampling method is cluster sampling, The selected sample size was about 115 people and 79 responses were collected.

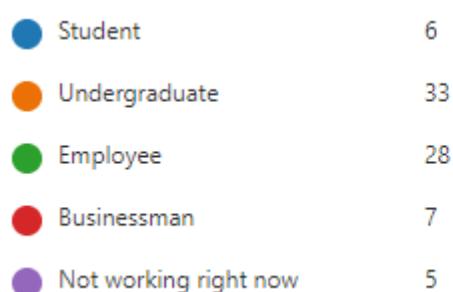


Figure 2-10: Market research question 1 results

Figure 2.2-1 illustrates the participants of the survey. More than half of the participants were undergraduates in various universities and then employees at the second place. There were few students also participated in the survey.

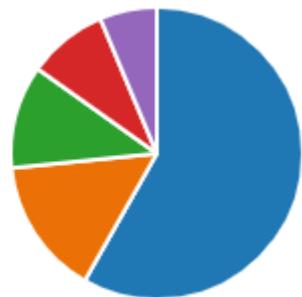
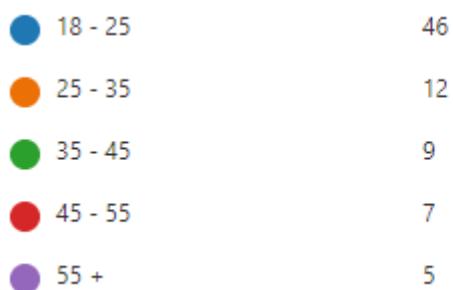


Figure 2-11: Market research question 2 results

Figure 2.2-2 illustrates the age variation of the participants. There were 46 people in between 18 -25 years age range and that's the highest varied age range. 12 people were in between 25 - 35 years age range and that's the second highest amount. In the 35-45 years age range there were 9 participants while 7 participants contributed in the range of 45 -55 years. The least number of contribution received from above 55 years age range and the value is only 5.

79  
Responses

3.18  
Average Number

Figure 2-12: Market research question 3 results

In the figure 2.2-3, when considering the average it shows that people are how much stressed in day to day life. The question was to rate their stress level in an ordinary day on a scale of 1 to 5. Here the average number is 3.18 which is over 2.5 which is the average value of 5. This result shows that most of the people are stressed in their day-to-day activities.

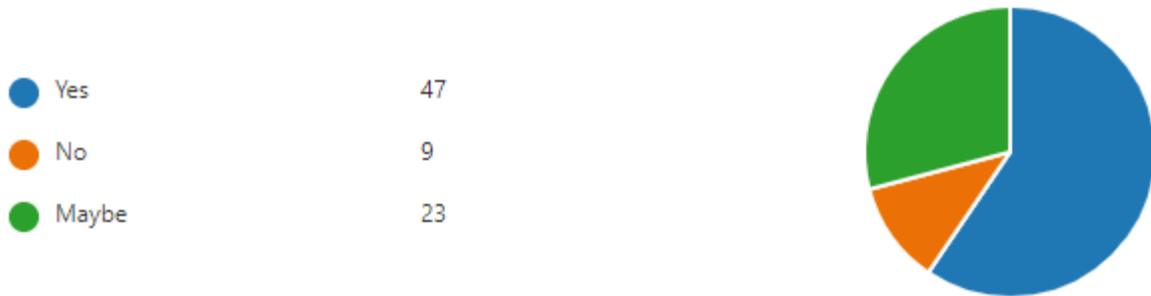


Figure 2-13: Market research question 4 results

In this question, participants were asked whether they have faced to emotional problems such as feeling depressed in the last month of time period. 59% people responded that they had faced emotional issues and around 12% people who didn't face to any issues. There are around 29% people who doesn't have any idea whether they have faced something or not.

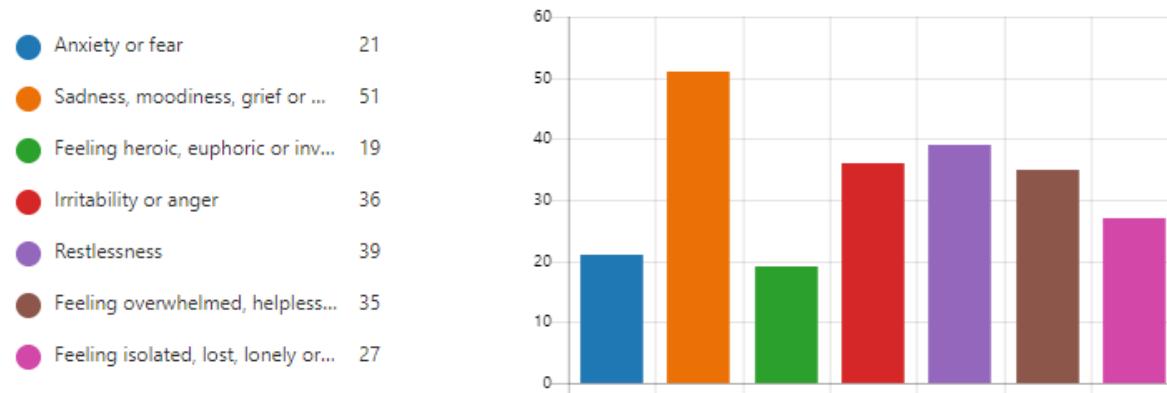


Figure 2-14: Market research question 5 results

In the Figure 2.2 5, it shows how people felt about their mental life in the last month. When analyzing this result, it seems most of them suffer from sadness, moodiness, grief or depression.

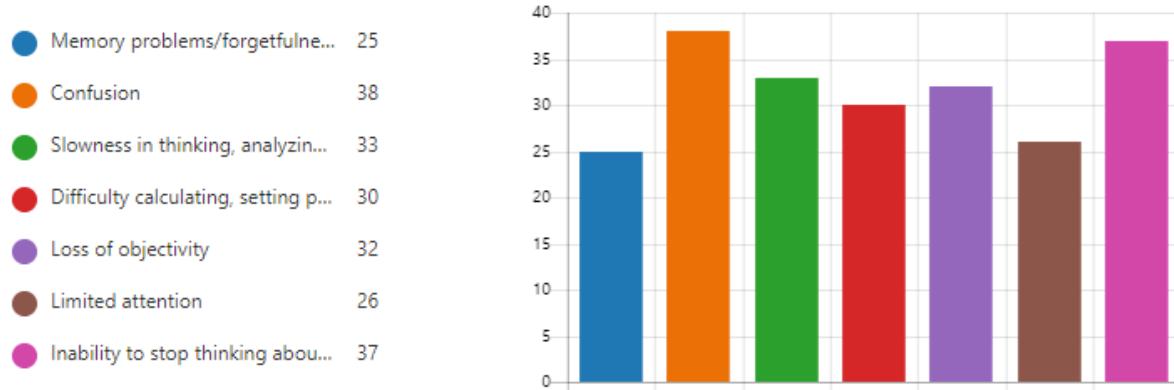


Figure 2-15: Market research question 6 results

In the figure 2.2 6, participants stated what are the cognitive effects they have noticed at themselves. Apparently, they have all the effects listed above.

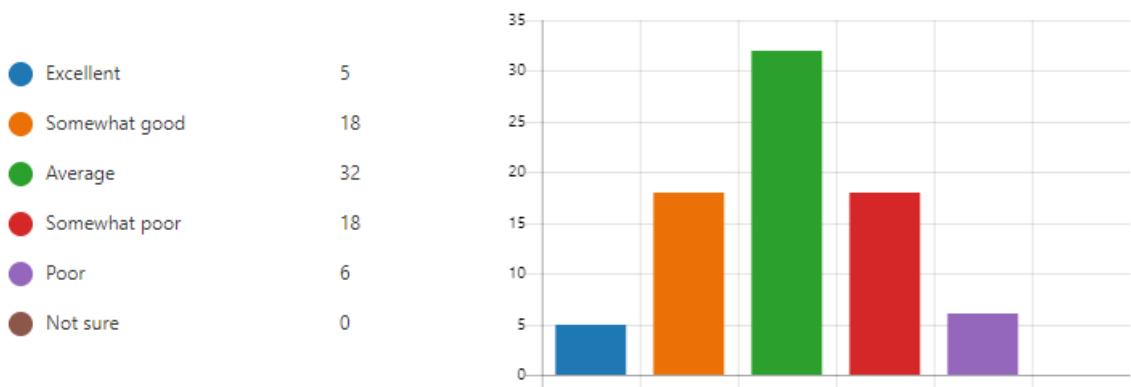


Figure 2-16: Market research question 7 results

In the figure 2.2 7, Participants are asked to rate their mental health. Very few of them were confident about their mental health yet around half of the participants are having average level of mental health while 6 of them are strongly agreed that they are having a poor mental health. Also 18 of them rated as they are having satisfactory mental health. In conclusion, the majority of the participants are not confident over their mental health.

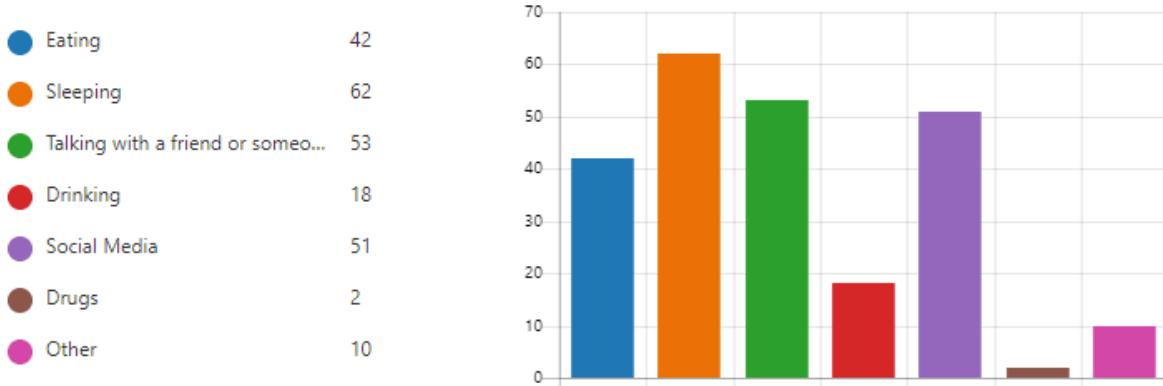


Figure 2-17: Market research question 8 results

The above question was a very important information to the market research which, the participants were asked what they are usually do to reduce their stress. And the objective was to point out how many of average participants are using “talking with a friend or someone” option listed below. Apparently around 67% of the participants used to talk with someone to relieve their mental stress.



Figure 2-18: Market research question 9 results

Figure 2.2 9 illustrates how participants were able to handle stress individually. The question was to rate on 1 to 5 scale. The result shows an average value of 2.89 which means participants are not much confident whether able to handle stress individually or not.

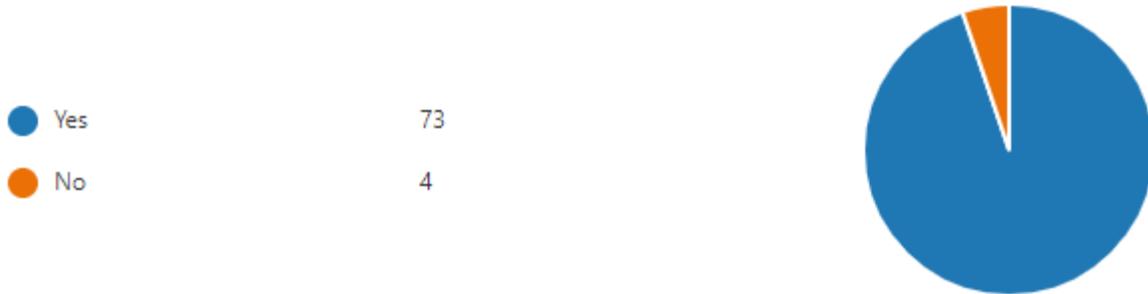


Figure 2-19: Market research question 10 results

The next question was another turning point of the research. Participants were asked the idea about “Talking with friend or someone” option in the 8<sup>th</sup> question. Since the research project is to develop digital companion like this, this was a very important question. When considering the results 94% of the participants were agreed that “Talking with friend or someone” will make a positive impact towards this issue.



Figure 2-20: Market research question 11 results

In the above question, the particular participants were asked the idea about having a digital companion instead of a human. Majority of the participants were given a positive feedback. Around 89% of participants think that it will be a good option for the issue.

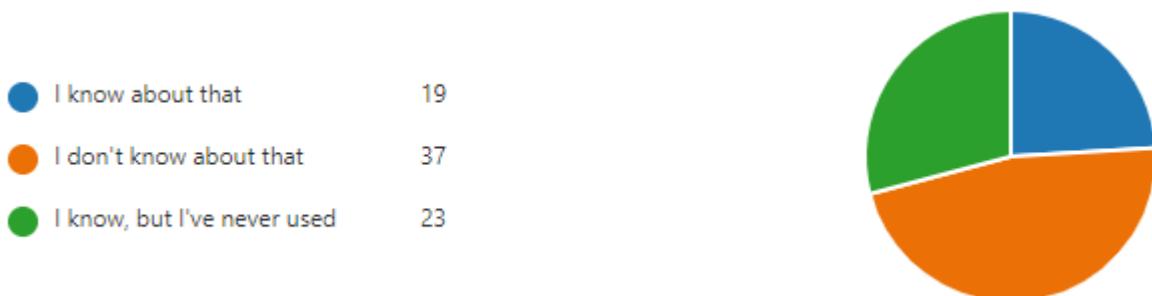


Figure 2-21: Market research question 12 results

After, questioning the participants about the awareness of the similar systems that are already exist. Figure 2.2 12 illustrates that majority of the participants were not aware of that. As a percentage, 46.8% participants were not aware about the existing systems regarding this scenario. Another 29.1% participants were aware about that, but they have never tried. The rest, 24% of them are likely used a similar kind of application.

Positive	13
Neutral	15
Negative	3
Currently I am not using some...	48

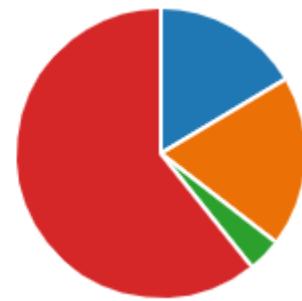


Figure 2-22: Market research question 13 results

From the users, asked about the reaction regarding the usage of existing similar applications. Most of them were not used such a system yet majority of the used participants were satisfied about the service. Only 3.7% are unhappy about the service such systems are providing.

Definitely need	14
Probably need	32
Neutral	30
Probably don't need	2
Definitely don't need	1

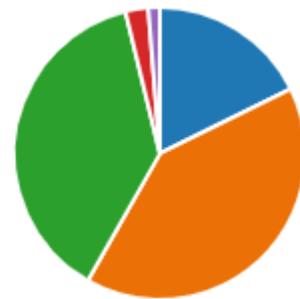


Figure 2-23: Market research question 14 results

Then, generally asked the participants, whether they think this service is something they need or not. More than half of participants stated that the service is needed and around other half was in a neutral mind. According to the figure 2.2 14 only 3 from all the 56 participants stated that they don't need a system like that.

Positive	56
Neutral	22
Negative	1



Figure 2-24: Market research question 15 results

Next, asked the participants the idea about the developed system. Whether they provide a positive or negative reaction. Luckily more than 70.8% of participants provide a positive feedback about the developed system while another 27.8% participants have given a neutral feedback. Only 1 participant out of all 79 participants provided a negative feedback towards the developed system.

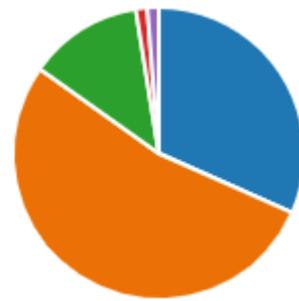
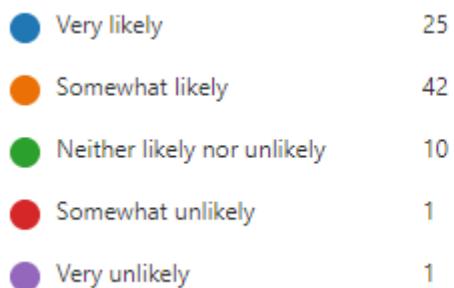


Figure 2-25: Market research question 16 results

In a market research, It is very important to understand the client base. So the participants were asked whether if the proposed system is published, whether they will use it. More than 84% of participants clearly stated that they will get the application when it is available.

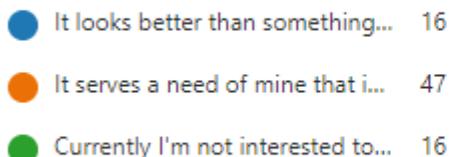


Figure 2-26: Market research question 17 results



Figure 2-27: Market research question 18 results

After that participants were asked would they recommend this application to another individual. The question was to rate on 1 to 5 scale and the figure 2.2-18 result shows a 4.19 average value. Which means participants are very likely to recommend the proposed system towards another individual.

2	anonymous	* Definitely the trustworthiness.. The application shouldn't share our 'mental status' here and there. * It's nice to have a human-similar voice. One shouldn't feel as he os talking with a robot. * In case of emergency, such as an occasion that the bot understands a suicide attempt due to depression, it could inform a closed person, quickly. Wishes for a good job..!
3	anonymous	A chatbot that is more creative and not monotonous in it's approach
4	anonymous	If the digital companion is able to give personalised responses, other than automatically generated responses, it would be better.
5	anonymous	It should be safe to the user who use it.
6	anonymous	Positve solutions
7	anonymous	I need something to make me positive in my restless and stressed life.
8	anonymous	Having a companion
9	anonymous	I'm really sorry to say that I don't expect anything. These applications cannot replace a human companion with higher level of wisdom who can guide us to a true solution. Never!
10	anonymous	I think it should be a good understanding of others mentality
11	anonymous	There are a lot of isolated people in society now. In today's technologically advanced world, people are less likely to associate with other people. Therefore, using such a method can reduce their stress. I think it will minimize a lot of accidents.

*Figure 2-28: Market research question 19 results*

Finally, participants were asked an open-ended question, what would the special functionalities willing to have in this proposed system. Figure 2.2-19 illustrates the opinions received from participants.

In conclusion, after conducting the market research it was found out that most of the people have positive feeling towards the proposed system. Some participants eagerly waiting to use this application. And also, throughout the market research, valuable opinions regarding the functionalities are collected.

### **3. Methodology**

This section includes the most vital part of the report, with all aspects closely related to the artefact itself.

This project was created using the Agile technique. In the sense that it follows an iterative and flexible approach, was determined that developing this system utilizing Agile methodology was more effective. The most significant advantage of this choice is that agile is based on a reliable development approach. It enables the project to be broken down into smaller modules and treated as a separate project. This method would be advantageous because the project includes numerous capabilities. Furthermore, agile prioritizes customer feedback and allows for the reduction of features, which will assist the developed project because the project will be tested with real people for a vast set of test cases. As a result, agile approach was profitable from faster development, higher quality, and customisation of the generated project.

#### **3.1. Planning**

In the first stage of the project, A proper feasibility study was conducted in order to check the feasibility of the developed system and to assess the current state of developed systems related to the developed project. Also, the study was result in identifying the experts and best practice technologies about the developed project subject. Further, the conducted literature review achieved to determine the methodologies used in past studies related to the developed project subject.

Following time, cost and resources planning process was conducted in order to estimate the developed project. In the process, tasks that requires a cost and costly resources are identified. A Work breakdown structure was created. To convert the defined plan into an operational timeline., A Gantt Chart has been created for the developed project.

#### **3.2. Requirement Gathering & Analysis**

The requirement gathering process for the developed system was conducted in two stages. Primary data gathering and secondary data gathering. The primary data gathering stage was a literature review. In the primary data gathering it was able to study about existing systems, pros and cons of existing systems and what scope should be developed. The conducted literature review can be found in the chapter 2.1

The secondary data collection method was carried out in the form of market research. An online survey is undertaken for which people across various ages are given a questionnaire with around 20 questions about the developed project idea and background. The survey was conducted through Microsoft Forms platform. Around 100 responses are collected. The conducted market research and analysis are discussed under [chapter 2](#)

### 3.3.Design

In the design phase, UML diagrams were created to visually represent the system. In the first sprint database will be designed. Graphical User Interfaces of user registration and user logins will be created. Machine Learning model design will be created. In the second sprint, Graphical User Interfaces of the chatbot will be designed. In the third sprint Graphical User Interfaces of mood analyzer function and external functions will be created. In the fourth print, All the other graphical user interfaces of the mobile application will be created.

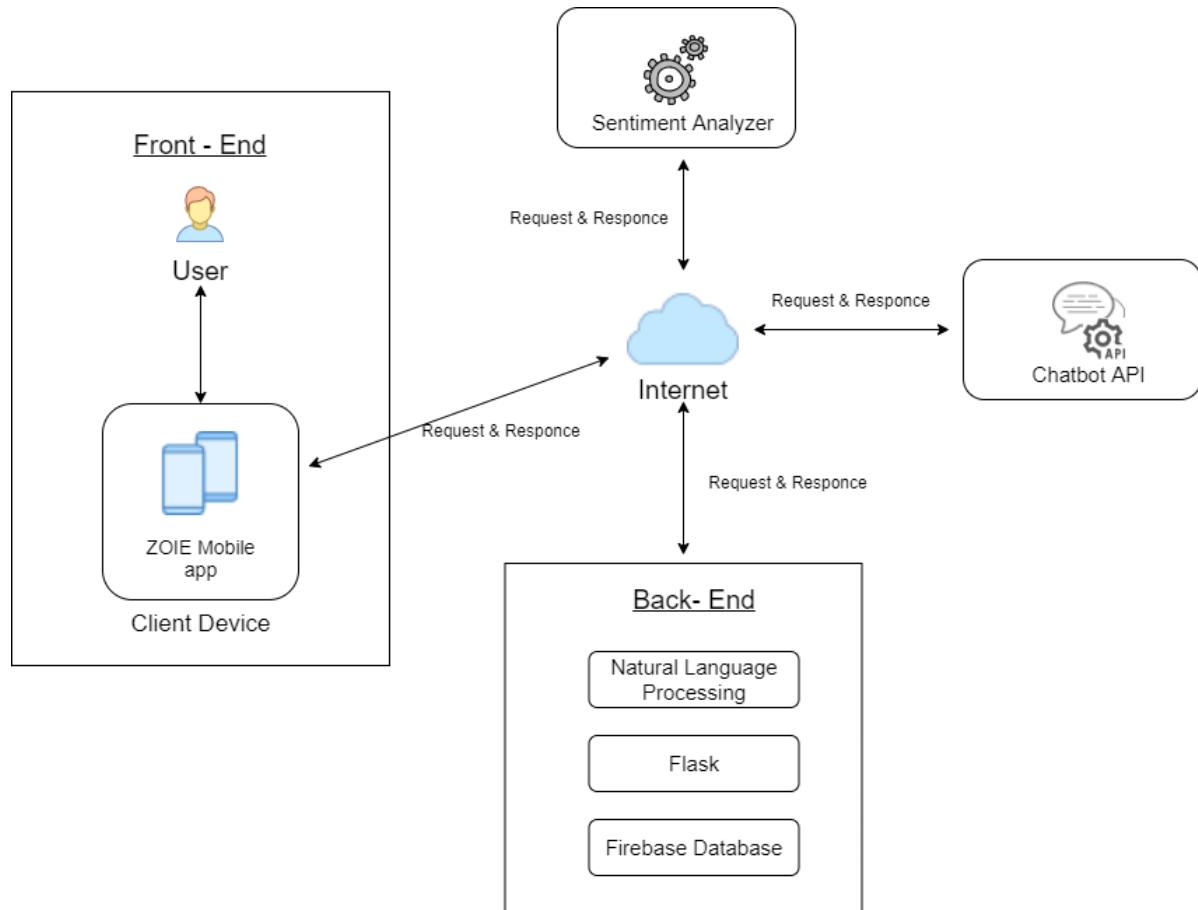


Figure 3-1: Architecture Diagram of ZOIE

The figure 3-1 illustrates the high-level architecture diagram of ZOIE mobile application. The ZOIE android application which is installed at client device, gather text inputs from user. Then the data will pass to sentiment analyzer hosted in cloud. The data will also be saved at the cloud database. The sentiment analyzer process the received data and analyze whether the text is Positive, Negative or Neutral. Then, the status will be sent to the mobile app as the response. The ZOIE chatbot is also acts same. Clients request will be received to the chatbot and it sends the response back to the application. NLP, Flask and Firebase handles this entire process in the back end

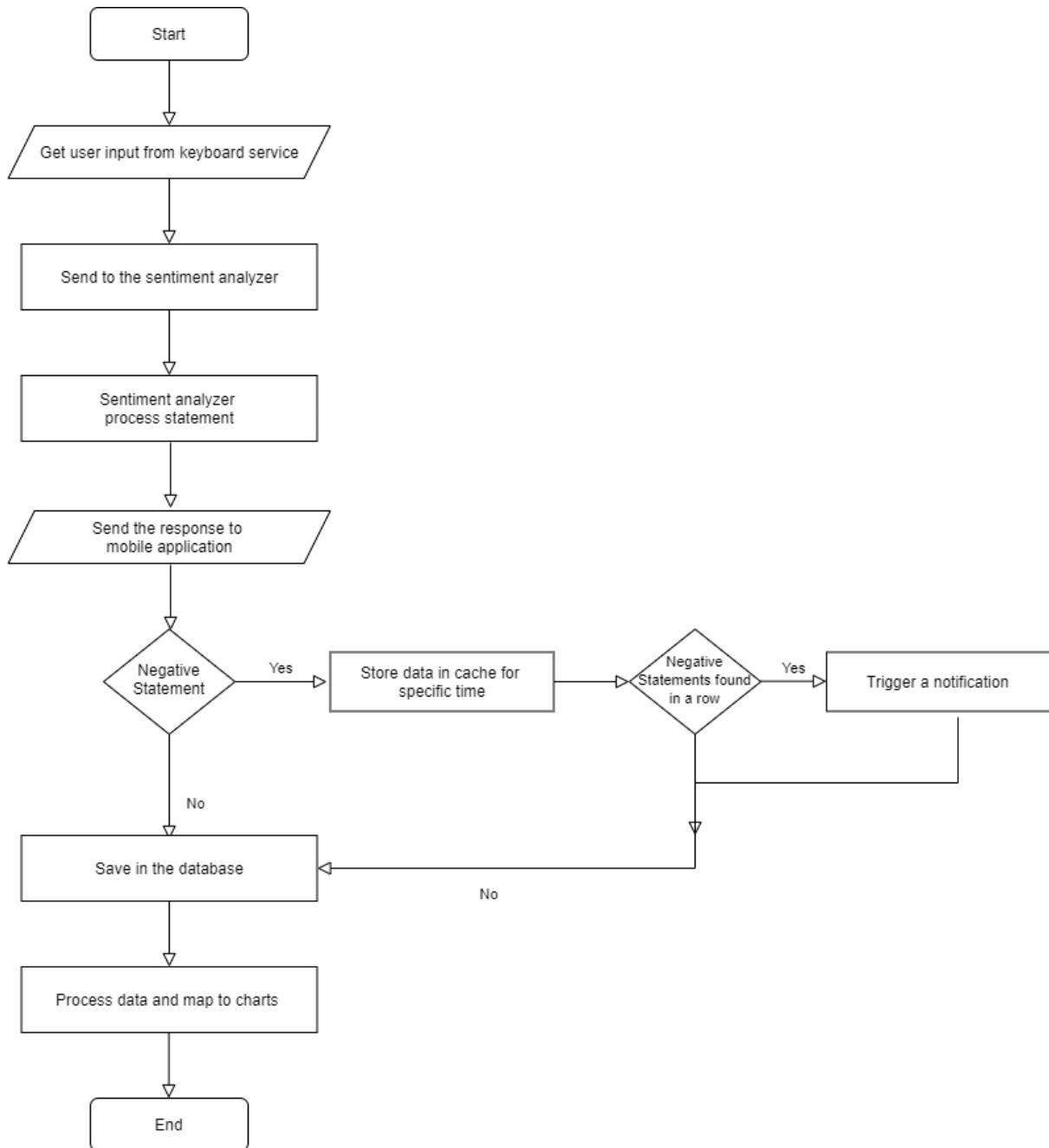


Figure 3-2: Sentiment Analyzer Flow Chart

Figure 3-1 describes the design of the sentiment analyzer which was developed to analyze sentiments.

### 3.4.Development

After completing the Planning, Requirement gathering and Design phases, development phase has started. The interfaces were designed in the previous phase. The implementation procedure was divided into four iterative stages. The project tools and technologies were finalized with the help of the acquired requirements from requirement gathering and analysis phase.

### ***3.4.1. Development Tools***

#### **Programming Languages**

- Python: Python was used to implement the complete Sentiment Analyzer. Initially this was planned to implement using Java but due to the Java's lack of support to the Sentiment Analysis libraries and APIs, Python was used to develop Sentiment Analyzer function
- Java: ZOIE main Android Application is completely implemented using java programming language.

#### **Tools**

- DialogFlow: Dialogflow is a Google developer platform, which is built for human-computer interaction technologies based on natural language conversion using artificial intelligence and machine language. Dialogflow was used to develop the chatbot of ZOIE.
- Firebase: Firebase Realtime database is a NoSQL database system, which can save real-time data in a cloud and that sync between application in real-time. Firebase as used as the database of the ZOIE android application
- PythonAnywhere: PythonAnywhere is an online integrated development environment and web hosting service based on the Python programming language. PythonAnywhere's web hosting service was used to host the Sentiment Analyzer program.

## Libraries

- Android Material
- Google Volley
- okHTTP
- Flask
- MP Android
- Lottie

## IDEs

- Android Studio: Android Studio 4.0 was used as the integrated development environment to develop the ZOIE android application
- PyCharm: PyCharm integrated development environment was used to develop the sentiment analyzer program.

The development process conducted in order to come up with the artefact are listed under [chapter 4](#).

## 3.5. Testing

Testing was carried out to ensure that the developments met the expected requirements and that the system was defect-free. Mainly testing was conducted as unit testing and integration testing. In the unit testing, every subproduct was individually tested and after performing unit testing, integration testing was performed to check whether each individual product actually works after integration. The test case given hereinafter provides an exact description of the tests which was taken place

### ***3.5.1. Testing method and tools used***

The ZOIE sentiment analyser was manually tested within the IDE which was the Pycharm. There, the program was locally ran and tested whether it provides the accurate output which is the status of the given statement.

The ZOIE mobile application was also manually tested under vast amount of test cases.

After the deployment of sentiment analyser as a server, Postman software was used to test the connectivity.

### ***3.5.2. Features to be tested***

- Registration
- Login
- Forgot Password
- Dashboard
- Meditation
- To Do List
- Reminders
- User Profile
- Chatbot
- Keyboard
- Sentiment Analyzer

Testcases for each mentioned functionality are explained under [chapter 5](#)

## 4. Implementation

This chapter explains the specific code segments used to develop each functions of the artefact.

### 4.1. Sentiment Analyzer Implementation

The sentiment analyzer was implemented with python programming language with the use of several sentiment analysis libraries. The mainly used library was Natural Language Toolkit (NLTK) which is the leading platform for building Python programs to work with human language data. The Textblob library was also used. Textblob is an open-source python library for processing textual data. The sentiment analysis process is conducted according to following steps.



Figure 4-1: Sentiment Analysis Process (Paul, 2021)

The figure 4-1 illustrates the steps in Sentiment Analysis process. In this sentiment analyser implementation section, implementation of these steps are discussed.

#### ***Text Input***

To get inputs to the sentiment analyzer, a separate keyboard has developed. The keyboard was developed in the ZOIE android application as a service. It captures user inputs and pass that data to the sentiment analyzer.

#### ***Tokenization***

Tokenization is splitting a phrase, sentence, paragraph, or an entire text document into smaller units, such as individual words or terms. Before perform tokenization in this sentiment

analyzer, all the words are converted to the lower case and the all the punctuation marks were removed.

```
# Convert the letter into lowercase
lower_case = text.lower()
print(lower_case)
```

*Snippet 1: Tokenization 1*

In the code, “text” variable contains the sentence that need to be analyzed. Then declared a variable called “lower\_case” and called the Python String lower() Method to convert the string to lower case. This was essential to perform the classification step.

```
# Remove punctuations
cleaned_text = lower_case.translate(str.maketrans(' ', ' ', string.punctuation))
print(cleaned_text)
```

*Snippet 2: Tokenization 2*

Then all the punctuation marks were removed. In the above code snippet “lower\_case” variable contains the string which converted to lower case in previous step. Then with the use of Python String translate() Method all the punctuations were removed and assigned the string to new variable called “cleaned\_text”.

```
# tokenized_words = cleaned_text.split()
tokenized_words = word_tokenize(cleaned_text, "english")
print(tokenized_words)
```

*Snippet 3 : Tokenization 3*

After cleaning the text, then tokenization was performed. To perform tokenization nltk.tokenize package was used. After performing all the words were splitted.

### ***Stop Word Filtering***

The process of converting data into something a computer can understand is called pre-processing. To perform pre-processing it is necessary to remove useless data. In the natural language processing (NLP) these useless data are called as stop words. To remove stop words NLTK stop words were used. In the below code snippet, “tokenized\_words” variable contains the string which cleaned in above steps. Then using a loop, word by word checked. The stop words were removed and remaining words were stored to the array called “final\_words”

```
final_words = []
for word in tokenized_words:
    if word not in stopwords.words('english'):
        final_words.append(word)
```

*Snippet 4: Stop words filtering*

### **Stemming**

Stemming is the process of generating morphologic variants of a root/base word. In this sentiment analyzer, stemming was done by list of predefined words. The words list was stored in a separate text document and all the base word was mapped with a sentiment. With the use of that store, the tokenized words were assigned with a sentiment.

```
emotion_list = []
with open('emotions.txt', 'r') as file:
    for line in file:
        clear_line = line.replace('\n', '').replace(":", "").replace(",", "").strip()
        word, emotion = clear_line.split(':')

        if word in final_words:
            emotion_list.append(emotion)
```

*Snippet 5: Stemming*

### **Classification**

Sentiment classification was mainly done using NLTK library. After performing above steps, polarity scores were assigned for the each word using SentimentIntensityAnalyzer().polarity\_scores() method. Then the values were counted using if statement and decided whether the whole input text was whether Positive statement, Negative statement or a Neutral statement.

```

def sentiment_analyse(sentiment_text):
    score = SentimentIntensityAnalyzer().polarity_scores(sentiment_text)
    neg = score['neg']
    pos = score['pos']
    val = 2
    if neg > pos:
        print("Negative Sentiment Found")
        val = -1

    elif pos > neg:
        print("Positive Sentiment Found")
        val = 1
    else:
        print("Neutral Sentiment Found")
        val = 0

    return val

```

*Snippet 6: Classification 1*

To improve the accuracy of this sentiment analyzer program more than one sentiment analysis were done. After completing all above steps and after deciding the sentiment behind the statement, again this process was conducted with Textblob library instead of NLTK.

```

txt = cleaned_text
y = TextBlob(txt)
polarityvalue = y.sentiment.polarity
polaritystate = "Neutral"
finalstatement = ""

```

*Snippet 7: Classification 2*

After removing punctuations and after converting the text to lowercase the input string was assigned to a variable called “txt”. Then with the use of the Textblob sentiment polarity analyzer the polarity amount was assigned to the variable called “polarityvalue”.

```

if polarityvalue < 0:
    polaritystate = ("Negative")
    secondStageStatus = -1
elif polarityvalue == 0:
    polaritystate = ("Neutral")
    secondStageStatus = 0
elif polarityvalue > 0 and polarityvalue <= 1:
    polaritystate = ("Positive")
    secondStageStatus = 1

```

*Snippet 8: Classification 3*

Then from a conditional operator, the polarity values were analyzed and decided the sentiment whether it is a negative statement, positive statement or a neutral statement.

Finally, the first stage result (NLTK result) and the second stage result (TextBlob) result were compared and decided the final sentiment of the statement.

## 4.2.Android Application Implementation

### 4.2.1. Keyboard

A unique keyboard service was implemented for the ZOIE in order to capture user input texts in order to perform the sentiment analyse process.

```

<Row>
    <Key
        android:keyLabel="q"
        android:keyEdgeFlags="left"
        android:codes="113"/>

    <Key
        android:keyLabel="w"
        android:codes="119"/>

```

*Snippet 9: Keyboard - keys*

ASCII character encoding was used to develop the keystrokes.

```

@Override
public View onCreateInputView() {
    keyboardView = (KeyboardView) getLayoutInflater().inflate(R.layout.keyboard_layout, root: null);
    keyboard = new Keyboard( context: this,R.xml.qwert);
    keyboardView.setKeyboard(keyboard);
    keyboardView.setOnKeyboardActionListener(this);
    return keyboardView;
}

```

*Snippet 10: Keyboard- onCreate*

The above code snippet starts the keyboard whenever a input text field is clicked.

```
char code = (char)i;
if(Character.isLetter(code)&& isCap)code = Character.toUpperCase(code);
inputConnection.commitText(String.valueOf(code), newCursorPosition: 1);
System.out.println(code);
arrayList.add(code);
```

*Snippet 11: Keyboard - Storing*

The above code segment was written to store the keystrokes. The stored keystrokes will be passed to the Sentiment Analyzer using a GET request.

#### 4.2.2. Chatbot

The chatbot was implemented using Dialogflow and the development of chatbot is discussed under chapter 3. In this section, integration of the chatbot to the ZOIE android application is illustrated.

```
String message = editMessage.getText().toString();
if (!message.isEmpty()) {
    messageList.add(new Message(message, isReceived: false));
    editMessage.setText("");
    sendMessageToBot(message);
    Objects.requireNonNull(chatView.getAdapter()).notifyDataSetChanged();
    Objects.requireNonNull(chatView.getLayoutManager())
        .scrollToPosition(messageList.size() - 1);
```

*Snippet 12: Chatbot - Get text*

First, the input text user has inserted was collected and validated. If the input contains a text, that text was sent to the sendMessageToBot method in order to build the message.

```
private void sendMessageToBot(String message) {
    QueryInput input = QueryInput.newBuilder()
        .setText(TextInput.newBuilder().setText(message).setLanguageCode("en-US")).build();
    new SendMessageInBg( botReply: this, sessionName, sessionsClient, input).execute();
}
```

*Snippet 13: Chatbot – Build message*

After building text in to the message format, It is passed to the chatbot on the cloud

```
InputStream stream = this.getResources().openRawResource(R.raw.credential);
GoogleCredentials credentials = GoogleCredentials.fromStream(stream)
    .createScoped(Lists.newArrayList( ...elements: "https://www.googleapis.com/auth/cloud-platform"));
String projectId = ((ServiceAccountCredentials) credentials).getProjectId();
```

*Snippet 14: Chatbot - Request response*

Then a session for the particular chat is created in order to continue the conversation.

```

SessionsSettings.Builder settingsBuilder = SessionsSettings.newBuilder();
SessionsSettings sessionsSettings = settingsBuilder.setCredentialsProvider(
    FixedCredentialsProvider.create(credentials)).build();
sessionsClient = SessionsClient.create(sessionsSettings);
sessionName = SessionName.of(projectId, uuid);

```

*Snippet 15: Chatbot - Create session*

The callback function was created to capture the bot's reply and display in the conversational interface.

```

public void callback(DetectIntentResponse returnResponse) {
    if(returnResponse!=null) {
        String botReply = returnResponse.getQueryResult().getFulfillmentText();
        if(!botReply.isEmpty()){
            messageList.add(new Message(botReply, isReceived: true));
            chatAdapter.notifyDataSetChanged();
            Objects.requireNonNull(chatView.getLayoutManager()).scrollToPosition(messageList.size() - 1);
        }
    }
}

```

*Snippet 16: Chatbot - Call back*

If there are any issues connecting to the cloud bot an error message containing “Failed to connect” will be displayed and in case if something goes wrong in the program “Something went wrong” error message will be displayed. Otherwise, once the reply is received, it will be displayed in the conversation interface of the ZOIE chatbot

```

} else {
    Toast.makeText( context: this, text: "something went wrong", Toast.LENGTH_SHORT).show();
}
} else {
    Toast.makeText( context: this, text: "failed to connect!", Toast.LENGTH_SHORT).show();
}

```

*Snippet 17: Chatbot - Toast message*

#### 4.2.3. Analytics

The My Analytics function maps user's mood status to several kinds of charts.

```

pieChart = (PieChart) findViewById(R.id.pieChart);

pieChart.setUsePercentValues(true);
pieChart.getDescription().setEnabled(false);
pieChart.setExtraOffsets( left: 5, top: 10, right: 5, bottom: 5);

pieChart.setDragDecelerationFrictionCoef(0.95f);

pieChart.setDrawHoleEnabled(true);
pieChart.setHoleColor(Color.WHITE);
pieChart.setTransparentCircleRadius(61f);

```

*Snippet 18: My Analytics - Pie Chart 1*

The above code creates a bar chart using MP Android library.

```
pieChart.animateY( durationMillis: 1000, Easing.EaseInOutCubic);

PieDataSet dataSet = new PieDataSet(yValues, label: "Days");
dataSet.setSliceSpace(3f);
dataSet.setSelectionShift(5f);
dataSet.setColors(ColorTemplate.JOYFUL_COLORS);

PieData data = new PieData(dataSet);
data.setValueTextSize(10f);
data.setValueTextColor(Color.YELLOW);

pieChart.setData(data);
```

*Snippet 19: My Analytics - Pie Chart 2*

. The above code segment was written to animate the chart and display the chart. All other charts are implemented in the same way. Only the chart type and attributes were changed.

#### **4.2.4. Meditation**

The meditation future contains of three main functions as motivation stories, meditation music and meditation posts.

```
webView = (WebView) findViewById(R.id.pgMotivationWebView);
webView.setWebViewClient(new WebViewClient());
webView.loadUrl("https://alltimeshortstories.com/inspirational-stories/");
```

*Snippet 20: Meditation - Meditation Stories*

The above code snippet renders the meditation stories page. It will open in a webview window.

```
webView = (WebView) findViewById(R.id.pgMediStoryWebView);
webView.setWebViewClient(new WebViewClient());
webView.loadUrl("https://gaana.com/playlist/gaana-dj-meditation-4");

WebSettings webSettings = webView.getSettings();
webSettings.setJavaScriptEnabled(true);
```

*Snippet 21Music: Meditation - Meditation Music*

The above code is written to render the meditation music page.

```

    webView = (WebView) findViewById(R.id.pgWebView);
    webView.setWebViewClient(new WebViewClient());
    webView.loadUrl("https://meditativestory.com");

    WebSettings webSettings = webView.getSettings();
    webSettings.setJavaScriptEnabled(true);

```

*Snippet 22: Meditation - Motivation Stories*

The above code snippet renders the meditation posts page in a webview.

#### 4.2.5. Reminders

The reminders feature sends notifications to the user. There are several notifications the ZOIE applications send to user. The development regarding a basic notification is illustrated below.

```

NotificationCompat.Builder builder;
builder = new NotificationCompat.Builder( context: this, channelId: "zoieN")
    .setSmallIcon(R.drawable.ic_add_alert)
    .setContentTitle("ZOIE is looking for you!")
    .setContentText("Hello Thaveesha, ZOIE is waiting for you")
    .setPriority(NotificationCompat.PRIORITY_DEFAULT);

```

*Snippet 23: Reminder - Build Reminder*

The above code snippet builds the notification. An Icon and unique Title and text is assigned to each notification. In the above notification “ZOIE is looking for you!” is the title and "Hello Thaveesha, ZOIE is waiting for you" is the body text of this particular notification.

The NotificationManagerCompat class was used to manage the notification and fallback

```

NotificationManagerCompat notificationManagerCompat = NotificationManagerCompat.from(this);
btnNSendNotification.setOnClickListener(v -> {
    Toast.makeText( context: this, text: "Reminder Set",Toast.LENGTH_SHORT).show();
    notificationManagerCompat.notify( id: 100,builder.build());
});

```

*Snippet 24: Reminder - Set Reminder*

Then the notification channel is implemented using below code snippet

```

int importance = NotificationManager.IMPORTANCE_DEFAULT;
NotificationChannel channel = new NotificationChannel( id: "zoieN", name,importance);
channel.setDescription(description);

NotificationManager notificationManager = getSystemService(NotificationManager.class);
notificationManager.createNotificationChannel(channel);

```

*Snippet 25: Reminder - Set Channel*

#### 4.2.6. To Do List

A simple to do list is managed using an array adapter and list view

```
toDoList = new ArrayList<>();
arrayAdapter = new ArrayAdapter<>( context: this,R.layout.list_view_layout,toDoList);
listView = findViewById(R.id.id_listView);
listView.setOnItemClickListener(new AdapterView.OnItemClickListener() {
    @Override
    public void onItemClick(AdapterView<?> parent, View view, int position, long id) {
        TextView textView = (TextView)  view;
        textView.setPaintFlags(textView.getPaintFlags() | Paint.STRIKE_THRU_TEXT_FLAG);
    }
});

listView.setAdapter(arrayAdapter);

editText = findViewById(R.id.id_edit_text);
```

*Snippet 26: To Do*

#### 4.2.7. Server Implementation

In order to analyze sentiments from input text, it was needed to implement a client- server architecture between ZOIE android application and the implemented Sentiment analyzer. To host the work the implemented Sentiment Analyzer as a server, Flask micro web framework has used.

```
from flask import Flask
from flask import request

app = Flask(__name__)

@app.route('/', methods=['GET', 'POST'])
def analyzer():
```

*Snippet 27: Flask Server*

The server is implemented in such a way that it responds to both HTTP GET and POST methods. The statement which need to be analyzed is passed as a HTTP POST request and the text is extracted and assigned as the cleaned text which need is passed to sentiment analysis process (which discussed under section 1.5.2)

```
@app.route('/', methods=['GET', 'POST'])
def analyzer():
    if request.method == 'GET':
        return 'Hello from ZOIE Sentiment Analyzer'
    if request.method == 'POST':
        inputText = request.args.get('string')
```

*Snippet 28: Flask - Handle Requests*

After making the sentiment analyzer as a server with the use of flask, it has hosted on pythonanywhere website which is an online integrated development environment and web hosting service based on the Python programming language.

## 5. Results and Discussion

This chapter outlines the final result of the conducted research. According to this research, the final outcome is a mobile application. Therefore, this section of the document covers the entire system functionality along with significance and necessity.

The application is developed in such a way that it can be performed the sentiment analysis process both from keyboard inputs in any application or from the chatbot of the application itself.

### 5.1. Results

The figure 5-1 illustrates the splash screen of the application. Splash screen is used to improve the user experience. The splash screen appears every time user opens the application. After the splash screen, there are several welcome screens which displays only for the very first time.

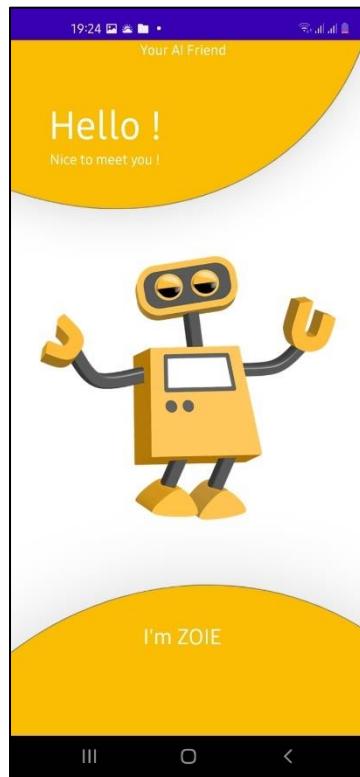


Figure 5-1: ZOIE Mobile Application - Splash Screen

The 5-2 and 5-3 figures show the sign-up screen and sign in screen which allows users to signup, using any email address and password. The Email address, Phone number input fields are validated. User needs to enter valid email address and phone number to proceed. After registration, application directs the user to the sign in screen, where user is able to continue to the application by providing the username and password.

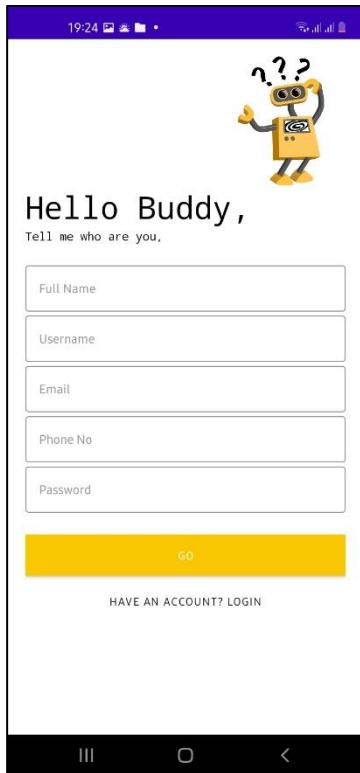


Figure 5-2: ZOIE Mobile Application -  
Login UI

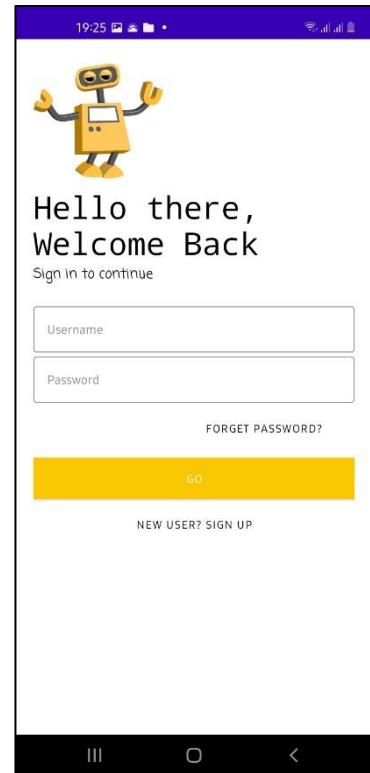


Figure 5-3: ZOIE Mobile Application -  
Registration UI

If user is already having an account and failed to login because of misplacement of the password, the application allows users to reset their password using the forgot password option. User must enter the email address which used while registering to the application. An email with a link will be sent to the relevant email address to change the password.

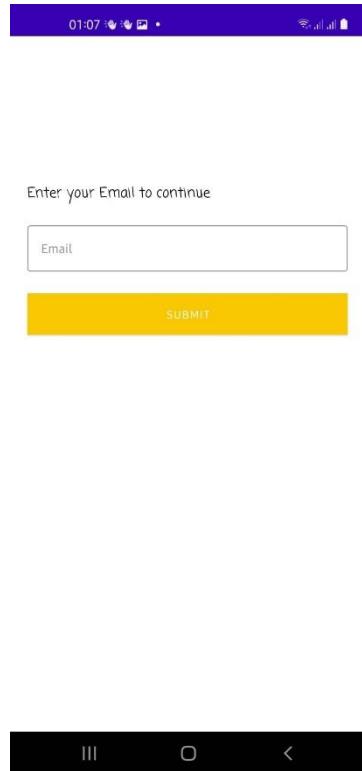


Figure 5-4: ZOIE Mobile Application- Forgot Password

After log in to the application the user is directed to the dashboard. The dashboard is the main screen which allows user to access to the functionalities provided by the application. The dashboard GUI consists with six main functions as follows;

1. Talk with ZOIE: The AI Chatbot which allows users to chat with the application.
2. Reminders: Allow users to set reminders to their selves.
3. My Analytics: The mood analyzer, which allows user to analyze their mood variation.
4. Meditation: Allow meditation mechanisms to users
5. To Do List: Allow users to maintain a To Do list
6. Profile: Allow users to maintain and update their information

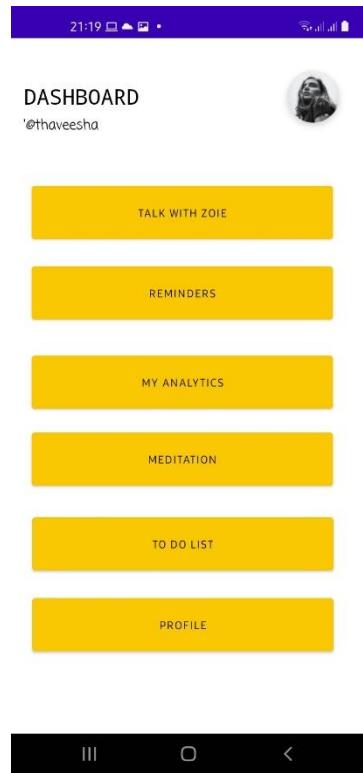


Figure 5-5: ZOIE Mobile Application - Dashboard UI

### 1. Talk with ZOIE

The Talk with ZOIE option allows users to interact with an AI chatbot. This allows users to feel like they are talking with a companion. This chatbot is trained in such a way that it is possible to meditate users through conversation. It is able to provide guidance to the stress and anxiety issues throughout the chat also. Sample conversations are illustrated below.

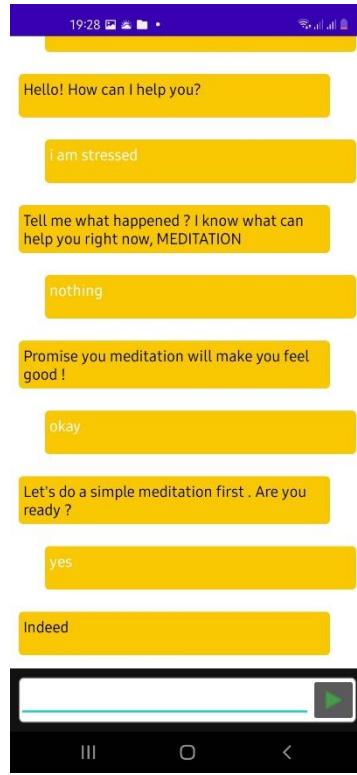


Figure 5-6: ZOIE Mobile Application - Chatbot UI

## 2. My Analytics

My Analytics feature is the mood analyser of this application. It is able to capture sentiments behind the user inputs. ZOIE application has its own keyboard and it allows the application to capture the sentiments behind the chats (user inputs) and analyse. The user is able to control the input capturing option. The application is only able to capture and analyse sentiment behind the inputs when user allows it. And user is able to turn off anytime.

The mood analyser is able to analyse the sentiment behind user and illustrates as three methods as follows.

1. Mood variation of the day
2. Mood variation of particular week
3. Mood variation of particular month

Mood variation of the day provides an overview of the mood variation of user in that day. Identified positive, negative and neutral sentiments are mapped into a 3D pie chart and illustrated.

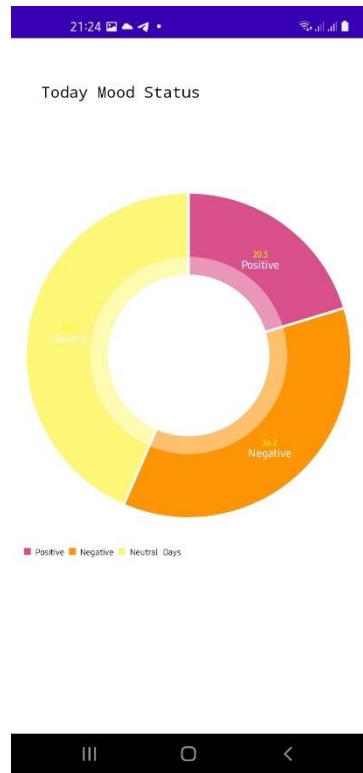


Figure 5-7: ZOIE Mobile Application - Mood Analyzer UI -1

Mood variation of particular week option initially illustrates a summary of the findings of mood variation of seven days. Additionally, it provides facilities to user to filter the week which they want to see. The mood analyser will analyse data and map to the chart and displays accordingly.

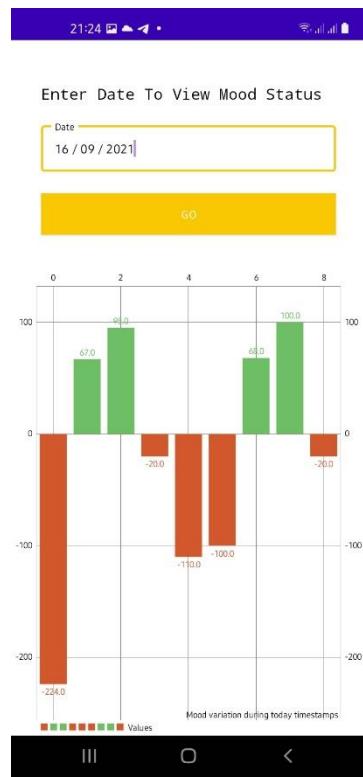


Figure 5-8: ZOIE Mobile Application - Mood Analyzer UI -2

Mood variation of particular month option initially illustrates a summary of the findings of mood variation for about thirty days. Additionally, it provides facilities to user to filter the month which they want to see. The mood analyser will analyse data and map to the chart and displays accordingly.

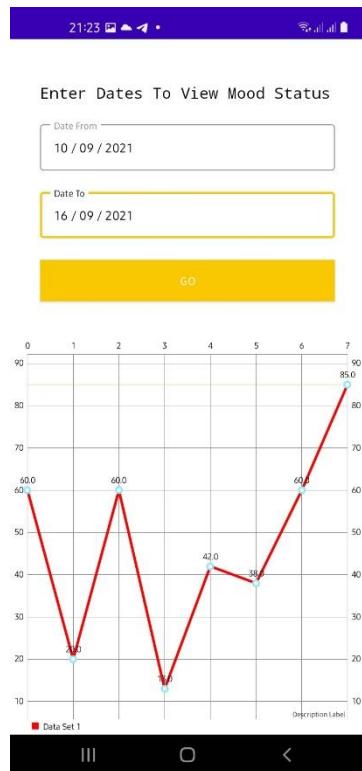


Figure 5-9: ZOIE Mobile Application - Mood Analyzer UI -3

### 3. Mediation

The meditation feature is one of the most important features provided by this system. The application provides three ways to involve into meditation itself.

#### 3.1 Meditation Articles

The application allows users to read meditative stories to relax their mind. This involves articles about physical mediation activities. The users are able to easily find them through the application and read.

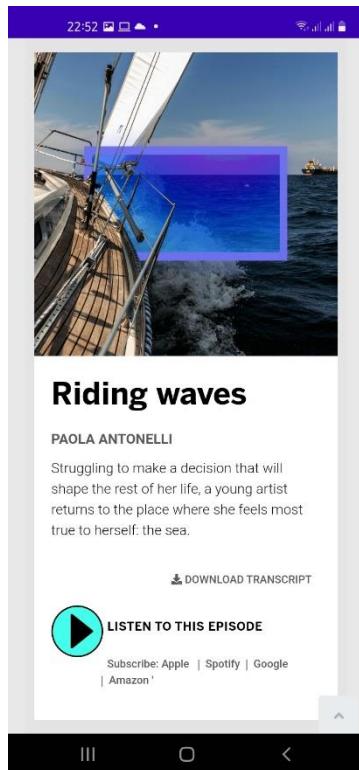


Figure 5-11: ZOIE Mobile Application - Meditation Articles UI - 1

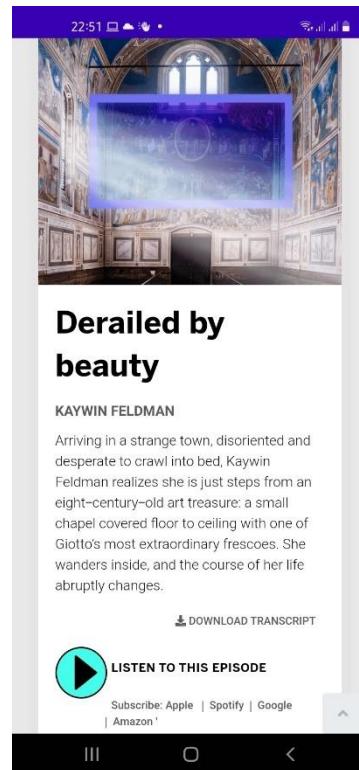


Figure 5-10: ZOIE Mobile Application - Meditation Articles UI - 2

### 3.2 Meditation Music

The application allows users to listen to the meditation music to relax their mind. The users are able to easily find meditation music through the application and listen.



Figure 5-12: ZOIE Mobile Application - Meditation Music UI

### 3.3 Motivation Stories

The application allows users to read motivation stories to inspiration. The users are able to easily find them through the application and read.



Figure 5-14: ZOIE Mobile Application - Motivation Stories UI - 1

Figure 5-13: ZOIE Mobile Application - Motivation Stories UI - 2

#### 4. To Do List

The application allows users to maintain a list of things that need to be done. The user is able to add To-dos and mark as completed when the particular task is performed.



Figure 5-15: ZOIE Mobile Application - To Do List UI

## 5. Reminders

The reminders option allows users to set reminders themselves. It is a great approach to self-management. Also, when user is not open the application in considerable time, the application itself sent notifications to the user to remind about the application. The <> figure illustrates a notification which is sent from the application due to user's inactivity.

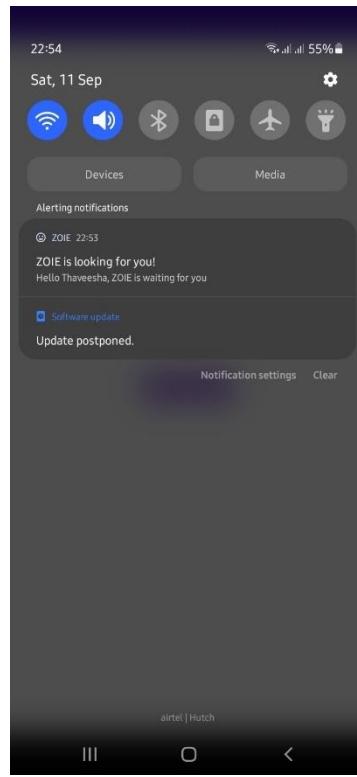


Figure 5-16: ZOIE Mobile Application - Push-up Notification Snapshot

## 6. Profile

The profile option allows users to manage their information on the application. User is able to update their information on their account as necessary.

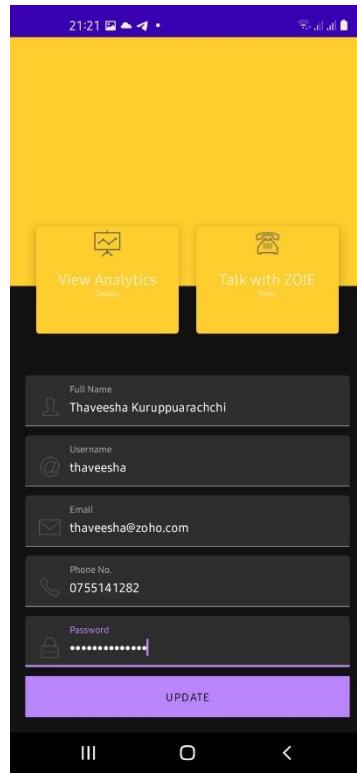


Figure 5-17: ZOIE Mobile Application - Profile UI

## 5.2. Testing

Table 4: Test Case 01 – Sign Up UI

Test Case ID: 1					
Name: Sign up					
Pre-condition: User need to have a valid email address					
No.	Description	Inputs	Expected Output	Actual Output	Result
1.1	Enter correct data for signup	Your Name: Thaveesha Kuruppuarachchi Username: thaveesha Email: <a href="mailto:thaveesha@zoho.com">thaveesha@zoho.com</a> Password: Th12#%jag56FGH Phone Number: 0755141282	Successfully signed up and redirected to the Dashboard GUI.	Successfully signed up and redirected to the Dashboard GUI	Pass
1.2	Enter invalid email address	Your Name: Thaveesha Kuruppuarachchi Username: thaveesha Email: <a href="mailto:thaveesha123">thaveesha123</a> Password: Th12#%jag56FGH Phone Number: 0755141282	Display Field wise error message	Field wise error message displayed	Pass
1.3	Enter invalid phone number	Your Name: Thaveesha Kuruppuarachchi Username: thaveesha Email: <a href="mailto:thaveesha@zoho.com">thaveesha@zoho.com</a> Password: Th12#%jag56FGH Phone Number: 321	Display Field wise error message	Field wise error message displayed	Pass
1.4	Signup with empty input fields	No input	Display Field wise error messages	Field wise error message displayed	Pass

**Hello Buddy ,**  
Tell me who are you,

Full Name	!
Field cannot be empty	
Username	!
Field cannot be empty	
Email	!
Field cannot be empty	
Phone No	!
Field cannot be empty	
Password	!
Field cannot be empty	

**Hello Buddy ,**  
Tell me who are you,

Full Name	Thaveesha Kuruppuarachchi
Username	thaveesha
Email	thaveesh123
Invalid Email addree	
Phone No	0755141282
Password	*****

**Hello Buddy ,**  
Tell me who are you,

Full Name	Thaveesha Kuruppuarachchi
Username	thaveesha
Email	thaveesha@zoho.com
Phone No	12345
Invalid Phone Number	
Password	*****

**GO**

**GO**

**GO**

[HAVE AN ACCOUNT? LOGIN](#)

[HAVE AN ACCOUNT? LOGIN](#)

[HAVE AN ACCOUNT? LOGIN](#)

Figure 5-18: Test Case 01 - Evidence

Table 5: Test Case 02 - Sign In UI

<b>Test Case ID: 2</b>					
<b>Name:</b> Sign in					
<b>Pre-condition:</b> User need to sign up and create account					
No.	Description	Inputs	Expected Output	Actual Output	Result
2.1	Enter correct details for sign in	Username: thaveesha Password: Th12#%jag56FGH	Successfully signed up and redirected to the Dashboard GUI.	Successfully signed up and redirected to the Dashboard GUI	Pass
1.2	Enter invalid username	Username: thaveesha123 Password: Th12#%jag56FGH	Display Field wise error message	Field wise error message displayed	Pass
1.3	Enter invalid password	Username: thaveesha Password: ABCD	Display Field wise error message	Field wise error message displayed	Pass
1.4	Signup with empty input fields	No input	Display Field wise error messages in all input fields	Field wise error message displayed in all input fields	Pass

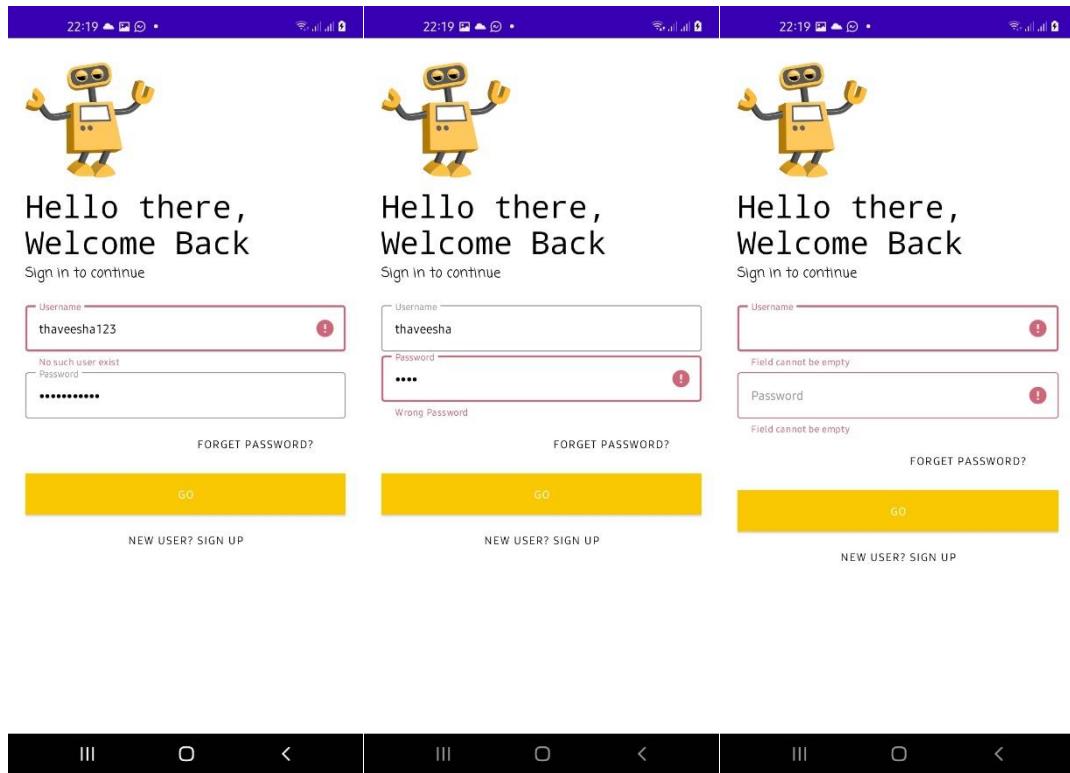


Figure 5-19: Test Case 02 - Evidence

Table 6: Test Case 03 - Forgot Password UI

<b>Test Case ID: 3</b>					
<b>Name:</b> Forgot Password					
<b>Pre-condition:</b> User need to sign up and have a valid account					
No.	Description	Inputs	Expected Output	Actual Output	Result
3.1	Enter valid email address	Email: <a href="mailto:thaveesha@zoho.com">thaveesha@zoho.com</a>	Display success message and password reset email is sent to the email address provided	Display success message and password reset email is sent to the email address provided	Pass
3.2	Enter invalid email address	Email: <a href="mailto:thaveesha123">thaveesha123</a>	Display Field wise error message	Field wise error message displayed	Pass
3.3	Proceed without providing a email address	No input	Display Field wise error messages in input field	Field wise error message displayed in input field	Pass

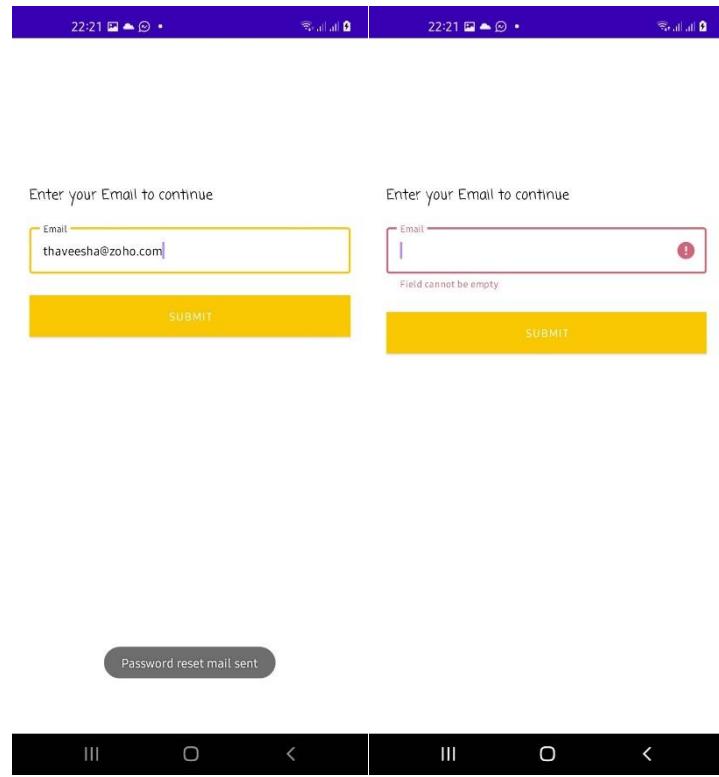


Figure 5-20: Test Case 03 - Evidence

Table 7: Test Case 04 - Dashboard UI

<b>Test Case ID: 4</b>					
<b>Name:</b> Dashboard					
<b>Pre-condition:</b> User need to sign in and navigated to the Dashboard screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
4.1	Navigate to the chatbot screen	User clicks TALK WITH ZOIE button	Successfully display the chatbot interface	Successfully displayed the chatbot interface	Pass
4.2	Navigate to the Reminders screen	User clicks REMINDERS button	Successfully display the reminders interface	Successfully displayed the reminders interface	Pass
4.3	Navigate to the Mood Analyzer screen	User clicks MY ANALYTICS button	Successfully display the Mood Analyzer interface	Successfully displayed the Mood Analyzer interface	Pass
4.4	Navigate to the Meditation screen	User clicks Meditation button	Successfully display the Meditation interface	Successfully displayed the Meditation interface	Pass
4.5	Navigate to the To Do List screen	User clicks TO DO LIST button	Successfully display the To Do List interface	Successfully displayed the To Do List interface	Pass
4.6	Navigate to the Profile screen	User clicks PROFILE button	Successfully display the Profile interface	Successfully displayed the Profile interface	Pass

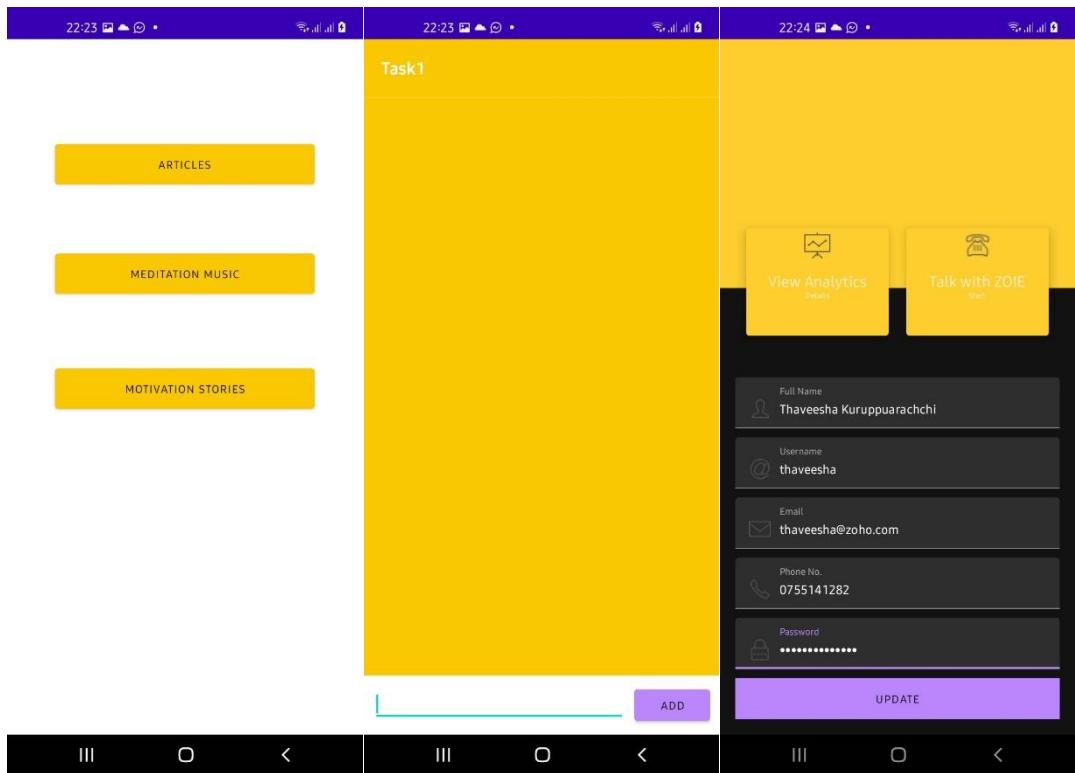
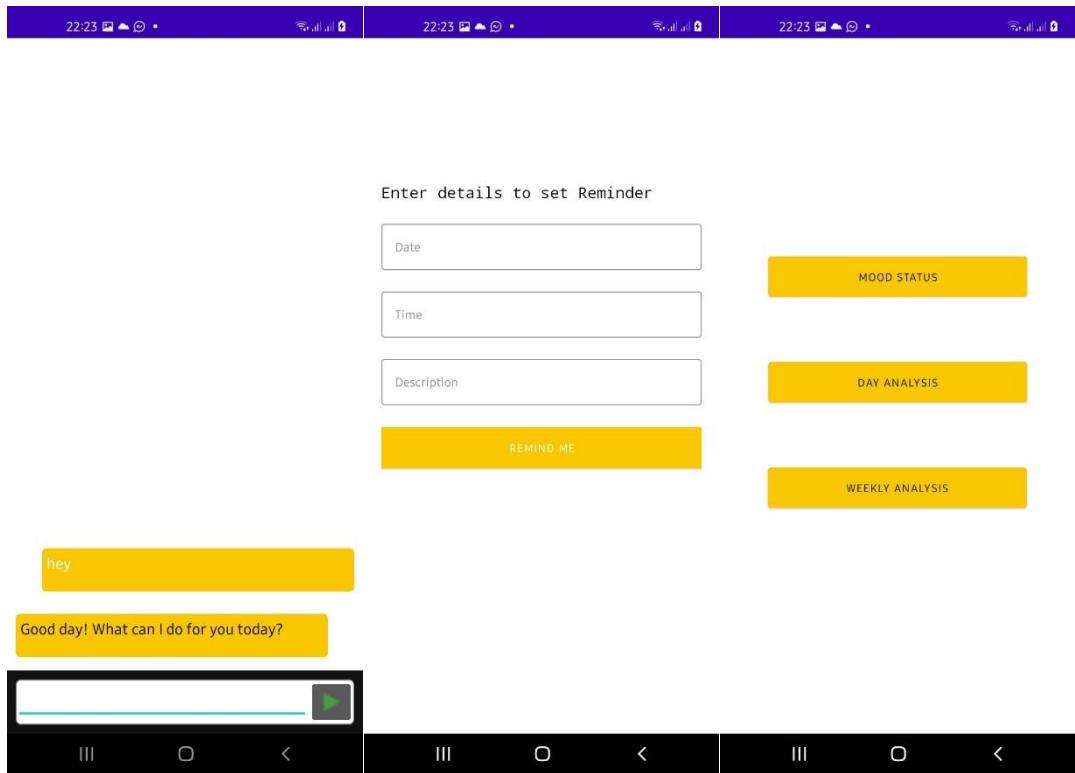


Figure 5-21: Test Case 04 - Evidence

Table 8: Test Case 06 - Mood Analyzer

<b>Test Case ID: 6</b>					
<b>Name:</b> Mood Analyzer					
<b>Pre-condition:</b> User need to sign in and navigated to Mood Analyzer					
No.	Description	Inputs	Expected Output	Actual Output	Result
6.1	Mood Status feature which illustrates Overall mood variation of the day	User clicks MOOD STATUS button on the Mood Analyzer screen	Analyze mood data of the day and display the summery chart	Analyzed mood data of the day and displayed the summery chart	Pass
6.2	Daily Analysis feature which illustrates Overall mood variation of the day during different time stamps	User clicks DAILY ANALYSIS button on the Mood Analyzer screen	Analyze mood data of the particular day and display the summery chart	Analyzed mood data of the particular day and displayed the summery chart	Pass
6.3	Weekly Analysis feature which illustrates Overall mood variation of the day during different dates of the particular week	User clicks WEEKLY ANALYSIS button on the Mood Analyzer screen	Analyze mood data of the particular week and display the summery chart	Analyzed mood data of the particular week and displayed the summery chart	Pass

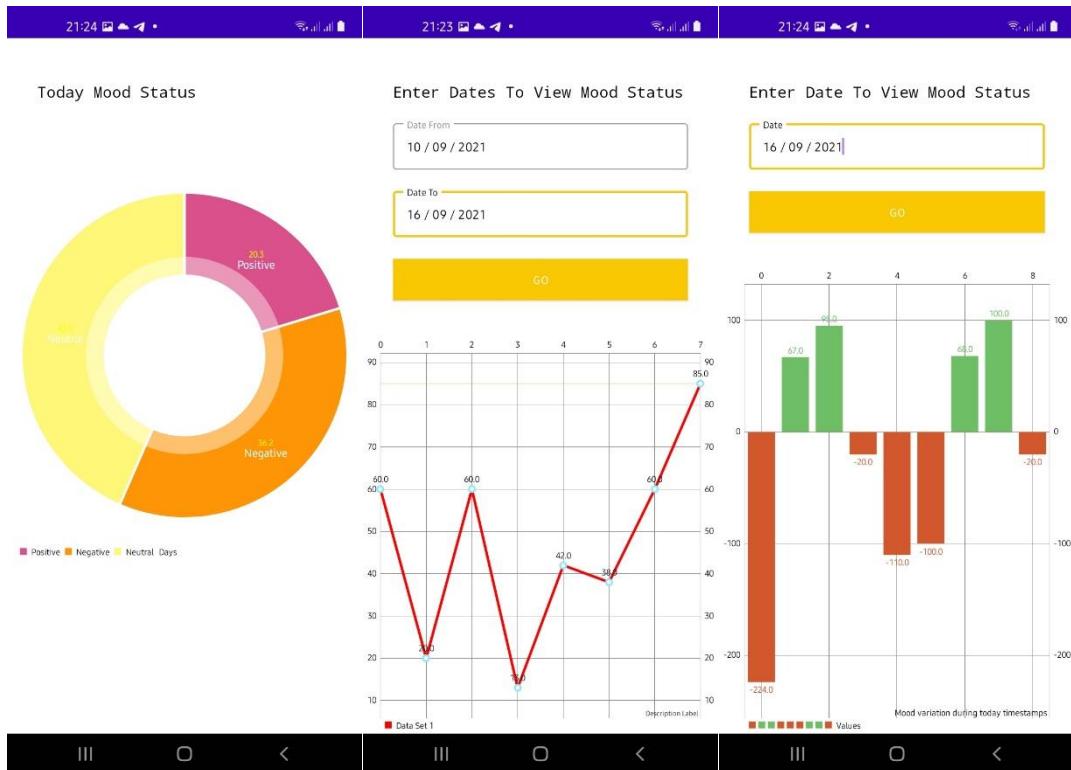


Figure 5-22: Test Case 06 - Evidence

Table 9: Test Case 07 - Meditation Feature

Test Case ID: 7					
Name: Meditation Feature					
Pre-condition: User need to sign in and navigated to Meditation screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
7.1	Articles feature which displays meditative stories	User clicks ARTICLES button on the Meditation screen	Load and display meditation stories	Loaded and displayed meditation stories	Pass
7.2	Meditation Music feature which plays meditative music	User clicks MEDITATION MUSIC button on the Meditation screen	Load and display meditation music to play	Loaded and displayed meditation music to play	Pass
7.3	Motivation Stories feature which displays meditative stories	User clicks MOTIVATION STORIES button on the Meditation screen	Load and display motivation stories	Loaded and displayed motivation stories	Pass

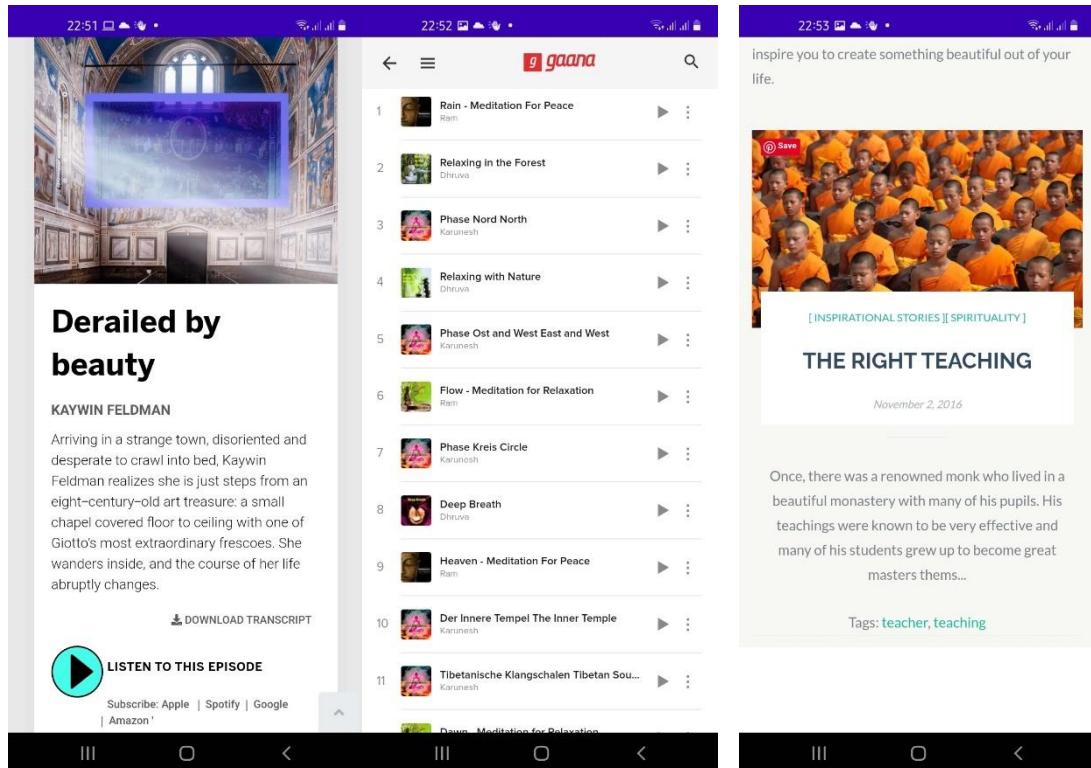


Figure 5-23: Test Case 07 - Evidence

Table 10: Test Case 08 - To Do List Feature

Test Case ID: 8					
Name: To Do List Feature					
Pre-condition: User need to sign in and navigated to To Do List screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
8.1	Enter ToDo and add	Task 1	Add a To do successfully	To do added successfully	Pass
8.2	Enter nothing and add	No inputs	Display Error Message	Error message displayed	Pass
8.3	Delete a added ToDo	Press on added to do	Successfully mark as done	Successfully marked as done	Pass

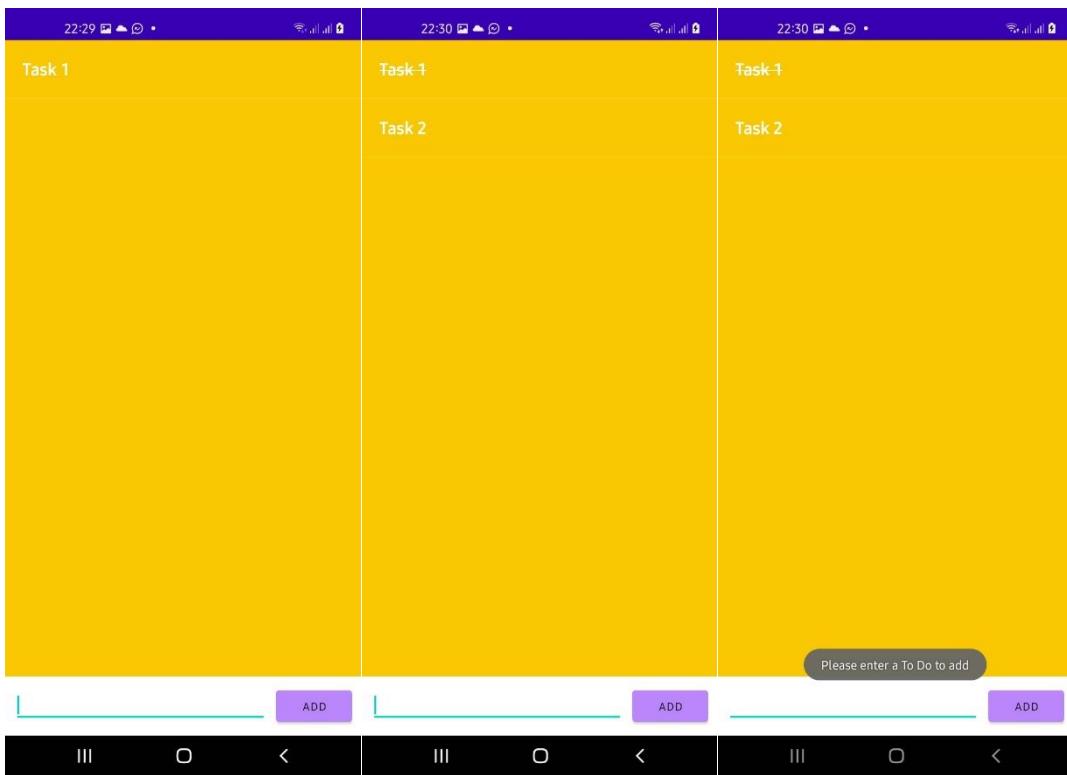


Figure 5-24: Test Case 08 - Evidence

Table 11: Test Case 09 - Reminders Feature

<b>Test Case ID: 9</b>					
<b>Name:</b> Reminders Feature					
<b>Pre-condition:</b> User need to sign in and navigated to Reminders screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
9.1	Enter Date time, Description and set reminder	Date : 11/09/2021 Time: 10.00 AM Description: Test	Reminder work at the given time successfully	Reminder successfully triggered at the given time	Pass
9.2	Set reminder without entering Date and Time	Description: Test	Display Field wise error messages	Field wise error messages displayed	Pass
9.3	Set reminder without description	Date : 11/09/2021 Time: 10.15 AM	Display Field wise error messages	Field wise error messages displayed	Pass

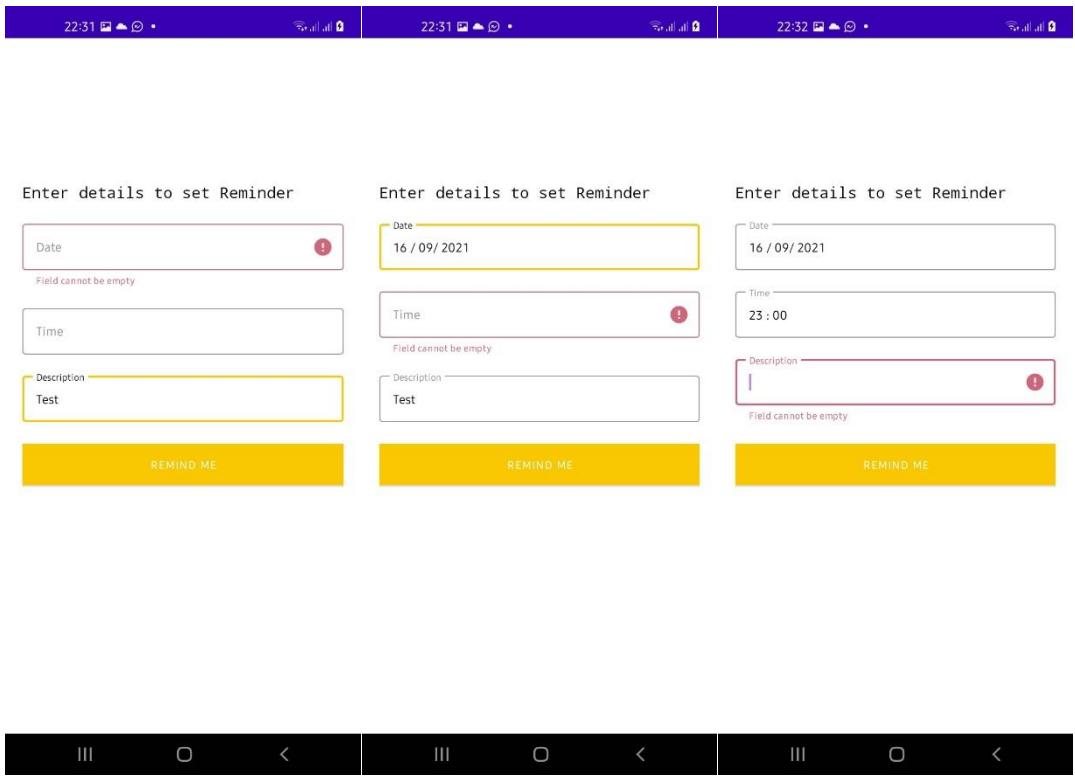


Figure 5-25: Test Case 09 - Evidence

Table 12: Test Case 10 - Dashboard UI

<b>Test Case ID: 10</b>					
<b>Name:</b> User Profile					
<b>Pre-condition:</b> User need to sign in and navigated to Profile screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
10.1	User details should be displayed	No inputs	User details successfully display in relevant fields	User details successfully displayed in relevant fields	Pass
10.2	Enter correct data and update	Full Name: Thaveesha Kuruppuarachchi Username: thaveesha Email: <a href="mailto:thaveesha@zoho.com">thaveesha@zoho.com</a> Phone Number: 0755141282 Password: Th12#%jag56FGH	Successfully update and display success message.	Successfully updated and displayed success message.	Pass

10.3	Enter invalid email address	Full Name: Thaveesha Kuruppuarachchi Username: thaveesha Email: <a href="mailto:12345@">12345@</a> Phone Number: 0755141282 Password: Th12#%jag56FGH	Display Field wise error message	Field wise error message displayed	Pass
10.4	Enter invalid phone number	Full Name: Thaveesha Kuruppuarachchi Username: thaveesha Email: <a href="mailto:thaveesha@zoho.com">thaveesha@zoho.com</a> Phone Number: 65471 Password: Th12#%jag56FGH	Display Field wise error message	Field wise error message displayed	Pass
10.5	Update with empty input fields	No input	Display Field wise error messages	Field wise error messages displayed	Pass

Table 13: Test Case 11 - Chatbot

<b>Test Case ID: 11</b>					
<b>Name:</b> Chatbot – Start a conversation					
<b>Pre-condition:</b> User need to sign in and navigated to Chatbot screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
11.1	Enter nothing and send to the chatbot	No Inputs	Display error message	Error message displayed	Pass
11.2	Enter something and send to the chatbot	Input: Hi	Chatbot responds with a welcome message and display	Successfully responded and displayed in the interface	Pass

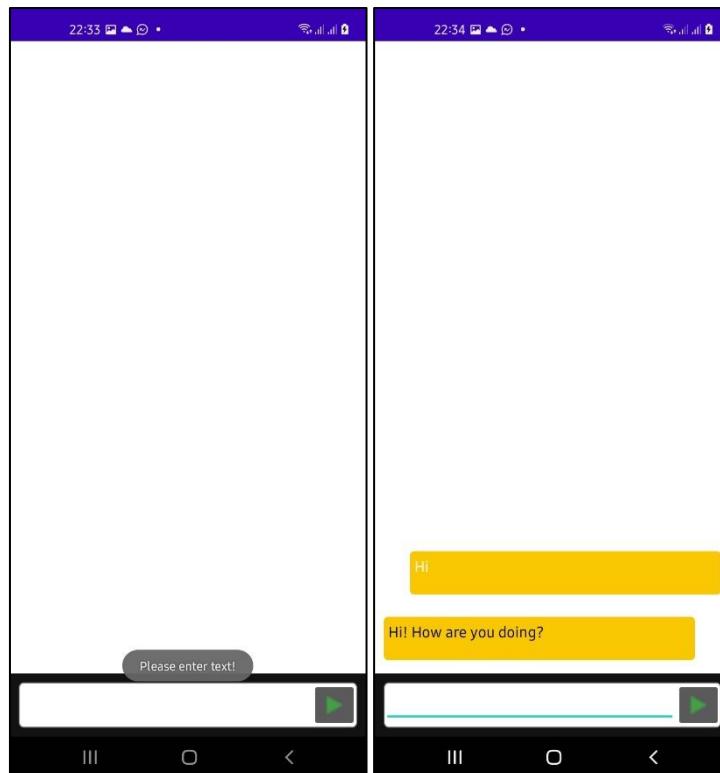


Figure 5-26: Test Case 11 - Evidence

Table 14: Test Case 12 - Chatbot Conversation

<b>Test Case ID: 12</b>					
<b>Name:</b> Chatbot – Make a conversation					
<b>Pre-condition:</b> User need to sign in and navigated to Chatbot screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
12.1	User having a conversation with chatbot	A simple dialog	Chatbot chats with the user as a companion	Chatbot acted as a companion	Pass

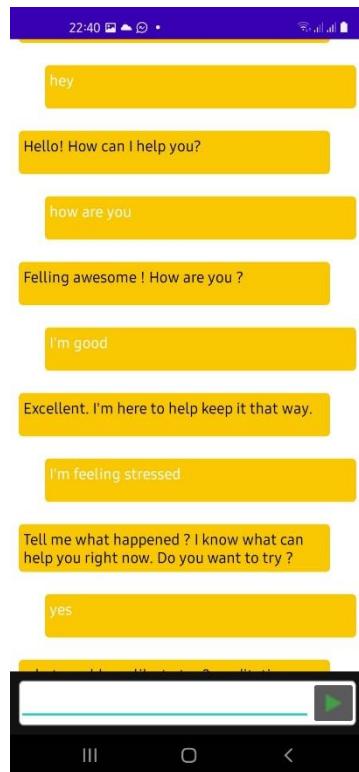


Figure 5-27: Test Case 12 - Evidence

Table 15: Test Case 13 - Chatbot: Meditation

<b>Test Case ID: 13</b>					
<b>Name:</b> Chatbot – Meditation Support					
<b>Pre-condition:</b> User need to sign in and navigated to Chatbot screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
13.1	User having a conversation with chatbot	Conversation	Chatbot doing meditation activities to the user	Chatbot did the meditation activities to the user as expected	Pass



Figure 5-28: Test Case 13 - Evidence

Table 16: Test Case 14 - Chatbot: Stress Relief

<b>Test Case ID: 14</b>					
<b>Name:</b> Chatbot – Stress Support					
<b>Pre-condition:</b> User need to sign in and navigated to Chatbot screen					
No.	Description	Inputs	Expected Output	Actual Output	Result
14.1	User having a conversation with chatbot	Conversation	Chatbot doing stress relief activities to the user	Chatbot did the stress relief activities to the user as expected	Pass

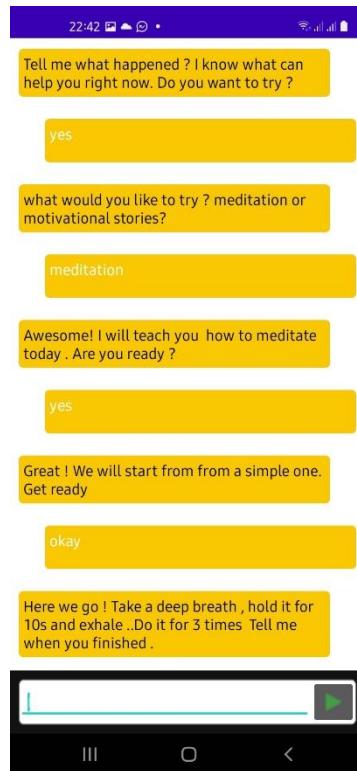


Figure 5-29: Test Case 14 - Evidence

Table 17: Test Case 14 - Keyboard

<b>Test Case ID: 15</b>					
<b>Name:</b> Keyboard					
<b>Pre-condition:</b> User need to start ZIOE keyboard service and enable access privileges					
No.	Description	Inputs	Expected Output	Actual Output	Result
15.1	User enables access and enters nothing on keyboard	No inputs	Nothing sends to database stores in the database	Nothing received to the database and no new records recorded	Pass
15.2	User enables access and types on keyboard	Testing keyboard service	Records the text, send to the database and store	Recorded the text, sent to the database and stored	Pass
15.3	User disables access and types on keyboard	Testing keyboard service	Nothing sends to database stores in the database	Nothing received to the database and no new records recorded	Pass

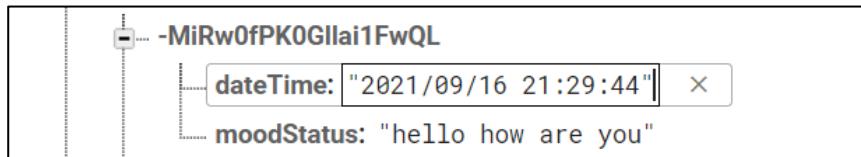


Figure 5-30: Test Case 15 - Evidence

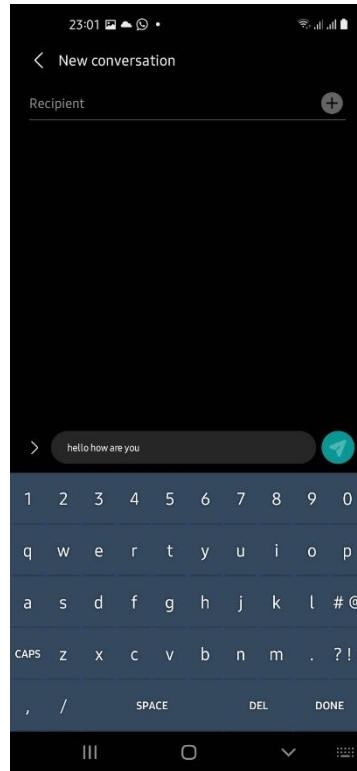


Figure 5-31: Test Case 15 – Evidence 2

Table 18: Test Case 16 - Sentiment Analyzer - Server

<b>Test Case ID: 16</b>					
<b>Name:</b> Sentiment Analyzer - Server					
<b>Pre-condition:</b> User need to start ZIOE keyboard service and enable access privileges					
No.	Description	Inputs	Expected Output	Actual Output	Result
16.1	Send HTTP GET request to the Sentiment Analyzer Server	No inputs	Server replies with default welcome message	Server replied with default welcome message	Pass
16.2	Send HTTP POST request to the Sentiment Analyzer Server without a text in parameter	No inputs	Server responds with an error message	Server responded with an error message	Pass
16.3	Send HTTP POST request to the Sentiment Analyzer Server with a text in parameter	Hello	Server executes the sentiment analyzer and responds with the sentiment identified.	Sentiment received as Neutral	Pass

			Expected sentiment: Neutral		
--	--	--	--------------------------------	--	--

thaveeshaZOIE.pythonanywhere.com

GET thaveeshaZOIE.pythonanywhere.com

Params Authorization Headers (6) Body Pre-request Script

Query Params

KEY	VALUE
string	I am happy
Key	Value

Body Cookies Headers (7) Test Results

Pretty Raw Preview Visualize HTML

Hello from ZOIE Sentiment Analyzer

thaveeshaZOIE.pythonanywhere.com

POST thaveeshaZOIE.pythonanywhere.com

Params Authorization Headers (7) Body Pre-request Script Tests Settings

Query Params

KEY	VALUE
string	I am happy
Key	Value

Body Cookies Headers (5) Test Results

Pretty Raw Preview Visualize HTML

```

1 <!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 3.2 Final//EN">
2 <title>500 Internal Server Error</title>
3 <h1>Internal Server Error</h1>
4 <p>The server encountered an internal error and was unable to complete
   | there is an error in the application.</p>
5

```

thaveeshaZOIE.pythonanywhere.com?string=Hello

POST thaveeshaZOIE.pythonanywhere.com?string=Hello

Params Authorization Headers (7) Body Pre-request Script Tests Settings

Query Params

KEY	VALUE
string	Hello
Key	Value

Body Cookies Headers (6) Test Results

Pretty Raw Preview Visualize HTML

Neutral

Figure 5-32: Test Case 16 - Evidence

Table 19: Test Case 17 - Sentiment Analyzer – Analyze positive

<b>Test Case ID: 17</b>					
<b>Name:</b> Sentiment Analyzer – Analyze Sentiment (Accuracy of Positive statement)					
<b>Pre-condition:</b> User need to start ZIOE keyboard service and enable access privileges					
No.	Description	Inputs	Expected Output	Actual Output	Result
17.1	Sends a positive statement to check whether Sentiment Analyzer analyses and responds correctly	I am the happiest person alive	Respond: Positive	Prints: Positive	Pass
17.2	Sends a positive statement to check whether Sentiment Analyzer analyses and responds correctly	I am very excited, I achieved it.	Respond: Positive	Prints: Positive	Pass
17.3	Sends a positive statement to check whether Sentiment Analyzer analyses and responds correctly	I felt that I finally won it.	Respond: Positive	Prints: Positive	Pass

thaveeshaZOIE.pythonanywhere.com?string=I am the happiest person alive

POST thaveeshaZOIE.pythonanywhere.com?string=I am the happiest person alive

Params ● Authorization Headers (7) Body Pre-request Script Tests Settings

Query Params

	KEY	VALUE
<input checked="" type="checkbox"/>	string	I am the happiest person alive
	Key	Value

Body Cookies Headers (6) Test Results

Pretty Raw Preview Visualize HTML ▾

1 Positive

The screenshot shows the Postman application interface. At the top, there is a URL bar with the text "thaveeshaZOIE.pythonanywhere.com?string=I am the happiest person alive". Below the URL bar, the method is set to "POST" and the target URL is "thaveeshaZOIE.pythonanywhere.com?string=I am the happiest person alive". The "Params" tab is selected, showing a table with one row where the key "string" has a value of "I am the happiest person alive". There is also an empty row for "Key" and "Value". Below the table, there are tabs for "Body", "Cookies", "Headers (6)", and "Test Results". The "Test Results" tab is selected, showing a table with one row labeled "1 Positive". At the bottom, there are buttons for "Pretty", "Raw", "Preview", "Visualize", and "HTML" (with a dropdown arrow), followed by a copy icon.

Figure 5-33: Test Case 17 - Evidence

Table 20: Test Case 18 - Sentiment Analyzer - Analyze Negative

<b>Test Case ID: 18</b>					
<b>Name:</b> Sentiment Analyzer – Analyze Sentiment (Accuracy of Negative statement)					
<b>Pre-condition:</b> User need to start ZIOE keyboard service and enable access privileges					
No.	Description	Inputs	Expected Output	Actual Output	Result
18.1	Sends a negative statement to check whether Sentiment Analyzer analyses and responds correctly	I felt that I've lost everything	Respond: Negative	Prints: Negative	Pass
18.2	Sends a negative statement to check whether Sentiment Analyzer analyses and responds correctly	I am very disappointed with him	Respond: Negative	Prints: Negative	Pass
18.3	Sends a negative statement to check whether Sentiment Analyzer analyses and responds correctly	I was very discouraged with what happened	Respond: Negative	Prints: Negative	Pass

thaveeshaZOIE.pythonanywhere.com?string=I am very disappointed with him

POST  thaveeshaZOIE.pythonanywhere.com?string=I am very disappointed with him

Params  Authorization Headers (7) Body Pre-request Script Tests Settings

Query Params

	KEY	VALUE
<input checked="" type="checkbox"/>	string	I am very disappointed with him
	Key	Value

Body Cookies Headers (6) Test Results

Pretty Raw Preview Visualize

1 Negative

The screenshot shows the Postman application interface. At the top, there is a URL bar with the text "thaveeshaZOIE.pythonanywhere.com?string=I am very disappointed with him". Below the URL bar, a dropdown menu shows "POST" selected. The main workspace contains a table for "Query Params" with two rows: one for "string" with value "I am very disappointed with him" and one for "Key" with value "Value". Below this, there are tabs for "Body", "Cookies", "Headers (6)", and "Test Results", with "Body" being the active tab. Under "Body", there are buttons for "Pretty", "Raw", "Preview", "Visualize", and "HTML" (which is currently selected). A preview window shows the number "1" and the word "Negative".

Figure 5-34: Test Case 18 - Evidence

### 5.3.Evaluation

To evaluate the developed system, a well-structured feedback questionnaire (Appendix E: [Feedback Questionnaire](#)) was given to 35 individuals to fill in order to gather their opinion about the system. The survey was conducted through Microsoft Forms. In this section results obtained from the feedback questionnaire is discussed.

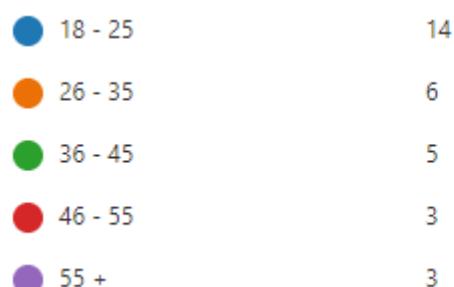


Figure 5-35: Feedback survey - Response for age

There were 31 feedbacks for the evaluation conducted. There were 14 people in between 18 – 25 years range. There were 06 people from 26 – 35 range and 5 people from 36 – 45 years range. 03 people from 46 - 55 years range and 03 people above 55 years were responded with their feedbacks.

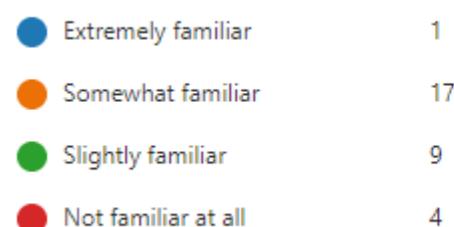


Figure 5-36: Feedback survey - Response familiarity

Before gather the opinion about the developed system, participants were asked about their familiarity regarding the similar systems which meditation or depression/ Anxiety/ Stress relieving mobile applications. The figure 5-14 shows the participants familiarity regarding such systems. Most of the respondents were familiar with such systems. There were only 4 people who never used a such system and used ZOIE as the first meditation or depression/ Anxiety/ Stress reliving mobile application.

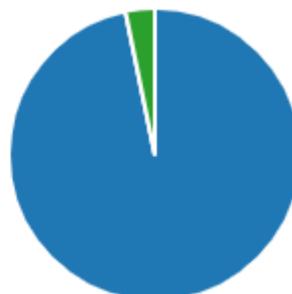
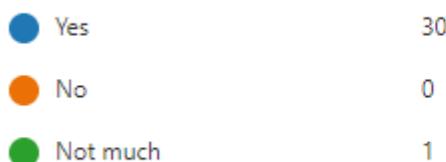


Figure 5-37: Feedback survey - Response for ZOIE usage

The figure 5-15 shows the respondents experience with ZOIE application. All the respondents who participated were managed to use the application before the feedback.



Figure 5-38: Feedback survey - Response for ZOIE usage time

The evaluation was conducted for a period of 6 days. This question was asked to evaluate where the system is interested to use or not. Unfortunately, there were 04 feedbacks that stated that they didn't use the application more than 3 days. As a percentage 12.9% of the participants were lost interest after 03 days.



Figure 5-39: Feedback survey - Response for Sentiment Analyzer experience

In the figure 5-17 participants were asked about their experience about the sentiment analyser of ZOIE. From 31 responses collected from users, the accuracy rate was received as 5.16 out of 10

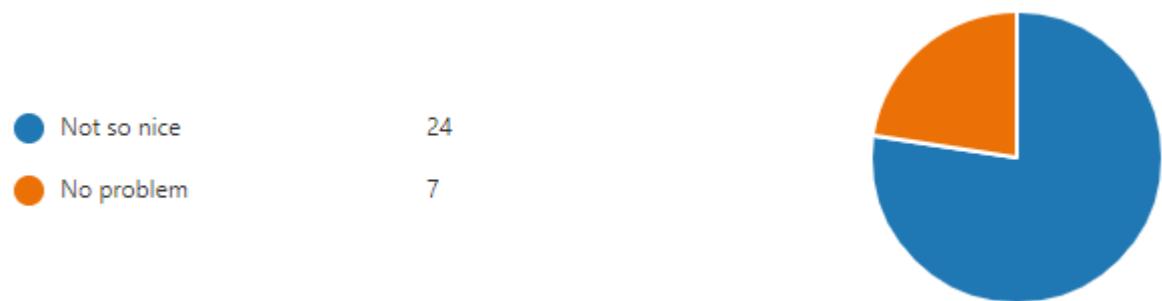


Figure 5-40: Feedback survey - Response for keyboard service

In order to analyse sentiments, a unique keyboard service was developed. the figure 5-18 shows the feedback of users about that. The majority finds it was not convenient approach to change the keyboard in order to analyse the sentiment behind chats.

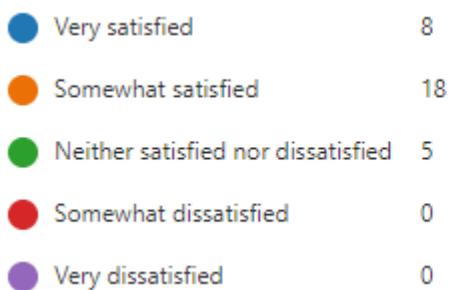


Figure 5-41: Feedback survey - Response for Mood Analyzer feedback

The question was regarding the Mood Analyzer function of the ZOIE application, which was the main function of the application. the figure 5-19 shows that almost all users were found it useful. There were no negative feedbacks received regarding the Mood Analyzer function.



Figure 5-42: Feedback survey - Response for Concept

The concept of the system was to include a sentiment analyser to a meditation application. In this question, the users were asked about their opinion about that concept. No user was given a feedback as it is a weak concept.



Figure 5-43: Feedback survey - Response for opinion about chatbot

The figure 5-21 shows the users opinion about the chat bot. The question was about whether they felt the ZOIE's Chatbot as a digital companion to them. There were 2 respondents agree with that and 12 out of the 31 participants were in neutral opinion. There were 17 users didn't find it as a companion.

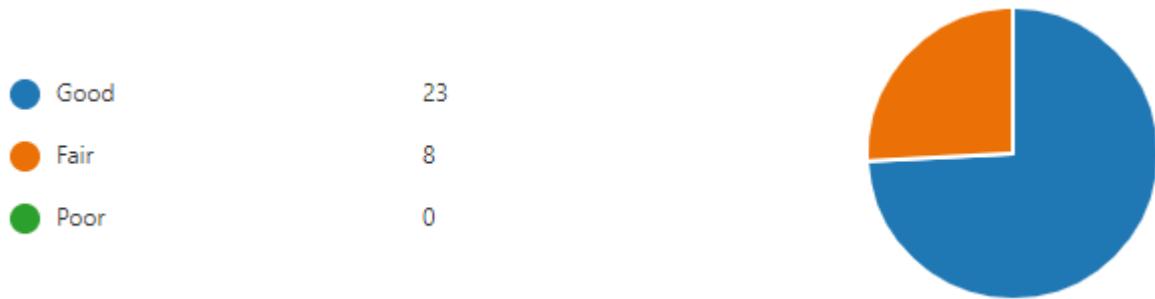


Figure 5-44: Feedback survey - Response for Meditation feature

In the figure 5-22 users were asked their opinion about the meditation activity which is providing through the ZOIE's chatbot. 23 out of 31 users stated that it is a good service while rest of the 08 users find it fair. There were no users stated that the meditation feature provided by ZOIE's chatbot was poor.

Good	16
Fair	14
Poor	1



Figure 5-45: Feedback survey - Response for stress relief activities

The figure 5-23 illustrates users' opinion about the stress relief activities providing through ZOIE's chatbot. 16 users stated that it was a good feature while 14 users found it a fair feature. There was 1 user who found the service was poor. Overall, 96.77% users found this as a good feature.

<b>31</b>	<b>3.16</b>
Responses	Average Number

Figure 5-46: Feedback survey - Response for overall satisfaction about chatbot

The figure 5-24 illustrates users' overall opinion about the chatbot of the ZOIE application. From the 31 received responses, 3.16 out of 5 overall rating was received. As a percentage 63.2% users having a positive opinion about the chatbot feature.

Extremely interesting	3
Very interesting	21
Somewhat interesting	6
Not so interesting	1
Not interesting at all	0



Figure 5-47: Feedback survey - Response for satisfaction about meditation activities

The ZOIE application is provided meditation activities in 3 ways. In the above question, users were asked their opinion about that meditation features provided by the application. 03 users stated that it was extremely interesting. 21 users found it very interesting feature while 06 users stated that the feature is somewhat interesting. There was 1 user who stated that, the meditation features are not so interesting. As a summary, 96.77% of users stated that mediation features are interesting and useful.

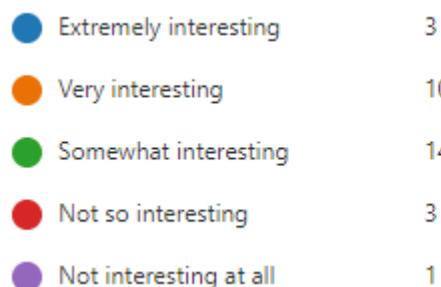


Figure 5-48: Feedback survey - Response for personnel management features

In addition to the meditation features provided, ZOIE application also provides some features to manage daily activities. The figure 5-26 illustrates users' opinion about that activities. 03 users stated that these features are extremely interesting while 10 people found it very interesting and another 14 stated that it's interesting to some extent. There are 04 users who found that these functions are not interesting neither useful. As a percentage, 87% users stated that these functions are useful.

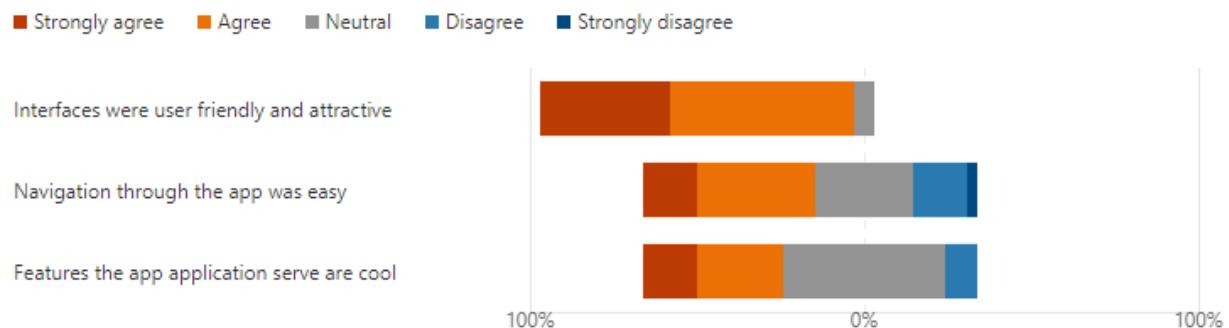


Figure 5-49: Feedback survey - Response for opinion about GUI

The figure 5-27 illustrates users' overall opinion about the user interface and features of ZOIE application. When considering the feedbacks received, almost all users were found that user interfaces of the application were user friendly and attractive. There are neutral feedbacks regarding the navigation system of the application. Some users found it navigation was convenient as same as some users found it is non convenient. When considering the features that application provides, majority of the users agreed with that application has some interesting features.

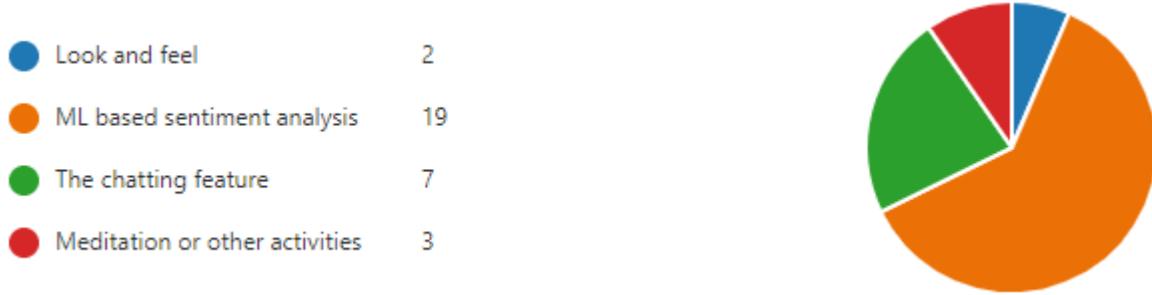


Figure 5-50: Feedback survey - Response for favorite feature

At the last section of the feedback questionnaire, users were asked about what was the feature they most loved. 19 users responded with that, Machine Learning based sentiment analysis was their favourite while another 07 users responded with that, chatting feature was interesting to them. Another 03 users were interested on meditation/ other activities while another 02 were interested about the look and feel of the ZOIE application.



Figure 5-51: Feedback survey - Response for encountered issues

Then there was an open-ended question about user encountered issues while using the application. There were 08 responses for that question and the most common issue that users stated are sentiment accuracy was not sufficient.



Figure 5-52: Feedback survey - Response for overall rating

The figure 5-30 illustrates users' overall rating about the developed system. From 31 responses 4.00 out of 5 average rating was received.

## **5.4.Discussion**

### **5.4.1. Reliability and Accuracy**

#### **5.4.1.1. Accuracy**

When discussing about the reliability and accuracy of the ZOIE mobile application, the accuracy rate and reliability is tested in the integration testing phase. When considering about the ZOIE main android application, in each integration testing, all the features of ZOIE worked accurately. Thus, the accuracy rate of the rest function can be stated as 100%.

When comes to the sentiment analyser, the accuracy rate of the sentiment analyser is currently at a low value. The reason behind the matter can be classified in to two

1. Understanding of the language

Understanding the language means, the sentiment analyser is only able to understand English words. It is not currently developed for any other language. Also, with English language, the sentiment analyser cannot able to understand short forms of shorten words which usually used when chatting.

2. Ability of the libraries used

The sentiment analysis process is implemented using a combination of several libraries which are explained under Chapter 3 section. These libraries are developed using a limited number of terms. Therefore, there is a possibility of inputting a term which is not included in any library. In such case, the sentiment analyser may fail to produce the accurate result.

Due to the mentioned two matters, accuracy rate of the sentiment analyser was reduced. In the evaluation, the researcher has included a question about the accuracy of the sentiment analyser. The NPS was recorded as a minus value. Considering the above-mentioned situation, the accuracy rate of the sentiment analyser can be stated as 50%.

When considering the chatbot of the ZOIE mobile application, the chatbot is trained to perform simple mediation activities and stress relieve activities through a conversation. When testing the chatbot, it was noticed that, the chatbot might crashed when the inputs are not passed as a flow. Further the chatbot is also having the understand of the language issue which is mentioned above. In the system evaluation survey, there was a separate section to examine the user's feedback (results are stated under section 4 - evaluation) overall satisfaction about the chatbot was reported as 3.16 out of 5. Considering all these, Accuracy of the ZOIE's chatbot can be stated as 65%

When concluding the accuracy of the ZOIE by combining the all-mentioned components together, accuracy rate can be stated as 71.6%

#### **5.4.1.2. *Reliability***

When considering the reliability, the ZOIE main android application doesn't depend on anything except its Realtime database on firebase, the firebase database having some limitation and as well as doesn't guarantee the security. Thus, reliability is average. Sentiment analyser is currently hosted in a free hosting provider which is only providing the service only for three months. The chatbot of the ZOIE doesn't depend on external interfaces thus, reliability is ensured.

As a conclusion, accuracy of the developed ZOIE mobile application is average. In order to improve the accuracy, some future work is needed. It's listed under section 6.5. The application is having an average reliability which is currently acceptable because the application is on the initial stage, behind the commercial level. Once the ZOIE application is releasing for the commercial usage, the above-mentioned reliability issues can be overcome through the premium plans of the used services. In such case, application reliability can be guaranteed up to its topmost.

#### **5.4.2. Emerged Issues**

##### Accuracy of the Sentiment Analyzer Function

After implementing the Sentiment Analyzer function initially with the use of NLP libraries, an issue regarding the accuracy of the function has detected. As example, the function identifies "I am angry" as a negative sentiment but not identified "I am not angry" as a positive sentiment because the system was intended to analyse sentiment based on the words.

Solution taken: With the proper guidance of the supervisor, I worked hard on the mentioned issue, I have integrated more libraries along with the main (NLTK) library in order to improve the accuracy. The "TextBlob" library is one of the libraries added regarding this matter.

##### Integration of Sentiment Analyzer Function

After implementing the Sentiment Analyzer function using Python programming language, an issue was raised regarding integration of this function with the project since the ZOIE main project was the Android project which was totally programmed using Java programming language.

Solution taken: The client server architecture was implemented between ZOIE mobile application and Sentiment Analyser. The sentiment analyser is developed as a server using Python Flask API. Volley library was used to implement the client side on ZOIE mobile application.

##### Privacy Issues Regarding the input tracking

The supervisor has mentioned that, there is a privacy issue when the application monitors and records all the inputs which user inputs for the device.

Solution taken: Implemented a permission allowing mechanisms which the user is able to allow permission to the applications that user wishes to use the input tracking for the sentiment analysis process. Otherwise, the inputs are not recorded. With this solution, the privacy issue can be deducted.

## **6. Conclusion and Future Work**

This chapter includes the overall summary, and future work.

### **6.1. Conclusion**

The aim of the research was to

- Develop a mobile application which enables the user to collaborate with a digital companion towards a better mental health.**

To achieve the research aim, a research methodology was designed, a vital part of which was the setting of objectives that are completed. The objectives of the research are listed below. All of these objectives were completed as part of the research. Furthermore, the results obtained as a direct consequence of meeting these objectives are stated

- To identify the existing AI related chatbots/ mood tracking mobile applications, analyze and study their behavior.**

In order to identify the existing AI related chatbots/ mood tracking mobile applications a proper literature review was conducted. More than 50 researches were referred and about 25 researches are documented in the chapter 2. To analyse and study about some chatbots and AI related meditation applications, the researcher installed and used that applications for a certain period of time. After conducting that requirement gathering and analysis phase, the researcher has gained wide knowledge about existing AI related chatbots/ mood tracking mobile applications. Hence the first objective was achieved.

- To get hands on experience about AI, ML and natural language processing applications on a project**

Sentiment analysis is the use of natural language processing which is a one main field of Machine Learning. In order to develop ZOIE application's sentiment analyser, the researcher has researched in the machine learning field. Then the researcher implemented the complete sentiment analyser with the use of Natural Language Processing. The researcher has gained hands on experience on the relevant field.

- To train a machine learning model and develop an AI based chatbot using natural language processing**

In order to develop the ZOIE chatbot, the researcher has trained a dialogflow chatbot and implemented the chatbot in to the ZOIE application.

- To develop a user friendly - interesting platform to users to interact with.**

The ZOIE application is an android application which is nicely designed. When considering the research evaluation results which are listed under the Chapter 4, it can be stated that ZOIE was developed as a user friendly and interesting platform to interact to the users. Hence, the final objective of the research was also achieved.

In conclusion, it can be concluded that, all the listed which were identified in the research were achieved during the research. The research met the final aim of the research. As a result of the research conducted, a meditation and stress relieving mobile application with newly concept was published successfully.

## **6.2.Limitations**

ZOIE is a new concept brought to the thousands of mental health related mobile applications; it is still possible that this system has its limitations. Therefore, following limitations can be considered.

- Platform dependency: The ZOIE mobile application was initially developed only for the android devices.
- Language dependency: The ZOIE mobile application was initially developed only for English language.
- Sentiment analyzer accuracy is low
- Firebase authentication only verify 10K authentication per month
- Cloud functions provides only 125K invocations per month.
- There is a delay between API calls to analyze sentiments

## **6.3.Benefits of the system**

- Users will be able to learn about their selves with intelligent mood tracking.
- Users will be able to handle their moods all the day by interacting with the chatbot. It detects the bad times and feelings of user and helps to overcome soon.
- Users will be having an integrated personal assistant to manage their work. It can remind the user about the task user has to do.
- Users will be having an AI friend to chat and tell how was the day like a companion. it's empathetic, helpful, and will never judge about the user.

## **6.4.Future Work**

The ZOIE application was developed under a comparatively restricted scope because of the time limitations. There are some suggestions listed below.

- Extend the Natural Language Processing mechanisms in order to improve the accuracy of the sentiment analyzer.
- The mood analyzer function was initially designed to show summary charts about the mood variations. It can be extended.
- The number of meditation activities providing are less. It can be extended by adding new meditation activities to the meditation feature as well as training the chatbot for new meditation activities.
- Self-management features can be improved by adding new functions.

- Registration is currently limited to the manual method. It can be upgraded to Google or Facebook authentications in order to expand the UX.
- Making the application available in several languages which would increase the user experience

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# Appendices

## Appendix A: Poster



**ZOIE**  
Human sentiment analyzer mobile application  
using machine learning with an AI chatbot

### Introduction

Stress is the world mental health disease of the 21st century and may be the trigger for depression and even suicide if it is not treated properly. ZOIE - the mobile application, is an approach to understand individual's feelings and analyze the hidden sentiments behind the individuals in order to ensure the psychosocial well-being of the individual.

### Aims & Objectives

**Aim**

- To develop a mobile application which enables the user to collaborate with a digital companion towards a better mental health.

**Objectives**

- To identify the existing AI related chatbots/ mood tracking mobile applications, analyze and study their behavior.
- To get hands on experience about AI, ML and natural language applications on a project
- To train a machine learning model and develop an AI based chatbot using natural language processing
- To develop a user friendly – interesting platform to users to interact with.

### Requirements

As per the literature review conducted, considering the existing systems following features are identified as requirements of ZOIE

Feature	Woebot	Wysa	Replica	ZOIE
AI Chatbot	✓	✓	✓	✓
Meditation	✓	✓	✗	✓
Mood Tracking	✓	✓	✓	✓
Habit Tracking	✗	✗	✗	✓
Provide entertainment facilities based on users likes and dislikes	✗	✗	✓	✓
Monitors the mood all time	✗	✗	✗	✓
Analyze mood day/week/month wise.	✓	✓	✗	✓
Provide the feeling of a real companion	✗	✗	✓	✓
Consist with a virtual digital character	✗	✗	✓	✗

### Methodology

Planning	Agile methodology was used as the software development methodology. Four sprints were executed.
Requirement Gathering	Feasibility analysis is conducted. Defined the project activities, Determined the dependencies, Sequenced the activities, Estimated the resources, Estimated durations, Developed the project schedule
Design	Two requirement gathering stages were conducted. The primary data gathering stage was a literature review, Secondary data gathering was a market research.
Development	UML diagrams were designed. Database and user interfaces were designed in relevant sprints.
Testing	The system was implemented in four development sprints.
Evaluation	Unit testing and integration testing were done.
	Evaluation was conducted using a feedback questionnaire

### Conclusion & Future Work

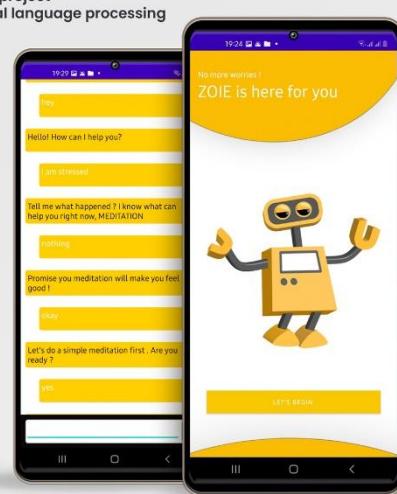
All of these objectives were completed as part of the research

The application will be improved on

- Accuracy of Sentiment Analyzer using extended NLP techniques.
- Number of meditation and self-management activities.
- Increasing the reach by overcoming platform dependency.

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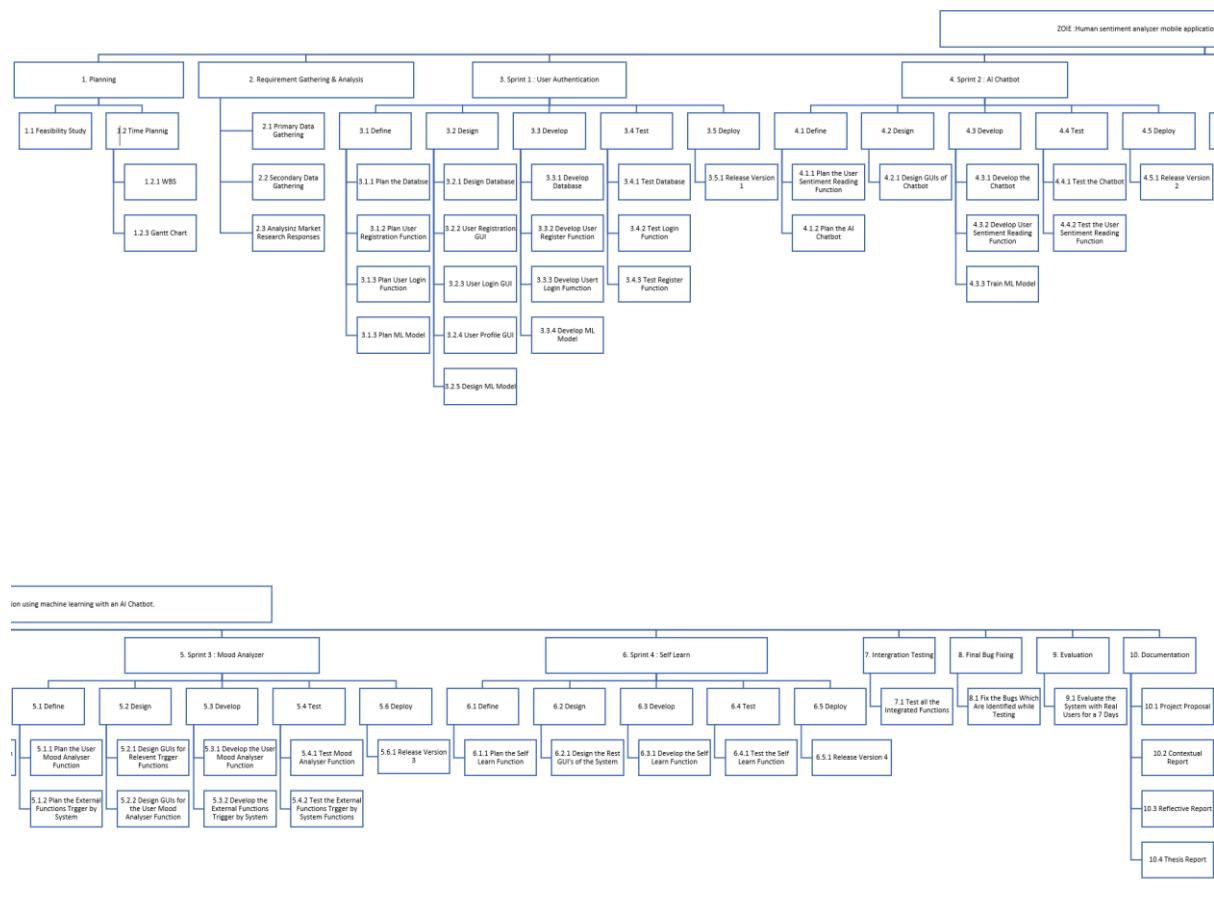
### Evaluation

★★★★★ 4.00 Average Rating

Thaveesha Kuruppuarachchi  
2022852  
Supervisor: Ms. Nideshika Ellepola

     Firebase

## Appendix B: Work Breakdown Structure





## **Appendix D: Market Research Questionnaire**

# **Human sentiment analyzer mobile application using machine learning with an AI Chatbot.**

Hello, This is a research project being conducted by me about developing a human sentiment analyzer mobile application. You are warmly welcome to participate in this research project.

Your participation in this research study is voluntary and there will be no right or wrong answers. The researchers are interested in your behavior and opinions. The procedure involves filling an online 20 questions survey that will approximately take 10 minutes. The survey questions will be about your day to day mental health.

The survey will not contain information that personally identifies you. Results will be used for scholarly purposes only and we will do our best to keep your information confidential. If you have any questions about the research study, please feel free to contact me.

Thank you for your time.

1. Which describes you the best?

- Student
- Undergraduate
- Employee
- Businessman
- Not working right now

2. Age group you are belong to \*

- 18 - 25
- 25 - 35
- 35 - 45
- 45 - 55
- 55 +

3. On a scale of 1 to 5, How stressed do you feel on an ordinary day? \*

1	2	3	4	5
<input type="radio"/>				

4. During the past 4 weeks, have you ever had any problems with your daily life due to any emotional problems, such as feeling depressed, sad or anxious? \*

- Yes
- No
- Maybe

5. If you ever feel stressed, What are the usual PSYCHOLOGICAL or EMOTIONAL effects of stress you've noticed at yourself? (Skip if you never had these issues)

- Anxiety or fear
- Sadness, moodiness, grief or depression
- Feeling heroic, euphoric or invulnerable
- Irritability or anger
- Restlessness
- Feeling overwhelmed, helpless or hopeless
- Feeling isolated, lost, lonely or abandoned

6. If you ever feel stressed, What are the usual COGNITIVE effects of stress you've noticed at yourself? (Skip if you never had these issues)

- Memory problems/forgetfulness
- Confusion
- Slowness in thinking, analyzing, or comprehending
- Difficulty calculating, setting priorities or making decisions
- Loss of objectivity
- Limited attention
- Inability to stop thinking about the disaster or an incident

7. Overall how would you rate your mental health? \*

- Excellent
- Somewhat good
- Average
- Somewhat poor
- Poor
- Not sure

8. What are your personal methods you use to relieve stress? (Select all that apply) \*

- Eating
- Sleeping
- Talking with a friend or someone
- Drinking
- Social Media
- Drugs
- Other

9. How able do you feel to handle stress and be positive about your life when you are experiencing it alone? \*

- 1    2    3    4    5
- - 
  - 
  - 
  -

10. What do you think about the "Talking with a friend or someone" option in the previous question?  
Would you think that it will be effective ? Will a trustworthy friend make a positive impact towards your mental health ?

- Yes
- No

11. What's your idea about having a digital companion who you can trust and talk about your life. ? which will be helpful to reduce the stress on you ? \*

- It will be helpful
- Maybe
- I don't think it will help
- I have no idea about it

12. There are some mobile applications which acts as a companion, chats with you, understands you and help you to manage your day to day life better. Do you aware of that ? \*

- I know about that
- I don't know about that
- I know, but I've never used

13. If you are/were a user of that kind of application, what is your first reaction to the service ? \*

- Positive
- Neutral
- Negative
- Currently I am not using something like that

14. When you think about the service, do you think of it as something you need or don't need? \*

- Definitely need
- Probably need
- Neutral
- Probably don't need
- Definitely don't need

15. If we are developing a similar application with more functionalities, like if the app can understand your emotional situations and helps you to maintaining positivity throughout the day and guide you for a higher level of productivity, what is your reaction to it? \*

- Positive
- Neutral
- Negative

16. If the service is available today, how likely would you be to get the service? \*

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely

18. How likely is it that you would recommend our new service to an another individual ? \*



19. In your own words, what are the things that you personally expect in these kind of application?

Enter your answer

## **Appendix E: Feedback Questionnaire**

# **Human sentiment analyzer mobile application using machine learning with an AI Chatbot.**

Hello, This is a research project being conducted by me about developing a human sentiment analyzer mobile application. You are warmly welcome to participate in this research project.

Your participation in this research study is voluntary and there will be no right or wrong answers. The researchers are interested in your behavior and opinions. The procedure involves filling an online 20 questions survey that will approximately take 10 minutes. The survey questions will be about your day to day mental health.

The survey will not contain information that personally identifies you. Results will be used for scholarly purposes only and we will do our best to keep your information confidential. If you have any questions about the research study, please feel free to contact me.

Thank you for your time.

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- Student
- Undergraduate
- Employee
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- Not working right now

2. Age group you are belong to \*

- 18 - 25
- 25 - 35
- 35 - 45
- 45 - 55
- 55 +

3. On a scale of 1 to 5, How stressed do you feel on an ordinary day? \*

1    2    3    4    5

1     2     3     4     5

4. During the past 4 weeks, have you ever had any problems with your daily life due to any emotional problems, such as feeling depressed, sad or anxious? \*

- Yes
- No
- Maybe

5. If you ever feel stressed, What are the usual PSYCHOLOGICAL or EMOTIONAL effects of stress you've noticed at yourself? (Skip if you never had these issues)

- Anxiety or fear
- Sadness, moodiness, grief or depression
- Feeling heroic, euphoric or invulnerable
- Irritability or anger
- Restlessness
- Feeling overwhelmed, helpless or hopeless
- Feeling isolated, lost, lonely or abandoned

6. If you ever feel stressed, What are the usual COGNITIVE effects of stress you've noticed at yourself? (Skip if you never had these issues)

- Memory problems/forgetfulness
- Confusion
- Slowness in thinking, analyzing, or comprehending
- Difficulty calculating, setting priorities or making decisions
- Loss of objectivity
- Limited attention
- Inability to stop thinking about the disaster or an incident

7. Overall how would you rate your mental health? \*

- Excellent
- Somewhat good
- Average
- Somewhat poor
- Poor
- Not sure

8. What are your personal methods you use to relieve stress? (Select all that apply) \*

- Eating
- Sleeping
- Talking with a friend or someone
- Drinking
- Social Media
- Drugs
- Other

9. How able do you feel to handle stress and be positive about your life when you are experiencing it alone? \*

- 1
  - 2
  - 3
  - 4
  - 5
- - 
  - 
  - 
  -

10. What do you think about the "Talking with a friend or someone" option in the previous question?  
Would you think that it will be effective ? Will a trustworthy friend make a positive impact towards your mental health ?

- Yes
- No

11. What's your idea about having a digital companion who you can trust and talk about your life. ?  
which will be helpful to reduce the stress on you ? \*

- It will be helpful
- Maybe
- I don't think it will help
- I have no idea about it

12. There are some mobile applications which acts as a companion, chats with you, understands you and help you to manage your day to day life better. Do you aware of that ? \*

- I know about that
- I don't know about that
- I know, but I've never used

13. If you are/were a user of that kind of application, what is your first reaction to the service ? \*

- Positive
- Neutral
- Negative
- Currently I am not using something like that

14. When you think about the service, do you think of it as something you need or don't need? \*

- Definitely need
- Probably need
- Neutral
- Probably don't need
- Definitely don't need

15. If we are developing a similar application with more functionalities, like if the app can understand your emotional situations and helps you to maintaining positivity throughout the day and guide you for a higher level of productivity, what is your reaction to it? \*

- Positive
- Neutral
- Negative

16. If the service is available today, how likely would you be to get the service? \*

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely

17. If you're likely to get this application, Which of the following are reasons that you might get this app? \*

- It looks better than something I already used
- It serves a need of mine that is not currently being met
- Currently I'm not interested to try this

18. How likely is it that you would recommend our new service to an another individual ? \*



19. In your own words, what are the things that you personally expect in these kind of application?

Enter your answer