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REALIZATION OF MENTAL HYGIENE USING DEEP LEARNING

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LETTER OF APPROVAL

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ABSTRACT

The scope of our study involves the delivery of high-quality mental health applications and services through the use of efficient, available and affordable technologies that are accessible to developing nations like Nepal where these facilities are in immense demand despite the constraints in resources. The project points out the important considerations and critical factors required for the successful implementation of mobile and Artificial Intelligence (AI) technologies in the field of mental health. The project focuses on the use of AI and smartphone technologies to promote the mental health and digital well-being of its users by exploiting the power of edge devices like smartphone and internet technologies. These involve integration of deep learning based text analysis tools like sentimental analysis, conversational AI and mobile applications installed on smartphones. Nepalese studies from 2017 have shown that there are only 150 psychiatrists, 70 psychiatric nurses and 28 clinical psychologists to serve 28 million people in the country. There are many indications that mobile and AI technologies are useful in healthcare provisions. Mental health apps have seen a spike in the number of downloads since the beginning of the pandemic going to show the need for mental health solutions through mHealth. Based on this revelation, a flutter based cross platform mental health application focusing on screening using sentimental analysis was developed to address these issues.

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LIST OF SYMBOLS / ABBREVIATIONS

AI	Artificial Intelligence
ANN	Artificial Neural Network
API	Application Programming Interface
BERT	Bidirectional Encoder Representations Transformers
CNN	Convolution Neural Network
COVID-19	Coronavirus Disease of 2019
CPU	Central Processing Unit
GAD	General Anxiety Disorder
GPU	Graphical Processing Unit
GRU	Gated Rectified Unit
GUI	Graphical User Interface
IDE	Integrated Development Environment
KNN	K-Nearest Neighbor
LSTM	Long short-term memory
ML	Machine Learning
NN	Neural Network
OLBI	Oldenburg Burnout Inventory
PDF	Probability Distribution Function
PHQ	Patient Health Questionnaire
PNN	Probability Neural Network

PSS	Perceived Stress Scale
PTSD	Post-Traumatic Stress Disorder
ReLU	Rectified Linear Unit
RNN	Recurrent Neural Network
UI	User Interface
WHO	World Health Organization

1 INTRODUCTION

Mental Health is a vast topic that deals with emotional and psychological well-being. The emotional and psychological status of a person determines how healthy their thought process is. People may feel different in each unit of passing time which is normal but when the same feeling of disappointment, sadness, and anxiety occurs for a long time, it affects many aspects of a human being. Entering this phase or stage is said to be mentally unhealthy which results in the emergence of multiple problems slowly reaching the surface that can be seen by others as loss of sleep, insomnia, suicidal thoughts, physically inactiveness, unhealthy eating habits, substance addiction along with other problems. In this regard, the topic of mental hygiene is as much or even more important than physical health. Due to the stigmatization of the term to cover only some disorders and high scale problems, it has resulted in less understanding of the common problems and a lack of safe, open, welcoming environment for someone suffering from mental health problems to feel accepted which in turn results in less people seeking medical attention and help and understanding of the problems that are very important in a broader perspective. In order to reach different parts of the world to make everyone aware of the importance of mental hygiene, multiple workshops are being conducted around the world along with the emergence of simple, cheaper alternatives to therapy sessions in the form of mental health apps. Due to the increasing popularity of receiving information from smart devices, many companies have taken up online platforms to publish applications on different platforms to provide basic information about mental health.

1.1 Mental Health and Covid-19

Our emotional, psychological, and social well-being are all part of our mental health. It has an impact on the way we think, feel, and act. It also influences how we deal with stress, interact with others, and make decisions. The COVID-19 pandemic caused many changes in the

life of an individual. The uncertainty, disrupted daily routines, financial strains, and social isolation was introduced during the pandemic. Individuals were worried daily about getting infected. While trapped and cooped in their homes, they panicked about the duration of the pandemic, whether their job will be affected, and what the future holds. The overabundance of information, rumors, and misinformation caused them to feel out of control and unsure of the direction they should take.

Pandemic was the cause of many mental health-related developments such as stress, anxiety, fear, sadness, and loneliness. When compared to surveys conducted prior to the pandemic, surveys show a significant increase in the number of adults in the United States reporting symptoms of stress, anxiety, depression, and insomnia.

Individual circumstances affected the extent to which one was affected by the pandemic. It was found that the contractors were much more affected by job concerns than permanent employees. In another scenario, parents with children faced a different and challenging problem of having to balance work and homeschooling. For those that lived alone, they faced the challenge of having no one to talk to. Project Management and IT Operations roles were most affected during the pandemic. They were under duress as they faced unprecedented pressure in having to quickly transition large workforces to a remote/virtual environment. Since the crisis began, 56% of companies increased the level of personal and emotional support provided to employees.

Workers in the healthcare industry who were exposed to COVID-19 may be at a higher risk of developing mental illnesses. In Nepal, 41.9 percent of healthcare workers had anxiety symptoms, 37.5 percent had depression symptoms, and 33.9 percent had insomnia symptoms during the pandemic.

The recent coronavirus pandemic has revealed deep cracks in the healthcare system of countries all around the world. During the pandemic, certain groups were more vulnerable to

stress and anxiety and needed continuous care. But, due to various reasons, not everyone had access to health services as needed or required.

However, the prospects for mental health apps significantly improved as a result of the global lockdown imposed during the COVID-19 pandemic. COVID-19 finally forced the corporate world to consider the importance of mental health and employee well-being. As if a switch had been turned on, corporates realized there is a positive correlation between workplace productivity and the mental health of employees. As companies began to shift more heavily to the digital world, digitalization became more prominent, resulting in massive growth in the market for mental health apps.

1.2 Current Scenario of Nepal

Despite the availability of treatments for mental illness, there is a significant disparity between the number of people who need mental health care and those who actually take the initiative to receive it. According to the WHO's recent World Mental Health Survey initiative, 86.3 percent of people in low or middle-income countries with anxiety, mood, or substance disorders received no treatment in the previous 12 months. Out of the patients that did receive treatment, most received insufficient care. Of the few recognized barriers to proper utilization of mental health care, low perceived needs, stigma and discrimination associated with mental illness, inability to afford treatment costs, a poor identification, and referral system, and a shortage of human resources are the most common.

In a country like Nepal, where stigma and cultural norms play a large role in access and demand for services, it has become increasingly more important to manage the increasing burden of mental health problems. Stigma, poverty, and poor availability of skilled mental health workforce have created a significant treatment gap in mental health care. Not everyone can afford traditional in-office therapy sessions. However, some do not have access to treatment for

various reasons. Many worries about the stigma of in-office treatment. This proves the need for accessible and effective treatment.

According to the Ministry of Health and Population of Nepal, approximately 15–20 percent of Nepal's population may suffer from some form of mental disorder with the leading illness being anxiety, post, and depression. Many Nepalese children are living in multidimensional poverty in terms of health, education, and living standards. Children of Nepal facing poverty are subjected to child labor, war, violence, sexual exploitation, human trafficking, and natural disasters such as earthquakes, floods, and landslides. These factors have a negative impact on child development which eventually rears its head and shows up as a mental disorder or illness down the line.

The proper establishment of social welfare has proved to be one of the barriers to the development and delivery of mental healthcare. Healthcare is expensive and most mental healthcare has to be paid out of the individual's pocket. However, in the year 2018, depression, psychosis, alcohol use disorder, and epilepsy were added to the Department of Health and Human Services' Basic Health Service Package 2075. As a result, the care and treatment of these four disorders will be provided at no cost.

There is a huge gap in access to mental healthcare which has been greatly hampered by mostly two factors (a) a lack of awareness about mental health; and (b) the prevalence of stigma. This necessitates the development and implementation of community-wide awareness-raising and anti-stigma campaigns. Moreover, in the government healthcare system, there is a lack of division and positions for mental health professionals equipped to deal with different aspects, stages, and levels of mental health illness. This necessitates the need to fill the vacancies in hospitals and the healthcare system with clinical psychologists, psychiatric nurses, psychosocial counselors, and community-based psychosocial workers.

Over the last decade, psychiatric services have seen tremendous growth. There has been an increase in the number of mental health professionals as well as the expansion of community mental health programs. The country's first child and adolescent psychiatry (CAP) unit was established under Dr. Arun Raj Kunwar in Kanti Children's Hospital in July 2015. The OPD is the only CAP service provider in Nepal. There are no inpatient facilities as of yet. Moreover, there are only two child and adolescent psychiatrists in the entire country. This indicates a severe shortage of child and adolescent mental health professionals in Nepal. In Nepal, approximately 20 Medical Colleges are currently in operation and MD programs are offered at only 14 of them. Only 12 of the 14 medical colleges offer MD Psychiatry training. Child and adolescent psychiatry services and training are extremely limited, with only a few medical schools offering them. No specialized postgraduate training in CAP is available at present times.

With a limited number of psychiatrists and professionals available to provide treatment to patients, there is a need and demand for a different way of treating and diagnosing patients. This can appear in the form of mental health and wellbeing apps to treat patients with mild mental health disorders.

1.3 Mental Health in Tech Sectors

The tech industry is known for its highly stressful environment. Work is highly demanding with difficult tasks that must be completed in a given amount of time. This results in late nights, keeping unusual hours to meet tight deadlines. Moreover, it is imperative to be available at any time of day. In this highly stressful environment, there is a much higher risk of mental illness. 51 percent of tech professionals have a mental health condition as reported by OSIM data. According to the National Alliance on Mental Illness, 19.1 percent of adults in the United States suffer from mental illness.

During the global pandemic, complexity rose in terms of completing work. 89 percent of IT professionals reported that they were under a lot of pressure at work while 84 percent found

it difficult to switch off from work while maintaining IT. Employees are leaving the highly stressful environment of the corporate world at a faster rate than ever before as a result of the emotional toll associated with mental health issues. To retain high-quality employees, it is imperative that corporations focus on the overall well-being of the employees.

In terms of mental health support and data collection, technology has ushered in a new era. Mobile devices such as feature phones, smartphones, and tablets are providing new ways for doctors and service providers to diagnose and treat patients. It has also helped the general public to seek help, track progress and gain a better overall understanding of mental health.

Users can connect with a peer counselor or a healthcare professional using smartphone mental health apps. They allow us the convenience of gaining treatment anywhere at any time. The popular apps being developed to address a range of mental health concerns are self-management apps, apps for improving thinking skills, skill-training apps, illness management, supported care, passive symptom tracking, and data collection.

1.4 Mental Health Applications

Mental Health Apps is a web or mobile app which provides mental healthcare facilities. Mental Illness and problems related to mental health are a common occurrence throughout the world, especially now due to the recent pandemic. As the number of patients in need of mental health care increases, the need for quicker and cheaper healthcare is required. To address this growing concern, digital healthcare apps have the potential to provide treatment at a decreased cost. The latest estimates suggest that between 165,000 and 325,000 health and wellness apps are now commercially available to patients, with >10,000 designed specifically for mental or behavioral health.

According to the Digital Mental Health Revolution report published by the WISH 2020 Forum on Mental Health and Digital Technologies, there are currently over 10,000 mental health apps, and nearly 100 mental health startups appear every year. The mental health apps are

designed for different age groups, demographics, and gender. Some apps like Talkspace aren't suited for children under 13 and some like BlueIce app is tailored to young people.

1.4.1 Categories of Apps in Mental Health

Globally, various techniques and approaches have been used and developed to motivate users and to take steps to help the users overcome their mental health illnesses presented and launched in the form of mental health apps. Each app targets different prospective users and is broken down into four categories. They can be categorized into:

- People with behavioral disorders
- People with mental disorders
- People suffering from mental depression
- People who appreciate mental health and want to stay mentally fit

Based on different classifications of users, it is then divided into different classes of mental health apps. They range from mental disorder apps to mental development apps. The features that are to be integrated into the system depend upon the class of the app and the identified problem of the users that the developer is trying to solve. Our proposed system falls under the latter category. Our targeted users are those who want to stay mentally fit and track their progress in terms of mood. It is not designed for users with severe mental or behavioral disorders.

Mentally healthy users who want to enhance their level of positive thinking, prevent and track mood swings, and gain important insights on common mental health-related problems will find our system complete and helpful in every way. Chatbot has been integrated to provide a friendly companion to users which acts as a built-in Psychologist.

This project was initiated to promote healthy thinking. It is aimed at lowering the barrier to seeking mental health support and tracking your mood and progress. Self-monitoring helps users monitor their stress levels, study their mood patterns, and also helps them to learn to

manage their stress in a better way. The application supplements the role of a doctor by providing an integrated analysis of the user's mood, personality, and preferences. It provides suitable guidance to the patients in terms of stress relief and management of moods. It was created to help improve the psychological state of mentally healthy people.

This project proposes a mobile app for detecting the indications of social, emotional, and mental disturbance that will be implemented by sentimental analysis. It will also provide interactive guidance on means to alleviate symptoms regarding common mental health problems. Similarly, the app provides easy access to screening tools that allow the user to make self-assessments regarding their mental health status.

1.4.2 Role of AI in Mental Health

Between 2017 and 2018, the number of adults suffering from mental illness increased by 19 percent, accounting for 1.5 million more adults than the previous year. With the recent pandemic, it is expected that the numbers will have risen significantly in the last two years. Seeking help for mental health issues has been fraught with stigma, which does not exist when seeking treatment for physical injuries or illnesses. Individuals often wait until they are in excruciating pain before taking the initiative and seeking treatment. It's worrying to consider how despite the availability of treatments, there is a significant disparity in the number of people who require and receive mental health care due to various reasons.

Given the scarcity of mental health professionals and qualified personnel to meet the needs of society and the community, as well as the stigma and discrimination associated with mental illness, we must develop a new model of service that is convenient, effective, and does not place a financial burden on individuals.

The use of AI can help ease the burden of professionals in the mental health sector in terms of the way we diagnose as well as treat patients. The use of AI allows for the early detection of

mental illnesses when interventions are more effective. Moreover, it also personalizes treatments based on an individual's unique characteristics, patterns, and habits. AI can help to integrate existing physical healthcare with mental healthcare by using machine learning algorithms to alert doctors and qualified personnel about patients at risk of developing mental health illnesses based on medical records.

Algorithms have proved in the past to be successful at detecting and identifying signs of depression and PTSD based on speech patterns and facial expressions. This can come as a handy tool for health providers who are in a rush and fail to recognize crucial signs after looking at patient’s day in and out where it is easy to miss the subtle signs of distress. These AI tools can serve as a backup and reduce human error and biases.

Language analysis can be used to track patients who are already receiving treatment and alert doctors if they take a turn for the worse before their next appointment or physical treatment. It is a handy tool to detect early signs of a problem. With mental health, it is crucial to intervene promptly before a downward trend becomes unhealthy and hard to get out of the spiral. AI tools can help in this regard by providing daily checkpoints between patients and mental health professionals.

Some applications in the mental health care field are Internet-based cognitive behavioral therapy chatbots, therapeutic computer games, electronic medical records, intelligent virtual worlds, and artificial companions. AI applications in the sector of mental health are not limited to just these few examples.

1.4.3 Digital Mental Health

Several initiatives have been launched around the world in the last decade to close the treatment gap for people with mental illnesses. One such approach toward mitigating the effects of mental health disorders is leveraging the power of digital health technology to deploy

assistive, preventative, and therapeutic solutions for people in need. Digital mental health encompasses a wide range of applications. It has been defined to be any digital health technology application that is focused on mental health assessment, support, prevention, and treatment. This goes on to include mobile health applications, wearables, consumer neuro-technologies, virtual reality systems, online platforms, care coordination systems, assisted living ecosystems, etc. Digital mental health tools are particularly consumed by young people who are early adopters of all things digital including digital health. They have been labeled as the primary end-users of the tool.

Even before the recent COVID-19 pandemic, the digital mental health sector had been rapidly expanding. However, the stress and anxiety brought on by the health crisis accelerated the demand for virtual behavioral health services. Many such digital mental health technology has been successfully launched which has allowed people to access mental wellness by putting it at our fingertips. It not only helps us to tailor it to our specific needs but also provides personalized care that is affordable and accessible.

1.4.4 Role of Smartphones in Mental Health

The current total number of mobile phone users is 7.26 billion, accounting for 91.54 percent of the world's population as of April 2022. This figure encompasses both feature phones and smartphones. According to Statista, the total number of smartphone users worldwide is now 6.648 billion, up from 3.668 billion in 2016. Currently, 83.72 percent of the world's population owns a smartphone, compared to only 49.40 percent in 2016. Between 2017 and 2022, the number of people with a smartphone increased by 49.89 percent. This number will only increase as we move forward into the digital era.

With the rise in ownership of smartphones, smartphone apps for mental health treatment offer a unique opportunity to increase not only treatment accessibility but also quality. Furthermore, for many students and professionals, mobile phones have become necessary tools that allow them to work more efficiently. Over the past few years, the demand for virtual therapy

has risen. This has been attributed to improved lifestyles and a fast-paced lifestyle. The number of mHealth apps has been rapidly increasing due to the increasing prevalence of mental health issues in students, professionals of all manner, and the employees of the tech industry, corporations, and organizations. Growing awareness of the need for mental health apps along with their benefits has propelled the virtual expansion of treatment options.

With burnout, anxiety, and depression on the rise, mental health apps are becoming more popular as a way to treat them.

1.5 Scope of Mental Health Applications

Mental health applications are gaining traction in developing countries like India. The availability of computing devices like smartphones and tablets has caused an increase in the mode of delivering mental health-related services such as consultation and diagnosis by virtual means. By 2022, the market for mental health apps is expected to reach US$ 6.2 Billion and by 2032, mental health apps are expected to be valued at US$ 30 Billion.

The Global Scope

In the wake of the pandemic, depression and anxiety have taken a heavy toll on students and professionals alike after being cooped for almost a year in highly stressful situations. With health expenditures rising and the prevalence of a weak economy in developing regions, free and cost-oriented well-being apps for mental health have been developed for use at a rapid rate.

Hundreds and millions of users have installed apps that incorporate proven techniques, such as CBT and ACT, for treating common mental health illnesses such as depression and anxiety. The popularity of these free mental health apps has caused an increase in demand for better mental health apps on the market.

In terms of platform, Android types are expected to account for 74% of the total market value in the mental health apps in the market. The apps focusing on depression and anxiety management are expected to accumulate 30% revenue through the year 2022. According to Fact.MR, the market in Asia-Pacific is likely to surge at a 26% value CAGR in a ten-year span from 2022 to 2032. Moreover, the mental health apps are expected to garner 34.4% of revenue in 2022 in North America.

Local Opportunities in Nepal

Mental health issues are a major public health concern, particularly in low- and middle-income countries like Nepal with limited resources and mental health services. The scope of delivering mental health apps through technology in a developing country like ours is immense considering how constrained we are in resources. Data from 2017 has shown that there are only 150 psychiatrists, 70 psychiatric nurses, and 28 clinical psychologists to serve 28 million people in the country. There are many indications that mental health apps may be proved useful in healthcare provisions.

The use of mental health apps in developing countries like ours can help to ease the burden on qualified personnel while limiting the geographical barriers between service receivers and providers. The use of downloadable smartphone apps and online tools can help to (a) create awareness at the base level of mental health-related problems; (b) support clinical care; (c) diagnose mental illnesses and provide solutions. Mental health apps focusing on different aspects and domains can be a useful and convenient way to deliver mental health care in Nepal where mental health is surrounded by discrimination and stigma. This creates an environment where patients don’t receive treatment for fear of being ridiculed and isolated by society and the public.

2 OBJECTIVES

Hundreds of mental health apps are already available on the market, providing easy-to-use tools to help people improve their lives. Each app focuses on a different aspect of mental health. While some are designed to help people suffering from depression, anxiety, or PTSD, others are based on positive psychology and use mindfulness and meditation to improve focus, happiness, and calmness. Before beginning work on the project, we outlined our specific set of goals, which are as follows:

- To promote healthy thinking and track the user's status and progress
- To provide insights on common mental health-related problems
- To implement Text based sentiment analysis using Deep Learning
- To provide interactive meditation exercises for stress relief
- To provide screening tools for self-assessments of mental health status
- To lower the barrier to seeking mental health support and tracking the user's mood and progress
- To integrate Chatbot in order to provide a friendly companion to users
- To promote healthy thinking in users
- To provide suitable guidance to the patients in terms of stress relief and management of moods.

3 LITERATURE REVIEW

3.1 A Comparative Study of Existing Mental Health Applications

Mental Health is a vast topic that deals with emotional and psychological well-being. The emotional and psychological status of a person determines how healthy their thought process is. People may feel different in each unit of passing time which is normal but when the same feeling of disappointment, sadness, and anxiety occurs for a long time, it affects many aspects of a human being. Entering this phase or stage is said to be mentally unhealthy which results in the emergence of multiple problems slowly reaching the surface that can be seen by others as loss of sleep, insomnia, suicidal thoughts, physically inactiveness, unhealthy eating habits, substance addiction along with other problems. In this regard, the topic of mental hygiene is as much or even more important than physical health. Due to the stigmatization of the term to cover only some disorders and high scale problems, it has resulted in less understanding of the common problems and a lack of safe, open, welcoming environment for someone suffering from mental health problems to feel accepted which in turn results in less people seeking medical attention and help and understanding of the problems that are very important in a broader perspective. In order to reach different parts of the world to make everyone aware of the importance of mental hygiene, multiple workshops are being conducted around the world along with the emergence of simple, cheaper alternatives to therapy sessions in the form of mental health apps. Due to the increasing popularity of receiving information from smart devices, many companies have taken up online platforms to publish applications on different platforms to provide basic information about mental health.

After cross-referencing applications to account for applications that are marked useful to the users with reasonable downloads from the user while also appearing in English language, five of the applications from different dimensions of mental hygiene are chosen for detailed comparison. The applications are chosen in such a way that detailed comparison between these

five applications can be used to extrapolate the condition of mental health applications in the world in a larger view as well. The five applications that are chosen are listed below.

1. Mindshift
2. Daylio
3. CBT Companion
4. What's Up?
5. Calm

Mindshift:

This mobile application is published on the Play Store by Anxiety Canada Association which mostly deals with anxiety. It defines what anxiety is and the symptoms to the users in basic. This application provides different methods for minimizing anxiety using coping cards that teach different techniques when used in real-life to help reduce anxiety. There is also a guided meditation feature for anxiety coping that takes the user through all the steps of breathing and imagination that help reduce anxiety. This application has been downloaded by 100K+ at the time of reviewing. The basic application size is 71MB.

Daylio:

Daylio is a mobile application published by Habitics that deals with mood tracking. Simply put, the application is a mood diary where a user can provide the major mood of the day along with reasons. The reasons could be the tasks performed, people met, food consumed along with others with a personal note of the day. These details are finely managed with customized charts that provide the mood details in the best understandable way with high privacy.

CBT Companion:

CBT Companion is an application that uses cognitive behavioral therapy (CBT) approaches to maintain mental hygiene. CBT Companion was published on Play Store by Resiliens, Inc. with 100K+ downloads at the time of the study. The applications deal with mental hygiene by providing CBT lessons and detailed information using video presentations. CBT Companion also consists of basic mental hygiene maintaining tools like Mood Diary, Medication Reminder, Writing Journals, Mindfulness tools, socializing importance and techniques.

What's Up?:

What's Up? is an application by Jackson Tempra which helps in maintaining mental hygiene by tracking and storing moods or feelings on a daily basis. It also consists of different mindfulness and motivating tools. Users also can maintain a personal diary and the app tracks the habit of the user and suggests if it is good or bad. This application has 500K+ user downloads.

Calm:

Calm is an application that mostly deals with mental health issues with guided meditation of numerous types which teach a detailed process of breathing and imagination to successfully perform meditation. This application includes a music section for reducing stress, anxiety, and sleep. There is also a blog page where real world therapists and doctors provide thoughts and ideas which also can be looked at as a consultation to the users about mental hygiene. This application has been downloaded by more than 10M users.

The whole feature is divided into 6 major features, they are Journal and Mood Entries, Visualization, Assessment and Screening, Medication and Exercise, and Self-Care and

Information. Journal and Mood Entries is the feature of an application that helps users by providing a platform where they could write up notes and moods of the day. Visualization features deal with visualizing all the details of the user's mood in the proper way so that we may conclude some information out of it. Assessment and Screening help users to find out what is the disease and its symptoms, then find how much the user is on the verge of being in a serious mental health problem and finally provide suggestions that could prevent that situation. Meditation and Exercise is the feature of the application through which users can perform guided step-by-step meditation and exercise to maintain their mental health. Self-Care and Information features of an application provide users with different information about mental hygiene in detail, frequently asked questions, myths, and facts in the mental health world.

Enlisting the features in rows and applications in columns, the table visualizes the features present in the application.

Table 1 Comparison of Mental Health Applications

Comparison of Applications with their features		Application				
		Mindshift	Daylio	CBT Companion	What's Up?	Calm
Features	Journal and Mood Entries	✓	✓	✓	⊗	✓
	Visualization	✓	✓	⊗	⊗	⊗
	Assessment and Screening	⊗	⊗	✓	⊗	⊗
	Meditation and Exercise	✓	⊗	✓	⊗	✓
	Self-Care and Information	✓	⊗	✓	✓	✓

The above diagram shows CBT Companion application as being the best application out of five applications taken up for research that might prove beneficial to users as almost all the features are covered in the best way possible. What's Up came out to be just an informatory application with very little to offer to users except for detailed information while Daylio, Calm, and Mindshift mostly focus on mood tracking and visualization of the user data present with minor exercises and guided meditation techniques. Thus, CBT Companion stands out amongst

all others as it also has a very detailed approach in all the features that it provides and can help users in many ways to maintain mental hygiene.

3.2 Machine Learning

Machine Learning is the field of computer science that deals with the development of intelligent machines that can learn continuously. It uses statistical methods and techniques like regression to simulate the decision making of human beings. It has the ability to learn and improve automatically by finding patterns in the large sets of data without any human involvements and instructions. The recent rise in computing power of computers has opened new doors of possibilities in the field of machine learning.

Machine learning algorithms are of various types. Based on their learning from the data sets and interactive experiences, there are three types of Machine learning algorithms: Supervised Machine Learning Algorithms, Unsupervised Machine Learning algorithms and Reinforcement Learning Algorithms.

3.2.1 Supervised Learning

Supervised Learning models are predictive machine learning techniques based on training of mathematical and statistical models upon a large set of labeled datasets. Supervised Learning is thus a class of machine learning algorithms primarily based upon the labeled data set.

Here, predictive analytics is achieved for this category of algorithms in which the result of the algorithm is the dependent variable whose value depends upon the value of independent data variables. It trains on the training datasets, and it improves its predictions through iterations.

There are principally two classes of supervised learning, corresponding to regression and classification. Supervised Learning is a widely used ML model which is applied into many real-

world scenarios, such as predicting sales reviews for successive quarters within the business for a specific product for a retail organization.

Linear Regression, Logistic Regression, Naive Bayes, Decision Trees, Support Vector Machine etc. are the examples of Supervised Learning Algorithms.

3.3 Neural Networks

Neural network is a structure that tries to mimic the operations of the human brain. It consists of a collection of units or neurons. It is a popular choice for implementing sentiment analysis and many different tasks. It can learn complex and non-linear relationships. It can generalize on the dataset and can predict the results for unseen data. It is a deep learning algorithm. Keras provides the implementation of a neural network. The neural network architecture is created using Keras with just a few lines of code. The model then needs to be compiled and trained using the training algorithm, and finally evaluated. Neural networks follow adaptive learning. They have the ability to adapt to the changing input.

3.4 Long Short-Term Memory (LSTM)

LSTM is a class of recurrent neural network that can take sequence of input data into consideration along with the actual data that is input into the system. LSTMs are therefore widely used in applications like natural language processing where the order of occurrence of the words is as important as the nature of the input words from the text. Unlike the general neural networks, LSTM has an internal state memory that can access the past states data while processing the present input data. In natural language processing, this is useful for preserving and forwarding the contextual information of past data.

3.5 Numpy

NumPy stands for Numerical Python. It is a standard data science library that consists of multidimensional array objects and a set of routines for performing complex calculations on those array objects. Utilizing the functions in NumPy, mathematical and logical operations on arrays can be performed easily in our data engineering projects. It is a cross-platform module and is originally implemented in C and C++ for faster computation. It also provides python bindings for use in python projects.

3.6 Pandas

Pandas is one of the important python libraries for data science applications and it offers a fast, powerful, versatile and straightforward way to use open supply knowledge analysis and manipulation tools, built on the premise of the Python programming language.
It's made mainly for operating with relative or labeled data each simply and intuitively. It provides varied data structures and operations for manipulating numerical data and time series. This library is made on top of the NumPy library.

Pandas allows us to read csv data from various formats, import them as dataframes, define series data, and perform high level filter operations and many more integration using numpy.

3.7 Sci-learn

Scikit-Learn is a dynamic and open-source machine learning library for Python. It supports the implementations of supervised and unsupervised machine learning, while also providing various algorithms for classification, regression, and clustering. The library is constructed with several other libraries in data science like NumPy and SciPy. It additionally plays well with multiple different libraries, such as Pandas and Seaborn.

3.8 Tensorflow

TensorFlow is one of the most popular and versatile open-source software package libraries for Machine Learning and Artificial Intelligence. It provides highly advanced and flexible APIs for implementing Machine Learning and Artificial Intelligence applications using minimal code. It is often used across a variety of tasks that encompasses a specific specialization in training and inference of deep neural networks. TensorFlow was developed by the Google Brain team for internal Google use in research, analysis, development and production. TensorFlow can be employed in a large sort of programming languages, most notably Python, furthermore as Javascript, C++, and Java. This flexibility lends itself to a variety of applications in many various sectors.

4 METHODOLOGY

4.1 Diagrams

4.1.1 Use Case Diagram

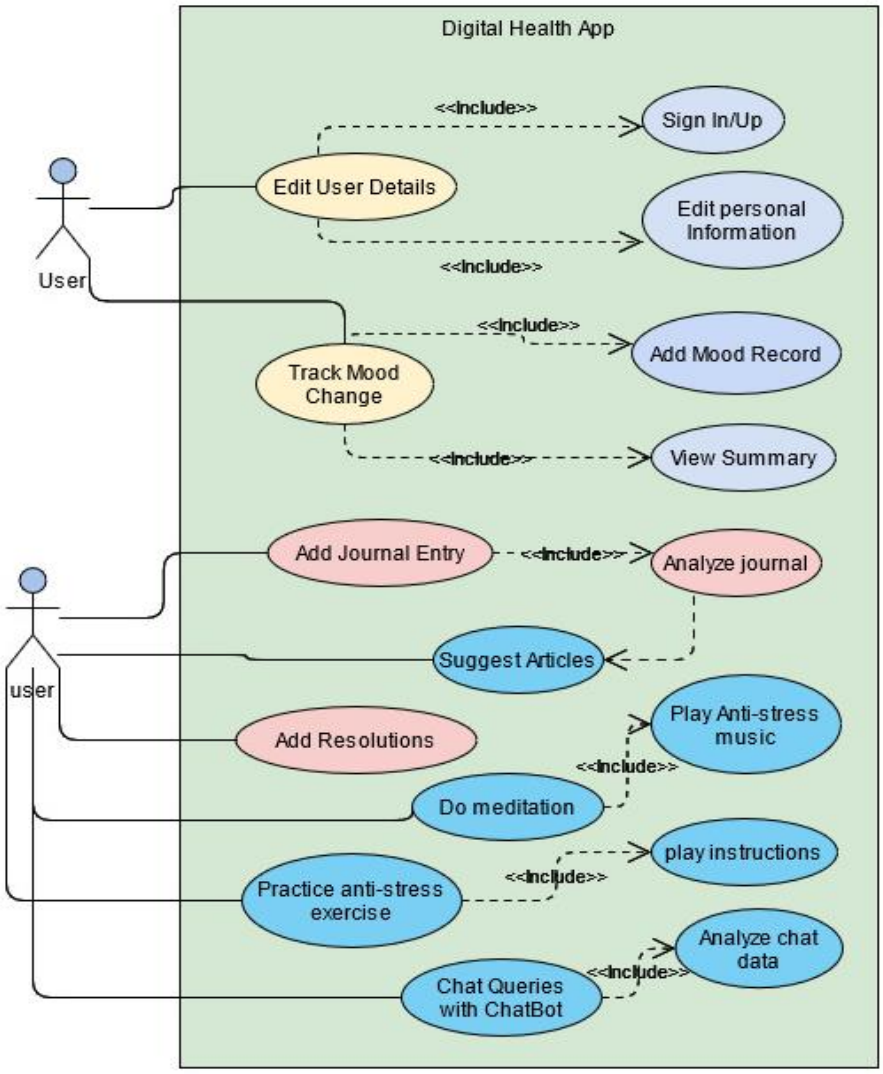


Figure 1 Use Case Diagram of Application

4.1.2 Class Diagram

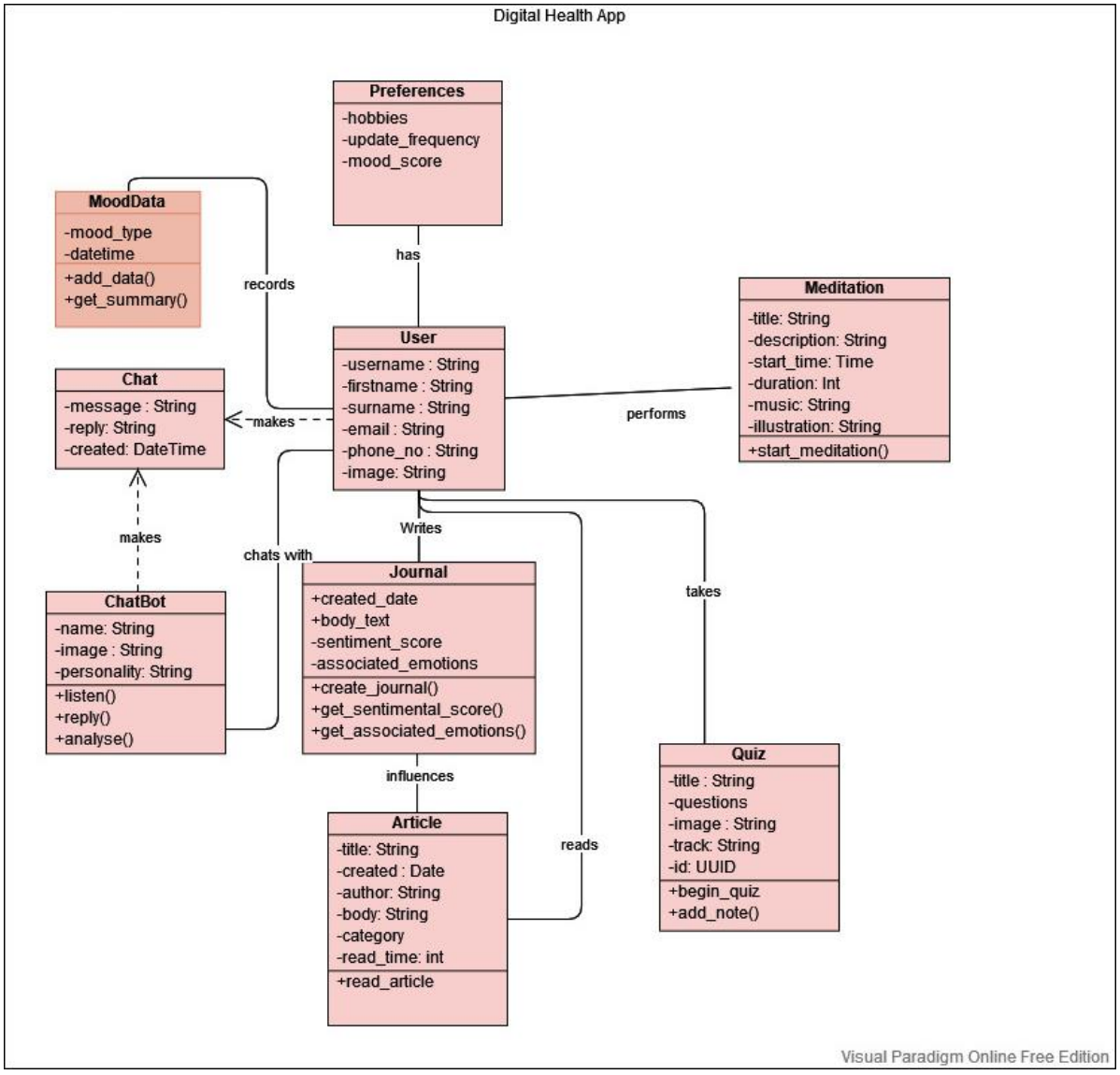


Figure 2 Class Diagram of application

4.1.3 Activity Diagram

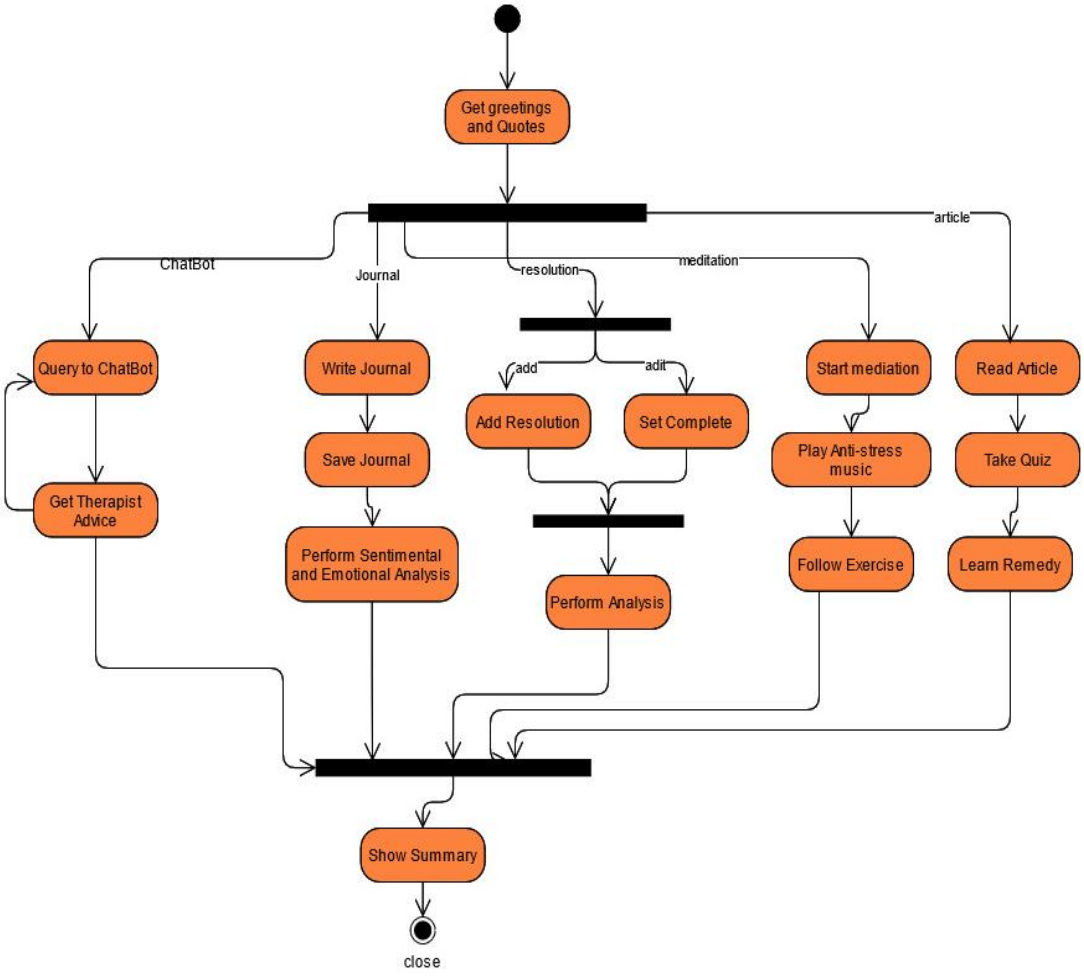


Figure 3 Activity Diagram of application

4.1.4 Deployment Diagram

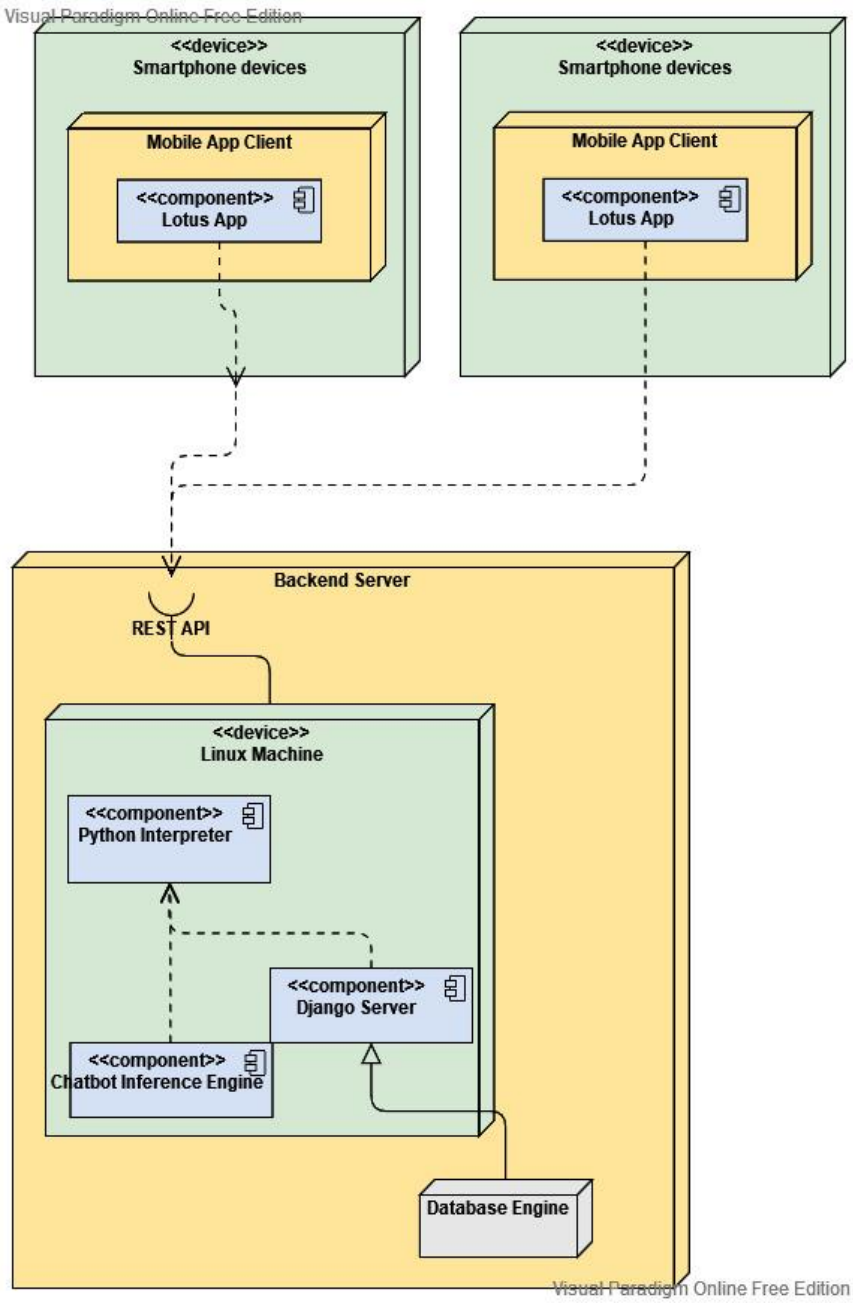


Figure 4 Deployment diagram for application

4.1.5 Flow Chart for Sentimental Analysis

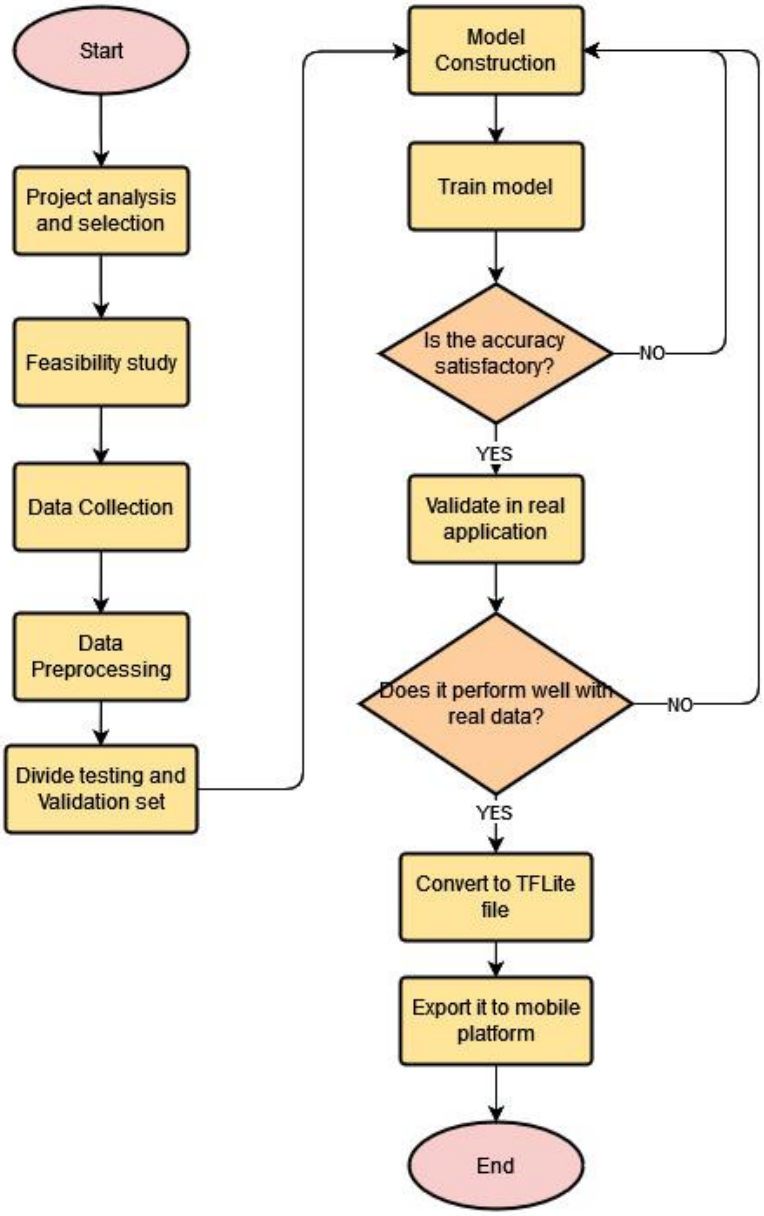


Figure 5 Flowchart for Sentimental Analysis

4.2 Iterative/ Incremental Software Development Model

The software development process used for this project was the Incremental Model. Incremental Model can be defined as a process of software system development in which project objectives are divided into multiple standalone modules of the software development cycle. During this model, every module goes through the requirements, design, implementation and testing sections. Each resultant product and results of the module adds incremental functionality and completeness to the previous release and this cycle of processes continues till the entire system achieved.

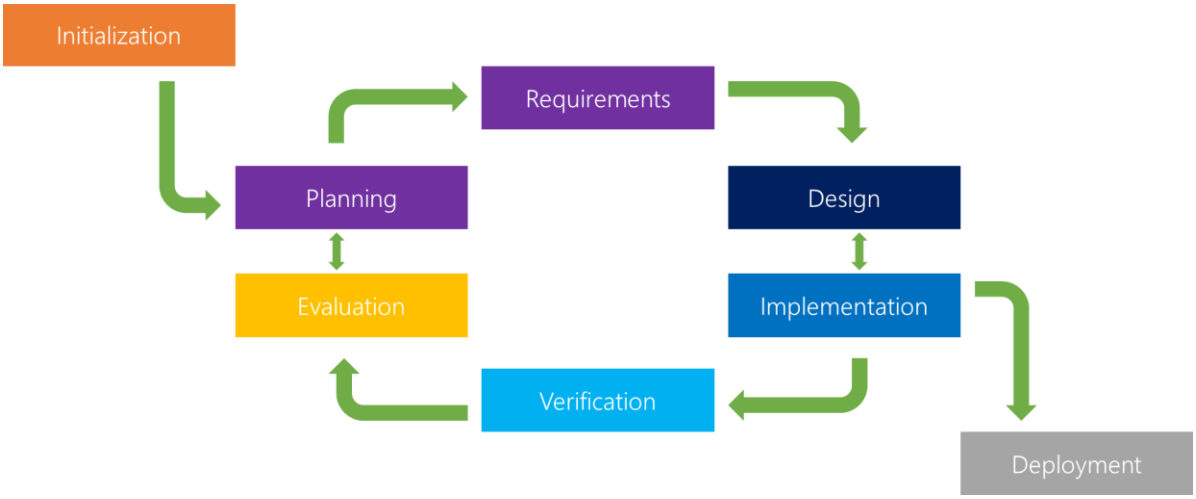


Figure 6 Incremental Software Development Model

The most common phases of this kind of model are as follows:

1. Requirement analysis: During the time of initial phase of the incremental model, the requirement analysis result identifies the requirements and therefore the system's useful requirements are understood by the requirement analysis team. To develop the software beneath the incremental model, this section performs an important role.

2. Design & Development: It is another important phase in which the phase of the incremental model of SDLC, the planning of the system practicality and therefore the development methodology are finished with success. Once a software system develops new practicality, the incremental model uses styling, designing and development phase.

3. Testing: After design and development, now within the incremental model, the testing phase checks the performance of every existing operation in addition to further functionality. Within the testing phase, the varied ways are accustomed to test the behavior of each task.

4. Implementation: Implementation phase allows the actual code writing section of the development system. It involves the ultimate coding that style within the coming up with and development phase and tests the operability in the testing phase. When completion of this phase, the outcome of our final product operation is increased and upgraded up to the final system product

4.3 Development of Sentiment Analysis Model

Sentiment Analysis is a process of finding out whether the sentence possesses positive or negative sentiment. The result can be scaled to any range but usually positive, neutral or negative are the outputs. The sentiment analysis can be used on these sentences which helps in analyzing different characteristics ranging from sentence to the person who wrote it. Thus, for our purpose this plays a vital role in analyzing user state mind from journal writing. It is a very important part of our project that performs some of the important features present in our application, so the sentiment analysis model that performs such tasks must be best performing on all terms. For our purpose, it plays a vital role in analyzing the user's state of mind from journals written by the user.

4.3.1 Data collection and preparation

IMDB movie reviews dataset is used for sentiment analysis. The dataset consists of 50,000 rows with two columns i.e. review and sentiment. Dataset is balanced as it contains 25,000 texts with positive sentiment and another 25,000 texts with negative sentiment. Stratified train-test-split is performed on the data to divide the data into train set and test set in the ratio 80%-20%. Scikit-learn and Keras API have been used for various purposes.

Data is preprocessed using regular expressions and some functions of Keras API. Texts are converted to lowercase, punctuations and numbers are removed. Tokenization is performed and a word-index mapping dictionary is created. The words and labels are encoded. The text is represented as a sequence and the sequences are padded and truncated to make them of equal length. After that, the LSTM model architecture is created. Embedding layer is used first to generate the embedding as dense vectors of fixed size. Then, hidden layers and output layers are added. Random Search is performed to search the best hyperparameters for the model including learning rate, number of neurons, and optimizers. It finds the best set of hyperparameters from the given grid of hyperparameters. Binary cross entropy loss function is used. Adam optimizer is chosen as suggested by Random Search.

Since the dataset is balanced, accuracy is used as the main metric for evaluating the model. The accuracy in the training set is 92.58% and the accuracy in the test set is 88.11%.
EarlyStopping is used to stop training when the model has stopped improving. EarlyStopping contributes to prevent overfitting. Using it, training stopped in 33 epochs. The tokenizer is saved and the model is first saved as a .h5 file and converted into tflite for use in mobile applications. The tokenizer and trained model are then used in the flutter app.

4.3.2 Model selection

Model selection is the process to select the best model among many candidates. It helps to choose the model that generalizes the best for the dataset. We trained different models using

scikit-learn and keras and chose the model that performed the best. Models are trained using a training set and evaluated with a test set using various classification algorithms and the best one is chosen.

Among the various models that were available for the implementation of sentimental analysis, the best results were obtained from the LSTM model. The various models that were considered were Naïve Bayes, Bernoulli Naïve Bayes, Simple Neural Network with Dense Layer, LSTM model, Bidirectional LSTM model and GRU model.

4.3.3 LSTM Model Design

LSTM stands for Long Short-Term Memory. It is a special kind of recurrent neural network architecture. LSTMs can deal with the vanishing gradient problems that occur when using traditional recurrent neural networks. They can be used for a wide variety of tasks including sentiment analysis. We used the Tokenizer class from Keras to tokenize the texts into tokens to convert the tokens into integer indices from the word-index dictionary. Padding and truncating is performed to make the sequences of equal length. After that, the LSTM model architecture is defined. The model consists of an Embedding layer which converts the positive integers into dense vectors. The parameters, input_dim and output_dim, are passed which are the size of the vocabulary and dimension of the dense embedding respectively. LSTM layer is used after embedding. It is then followed by dense layers. Adam optimizer and binary cross entropy loss function is used.

4.3.4 Model Tuning

Model tuning or hyperparameter tuning is the process of choosing the set of optimal hyperparameters. Hyperparameters means the parameters that are not learned from training, rather they are provided to the model before the training process begins. Data is used to learn model parameters, and hyper-parameters are tweaked to achieve the best fit. Because finding the ideal hyper-parameter can be time-consuming, search algorithms such as random search are

employed. RandomizedSearchCV class is used from the scikit-learn package for tuning the hyperparameters. Random search takes a grid of hyperparameters and uses a random set of points from that grid. Training the model on all possible parameters from the grid can be very time consuming so Random Search uses just some random set of points and still achieves good results.

4.3.5 Regularization

Regularization techniques like Dropout layer and EarlyStopping has also been used so that the model performs better in both the training and testing set, and does not overfit on the training set. The dropout layers randomly disable some of the neurons in the layer at each step during training at the rate provided as parameter. The inputs that are not disabled needs to be scaled by 1/(1-rate) so that the sum over all the inputs remain unchanged. Keras allows to stop the training early using EarlyStopping callback. EarlyStopping stops the training when the monitored metric score stops improving.

4.3.6 Model Evaluation

Model evaluation is the process of using evaluation metrics to assess the model's performance. As the dataset is balanced, accuracy has been used as the major evaluation metric. Accuracy is the ratio of the total number of correct predictions to the total number of predictions. Other metrics are also used to ensure the model performs better. Some model evaluation metrics are:

- Accuracy
- Precision
- Recall
- F1-score
- AUC score

4.3.7 Mobile and Edge Device Integration

Instead of performing all the computations in the cloud, it is possible to execute computations on mobile and edge devices. Since deep learning models are resource-intensive but edge devices have limited computational resources, the models need to be lightweight. This also reduces latency and can work offline as well without the need of Internet connectivity. Here, the power consumption is also low and it is better for privacy reasons.

TFLite Models

Tensorflow lite converts pre-trained tensorflow models into a lightweight form and optimizes for speed or storage. To make the inference, tflite models need to be installed in user's mobile devices. The sentiment analysis model is first trained with tensorflow and then the .h5 model is saved. After that, .h5 model is converted to tflite model using TFLiteConverter.

Quantization

The process of approximating a neural network that employs floating-point values by a neural network with low bit width numbers is known as quantization. The memory requirements and computing costs of employing neural networks are drastically reduced as a result of this. Quantization is a technique for reducing the size of a neural network while maintaining high performance accuracy. This is particularly critical for on-device applications, where memory and computing capacity are constrained.

4.4 Application User Interface Design

Goals of User Interface (UI)

There are some goals set which are to be achieved for a better understanding of what we are trying to communicate to the user. They are as follows:

- The application must provide security and privacy to the users.
- The application must be easy to use.
- The application must be understandable by a large number of people.
- The application must not lag or have any uncertain errors that degrade the user experience.
- The application must use colors that are easy to see and the assets used must also be informative.
- The application must be able to show the summarized view of all information it has stored.

Design of Good UI

While designing a perfect user interface for users, we tried to follow principles of designing a good User Interface and they are:

- User Familiarity: User familiarity means how much the user is familiar with the overall application. For that we have used a simple landing page with navigation bar in the bottom with application logo in top bar which is a familiar rule of designing user interface for mobile application. The navigation bar in the bottom helps users to navigate through all pages in a single tap.
- Consistency: Consistency means every screen must be designed with consistent variables. We in our application have used the same font, font size, background color and text color for headings, paragraph for overall consistency.

- Minimal Surprise: We have incorporated minimal surprise by providing each and every information about implications of the button and taps they are performing using alert box and informative buttons with appropriate colors.
- Recoverability: The error handling is being performed in each step so the user can recover from any mistakes they perform. Whenever error occurs the user is informed in detail about the user and effects of it in the application and data of the user.
- User Guidance: The application is designed in such a way that the user can know in detail about what the application is about, what each and every button does, what taps does, where to go for what reasons.
- User Diversity: The application uses both image and text to explain the information present such that diverse users can understand and use the application without any problem.

4.4.1 User Analysis

Users are a very important aspect of any application. They play a vital role in improving the product and thus, they must be analyzed. User analysis is a critical part of any project so, we have also performed certain analysis of the domain of users that are going to use the application and what they expect from us. As our topic deals with mental hygiene, so every person can relate to the topic and we feel they must know about it for improving and understanding their mindset. So, we have tried to incorporate every type of information to users from basics of mental hygiene to very useful and complex screening and self-assessment techniques. We have also provided chatbot and journal writing just to assist those people that have little knowledge about the topic and are trying to understand it in detail.

On the other perspective our application also assists therapists. Therapists may use this application as a base for information they require about their client and easily. All information about users' day to day moods to screening tests are summarized in a single screen which a

therapist can use to understand the situation of his client in more detail. Licensed therapists can also register themselves in the list such that they are suggested in our nearby therapist page.

The application is designed in a way that it helps all the people ranging from normal people for day to day use and maintaining their mental health using different features of our application to specialists who may take the information about the user in the application to understand the complex mental health issues in a more detailed and diverse way.

4.4.2 Sketches and Wire framing

Before starting the actual process of writing code using the programming language, the ideas must be visualized and analyzed. This can be done with the help of wireframes that represent the barebones structure of the application. It also highlights the core features of the application that need to be implemented.

During our development process, we used Figma as our preferred tool for shaping out our core ideas and defining the language for the application user interface. We used Figma to create all the screens in detail. The screens designed in Figma are listed below:

Figure 7 Wire framing of Onboarding screens

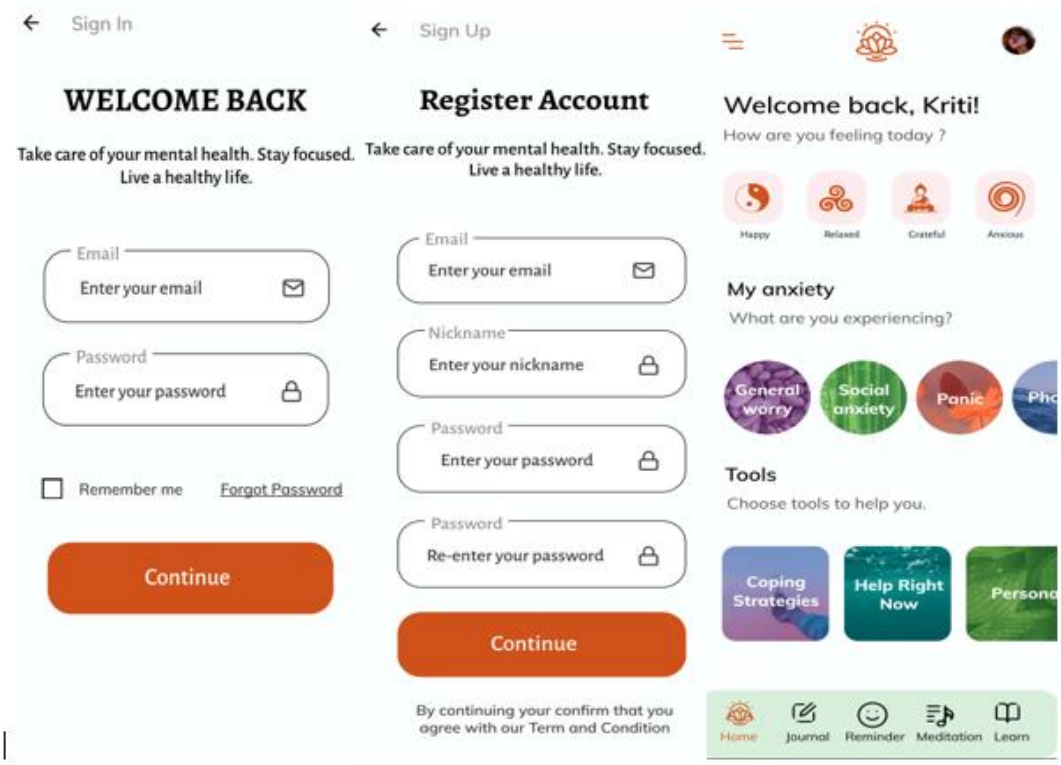


Figure 8 Figma design for Sign up screens and Home screens

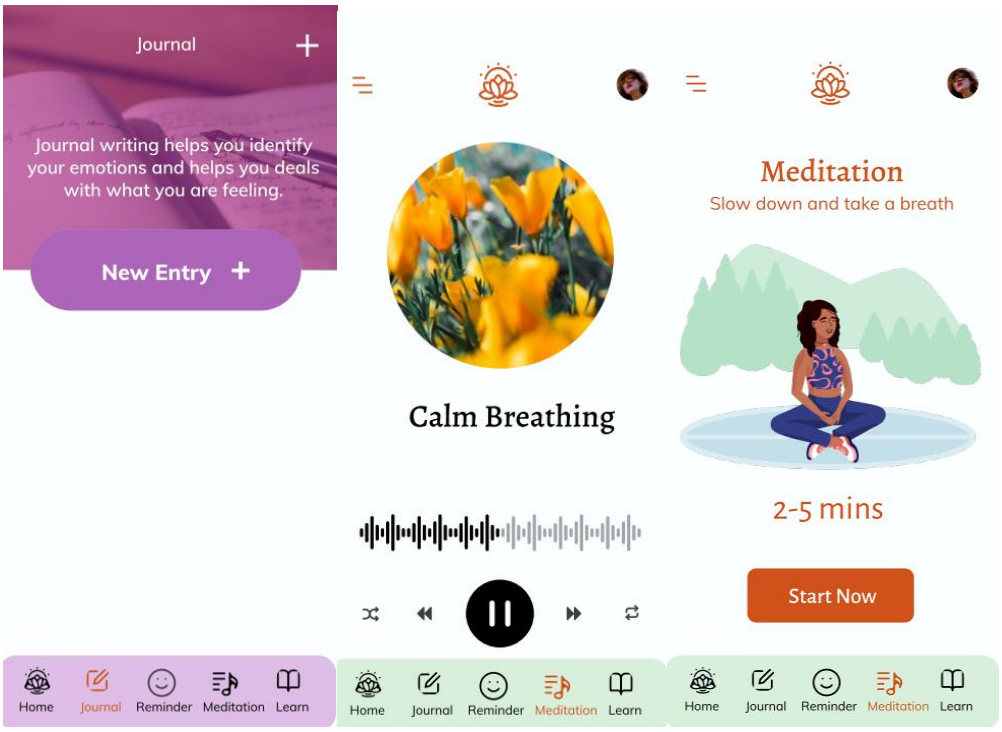


Figure 9 Application Screens for journal, music and mediation

4.4.3 Prototyping Using Figma and Adobe XD

Figma is a web-based graphics designing application where we can design user interfaces in the easiest way possible. In simple words, it is a user interface designing, prototyping and wireframing tool. Figma provides us three free projects to create where we can design our user interface. It is used to design all types of user interface ranging from complex web designs of different sizes to mobile application design of any difficulty. The fact that Figma can be used online without any extra licensing and installation makes it more portable, cross platform and easily accessible and shareable throughout the globe.

Adobe XD is a software that helps in user interface designing. This software needs licensing and proper installation before we can use its features. But the features provided by Adobe XD are more than other such platforms comparatively. It is known to be the best amongst

its competitors. Adobe, a renowned company for designing and editing applications have developed Adobe XD to assist user interface design, prototyping and wireframing of any difficulty. It can be used to design collaboratively and delivers different time-saving tools and workflow management for collaborative designing and wireframing.

4.4.4 Implementation of Design

Flutter is an open-source framework developed by Google for creating cross platform apps from a single codebase. Flutter is implemented in dart programming language. It enables development of UI elements declaratively as a tree of widgets.

After designing a simple mobile application in Figma, we then tried to implement those designs in Flutter. For the Flutter designing process, we started by just implementing the finalized design with basic widgets provided by Flutter without any navigation and integration which also means with dummy data and data models. The design implementation phase in detail was just aligning assets, placing buttons in the right place, managing the space in the best way possible. The straight implementation of the design was performed rapidly and completed in a very short period of time. After creation of all the pages required in Flutter according to the designs, we then shifted our focus to the navigation part. Navigation from one page to another is the most crucial part in creating a beautiful user experience. User experience deals with how users interact with the application which must be efficient and easy for the application to be good. Thus, this process took some amount of time, as we prepared a navigation bar in the bottom of the application from which a user can navigate to all the important features of our application. We also added a floating action button from which a user can directly move to the chat section in the application which happens to be the main feature of our application. Then, we also added secondary navigation from one page to another so that things are connected and be reached with ease when required.

Finally, the most time was spent on integrating our application with the backend. The main features that needed to be implemented from backend to our mobile application was user login, user register, user update and changing password. The application was successfully integrated such that a user can now login with required credentials through the application and get back the token which is then used for other information fetching. The token provided by the backend were of two types, one is access token and the other refresh token. Access token provided by the backend ensures access to the information stored in the backend while refresh token is used to refresh the access token after it expires. All these procedures were successfully performed as a part of login integration. Similarly, registration, changing password and user update was also performed similar to login.

As our backend contained data for the music feature of our application, we then integrated the music player of the application with the data present in the backend. The main problem in doing that integration was that the music player would only fetch and load the music from a secured http location but we firstly failed to do so, providing many errors related to its which was solved later. Then, music player integration was also performed successfully. Finally, all the information about mental health like anxiety, stress and many more with myths and facts page was also integrated with the application so that it can be viewed in the best way possible and users get benefitted from it. The following are the major topics that we have performed during the application development.

User Navigations

Users can navigate from one screen to another using the bottom navigation bar. The bottom navigation bar contains five major screens of our application listed with their relatable icons. The five major screens of the application are Home, Journal Writing, Mood Diary, Meditation and Profile. Users can traverse from one screen to another with a simple tap. Furthermore, navigations are also inbuilt in different submit buttons to traverse from one screen to other which present results of the previous screen.

Journal Writer

Journal Writer is the main feature of our application. Journal writing is the method of self-dialogue, most important for self-analysis. While writing up the experiences of life, the honest assessment of the situation and reaction is done. This allows people to understand self through positive and negative situations they face in their day-to-day life. Journal Writing helps in improving creativity and problem-solving skills. The writing up also helps in finding out patterns in our behavior in similar conditions and improvement measures we can perform next time the same situation occurs. The patterns also help in determining fears and problems then find measures to mitigate it. Journal writing basically helps in getting back to normal after a chaotic day. These all benefits of journal writing helps in mental well-being of the people. Our app focuses on writing journals day to day for all these benefits and moreover uses sentimental analysis to maintain a mood chart.

The sentimental analysis takes the journal writing of a person as an input then finds out the related sentiments as a score between 0 to 1, 1 being very positive and 0 very negative. Thus, these sentiment scores are stored and visualized in the sentiment chart. The sentiment chart uses these recorded data in order to draw a line chart with appropriate levels and allows the users to view the curves of the progress at a glance.

The journal writing page firstly has a list of all the journals they have written and their sentiment measures where users can tap and view each of them in detail and may edit, delete it as well. For new journal writing there is a floating action button in the same page with plus icon which when pressed routes to journal writing screen. Journal writing screen contains a tab bar with a save button to save the written journal. Beneath the app bar contains a huge text box where users can write up their journal and save it.

Chatbot Integration

Chatbot is another feature in our application where we provide a platform for users to communicate about their day-to-day bits and pieces to a bot that consoles them and provides minimal suggestions. The motive of this feature in our application is to make people deal with isolation by communicating to a bot that replies similar to humans. The day-to-day problems in users' life which they want to express and don’t have courage to do with real humans, they may communicate with the integrated chatbot.

Chatbot has a simple user interface design where there is a user's message on the right side and chatbot message on the left side. There is a message input box in the bottom with send button which when pressed sends the message to bot and bot reply is shown in the screen above. The message is sent to an API provided by the backend service of this application which requires a token of the user to authorize the user and message. Then, a reply message is sent if every parameter is verified.

Mood Recorder

Mood Recorder is the feature that records the mood of the user. There is a list of emotions that they may be feeling while they open up the application where the user may tap and confirm the entry for his current mood to be recorded. This allows the user to save their moods and feelings effortlessly and summarizes the results over the recent period using a pie-chart and line chart. These mood charts summarize mood entries and make the process of reporting and reviewing convenient for every user. Moreover, it can highlight unusual swings in moods.

Meditation

Meditation is a very important aspect in mental hygiene. Different studies in mental hygiene relation with meditation have found that meditation can play a big part in improving

mental health of a person drastically. Meditation feature in our application deals with providing users a basic day to day mental hygiene improving platform. It provides users a list of audio commands with soothing background that are to be followed in order to perform meditation. There are different types of meditation audios ranging from short minor anxiety tackling meditation to long improving mediations.

Relaxation Music

Relaxing music is one of the features of our application that can help the body to break free of existing stress. Relaxing music can be meditation music or natural sounds. Such type of music can promote relaxation of tense muscles, enabling users to easily release the tension from a stressful day. Once users relax their muscles and loosen up their body, their mind additionally relaxes, which may assist you to decrease lots of tension and stress that they might not have realized carrying.

4.4.5 Visualization of Data

Data visualization is the illustration of information through use of common graphics, like charts, plots, info graphics, and even animations. These visual displays of data communicate complicated data relationships and data-driven insights in a very means that's simple to understand.

Information visualization is used for a spread of purposes, and it’s vital to notice that it is not solely reserved to be used by data teams.

Sentiment Visualization

The sentimental score data that were obtained from the user’s journal entries were visualized by using a line chart. Additionally, we drew the lines that correspond to curves for individual scores, an average data line, and the baseline that separates out warning levels.

Mood Records and Summary

For the purpose of making the mood data easily visible and understandable, we have implemented a bar chart that summarizes the latest mood record data. Additionally different color schemes are used to distinguish between various mood categories. Finally, the mood summary shows the proportion of each mood data that was reported by the user over a certain period of time.

Bar chart comparison

For self-assessment and evaluation tools like the screening tools, we integrated a comparison tool that can show the details of how users are progressing towards better or worse conditions. This can actually point out the topics that a user should focus on more often.

4.5 Screening Tools Implementation

Our application incorporates some of the important screening tools for the frequently encountered mental health issues that are fundamentally based upon open source and widely accepted questionnaires.

Screening is a self-assessment tool that can be applied to detect the presence of mental conditions at its very early stage. It provides the users with a set of questionnaires evaluation of which can detect the possible traits of mental disorders in the user. By incorporating some of the best recognized and globally accepted screening tools of the psychiatric society, we incorporated self-administered screening of common mental disorders such as depression, anxiety disorder, stress and burnout. This allows users to continuously monitor their mental health status and make necessary amends for better health conditions.

The four primary screening tools that are implemented into our application are as follows.

4.5.1 Patient Health Questionnaire (PHQ-9)

It is a self-administered model for self-assessment and diagnostic tool for common mental health disorders. It analyzes the depressive symptoms that a patient may be experiencing to predict the depression severity.

Result interpretation:

The table that is shown below describes the 4 severity stages and their clinical recommendations:

Table 2 PHQ Interpretation

Score	Level of Severity	Suggested Recommendations
0 to 4	None	No specific recommendations
5 to 9	Mild	Monitoring symptoms
10 to 19	Moderate	Referring for treatment
20 to 27	Severe	Starting treatment and monitoring

Here, the cut off values are placed at 5, 10 and 20 points in which the score values that are above 10 are considered to indicate moderate to severe depression.

4.5.2 Generalized Anxiety Disorder (GAD 7)

The GAD is another self-administered mental health evaluation tool that is aimed at anxiety severity. It uses a list of questionnaires that can be given to patients. It can be used to assess the severity of some of the most common anxious disorder symptoms.

Interpretation:

The table that is given below describes the scores along with their interpretation and suggested recommendation:

Table 3 GAD Interpretations

Scores	Interpretation	Suggested Recommendations
0 to 4	No or little anxiety	Common symptoms but needs to continue to be monitored if there are still suspicions. Also, follow up GAD assessment can be performed in 2 weeks.
5 to 9	Mild anxiety disorder	Patient monitoring must be initiated.
10 to 14	Moderate anxiety disorder	The patient needs to be tested with various other quantitative and qualitative measures of psychological testing.
15 to 21	Severe anxiety disorder	Treatment should be initiated if it hasn't been already.

4.5.3 Perceived Stress Scale (PSS)

The Perceived Stress Scale score can be evaluated by summing the points given to the ten items and it ranges from 0 to 40 where:

Table 4 PSS Interpretation

Score	Interpretation
0 to 13	Low Stress
14 to 26	Moderate Stress
27 to 40	High Perceived Stress

4.5.4 Oldenburg Burnout Inventory (OLBI)

The OLBI is another self-administered and widely accepted tool developed as to burnout that contain statements that cover both ends of the exhaustion-vigor and cynicism-dedication transition series. This inventory tool is extensively being used in the field of research to measure job and academic burnout. It can also help users to assess their burnout severity based on their exhaustion and also the disengagement statements.

The total result of the OLBI score can be calculated by summing the results of two of the sub-totals. The interpretation for the test is based as the higher the score total, the greater will be the level of burnout. Some therapists can also categorize the OLBI scores under low, medium or high.

4.5.5 Big Five Personality Test

The application also supports self-report tests of one's personality by using the big 5 personality test. The big 5 personality traits are the most effectively accepted and most typically used model of personality test in educational psychology. This technique attempts to explain about a user's personality based on five traits: extraversion, neuroticism, agreeableness, conscientiousness and openness to experience. It evaluates these traits using a lot of a person's answers to the predefined questionnaires.

4.6 Core Application Logic Implementation

These consist of the application programs and codes that run behind the user interface and are responsible for the way our application works and the services it provides. The core application features in our application are as follows.

Data Persistence

Persistent data refers to the data that can be thought of as being stored permanently at rest with the incoming and outgoing of the data through software systems and devices.
It is the information that is set and can be recovered from whether in flash or memory back up. With the availability of persistent data, there is a confidence that changes will not be lost and the information is on the market later.
Thus, it is something that goes to a relational or NoSQL database system for future access.

Shared Preferences

Shared Preferences is one of the methods that is used in order to store and retrieve tiny amounts of primitive information as a key/value pair to a file on the device storage. Shared Preferences is logically equivalent to a wordbook or a key/value pair.

Our application uses the Shared Preferences package in order to remember the user's priorities and saved settings.

For storing the user preferences and setting data, we utilized the Shared Preferences package. Shared Preferences enables the developer to store and get back precise and non-repetitive data in a private file using a key-value pair. Though it does not scale up for storing tables of data, we found it per formant and perfectly suited for storing user data and applications states like settings data.

SQLite Database

SQLite is a lightweight and in-memory relational database that supports most SQL syntaxes and operations. Applications can use SQLite as the database to handle storage needs in smartphones and edge devices. SQLite APIs in flutter is provided by the SQflite plugin.

Our application generates various user data which needs to be stored and retrieved by utility applications to ensure smooth running of applications and enhance the user experience while using the app. We researched the SQL and No-SQL database technologies available on the platform for meeting the data persistence requirements of our application.

During our first iteration, we implemented a relational database using SQLite for storing data from the repetitive data sources like the journal entries and user resolutions. Using SQflite package from flutter community allowed us to implement our database tables and perform query operations on them using raw SQL.

However, this method didn't prove out to be capable of scaling up as the volume of data queries increased. Also, the use of raw SQL created rooms for SQL errors and faults. It also lacked proper higher-level functionalities that would be required for database migrations and watching database changes.

So, we switched to Drift, another package from flutter community which provides a higher-level wrapper around the SQLite database.

ORM - Drift

ORM refers to the Object Relational Manager. ORM allows developers to map the database query object into data objects in the programming language.

Our application uses Drift as the ORM over SQLite database under the hood. Drift allowed us to write easier and faster database queries without having to deal with raw SQL. Moreover, Drift also provides functionalities for watching database changes and streaming query results.

State Management

State Management is an important aspect of any application. State Management is required to ensure that the UI is consistent with the data that it represents and to ensure consistency between the several business UI components that can be scattered across multiple screens within our application but are dependent on a common data source. These pieces of data that define the exact status of an application at a given moment are called application states.

Local State Management

While for building simpler applications that consist of fewer UI components, flutter provides Stateful Widgets which can handle the state changes within a single widget. As a result, we started with this basic state management approach for updating our application UI whenever the application logic states changes.

Global State Management

However, as we began to implement newer features into the application and add more and more screens, we soon realized that handling the application state just with basic Stateful Widgets was not only tiresome but also inefficient regarding error handling and making updates.

So, we added the Provider package into the list of our application dependencies. Provider provides a simple mechanism for accessing the state of our application that is stored at the top of our widget tree and accessing them from any widgets below in the widget tree. This helps to pass and access the reference to the global objects like the database repository, login and authentication status, and connectivity states of the application from any of the widgets in the branches without worrying about consistency or drilling of the props data. It also enables us to easily debug our application as the important state objects are separated from the UI elements.

Eventually as the number of stores for recording application states grew in number, we opted towards using package Riverpod for state management which builds upon the functionalities of the provider, enabling shorter syntax and removing dependency on build context.

4.7 Application Backend and API development

Our application requires various services from the internet like authorization, data fetching and data backups. For this purpose, we implemented and deployed a Django server to implement these services through REST APIs. Then from our application, we consume these services using the http module that handles the http requests to the server and fetches the required data reliably.

User Authentication

JWT(JSON Web Token) authentication is used for authenticating users. Authentication helps to verify that the user is who they claim themselves to be. Users can login by entering their username or email address and password. Django provides a User model which has been customized to meet our requirements. The necessary adjustments to the User model have been made by inheriting the AbstractUser class provided by Django. Users need to register to the app by providing their details. The email address and encrypted password is saved in the database which will be required for authentication and authorization. Not all the resources can be accessed by all users as role-based access control has been implemented. When users enter an email address and password to login, a token is generated as a response if the credentials provided by the user are correct. That token will be used in the subsequent requests. The token has an expiry time. When it expires, a new token needs to be generated.

REST API

REST API is necessary for creating, updating, deleting and retrieving resources from the web server over HTTP. Django Rest Framework is a package built on Django and is used to create REST API. It is considered as the best choice for creating Web APIs when working with Django web framework. Different endpoints are created for several different resources. The framework also provides the browsable API which makes it easier to test and create requests during development.

Backend Architecture:

As mentioned earlier, backend has been implemented with Django web framework and sqlite database is used. Object Relational Mapping helps to query and manipulate databases in a pythonic way. The project consists of multiple django apps. Separate apps have been created for user, audio, chatbot, information and the likes in order to achieve low coupling and high

cohesion. The secret keys have been managed properly with the environment variables. The backend API has been deployed in Azure App service.

When the user tries to create or access any resource from the backend server, the flutter application sends the corresponding requests over HTTP to the web server. The server checks if the user has permissions to access the resource and then serves the response to the authorized user. Backend consists of APIs to simplify the presentation of information.

4.8 Implementation of Therapist Chatbot AI

The main task of the bot is to talk with the users like a human being and listen to their problems, interact, console them and provide some suggestions to a minor extent. For the chatbot, we had used the simple transformers library to use the Conversational AI model. Conversational AI model is the model that performs natural language based conversation tasks with input of its type and variations in personality of how the bot talks and handles messages. Conversational AI understands the language more nicely than simple deep learning chatbots that perform only the task they are given and nothing more. Also, it has been trained using a very large dataset and can be fine-tuned with other datasets. Hence, because of all these benefits we had chosen Conversational AI for chatbots. The following processes were performed to accomplish the task of building a conversational chatbot.

Collection of Data:

After intensive research about chatbot using different deep learning techniques, we came to the conclusion that the better one for our purpose would be personachat using and thus we started finding the resources to use to create a chatbot. It was found that there are many pretrained models for personachat using Generative Pre-trained Transformer (GPT) and as per our analysis using pretrained model would help our main motive as we require a chatbot but don’t have large resources to train it so much that it provides nearly perfect results. Thus, we

selected one pretrained model and used a simple transformer library to use that pretrained model for general chatbot conversation. General conversation was satisfactory enough for its use. But when asked about mental hygiene related questions it started returning gibberish output. So, we started finding dataset for fine-tuning the model with mental hygiene related.

After much research we found counselchat.com, which is a website that helps therapists connect with those in problems through a website and patients can ask their problems out which would then be dealt with by a therapist. Therapists try to help them to get out of the problem. Thus, this site had a feature of storing the conversation data between patient and therapist with their consent. The data was being used by Nicolas Bertagnolli to find out many different conclusions about the conversation between therapist and patient and had posted his article on his outcome in towardsdatascience.com in detail. There we found out the required data in required format for training our chatbot according to our requirement. The dataset consisted of 1839 cases where each case contained utterances, personality, candidates and history where utterances determine the scenario of what chat data it is from with history determining what is the context of this text and candidates represent candidate responses.

Implementation, Verification and Validation:

After this, we came to fine tuning the model which has already been trained on a large dataset is the best option. Firstly, we tried performing fine tuning process in Google Colab but it wasn't satisfactory as the resources provided by Google Colab was not successful enough for satisfactory result. Due to the resource constraints, training the chatbot was possible only utilizing a very small dataset and that too would be too time consuming. So we halted the fine tuning of conversational AI chatbot and tried to implement a simple chatbot implementing seq2seq architecture.

Seq2seq model:

Sequence to Sequence (seq2seq) models is a special class of RNN architectures used for machine translation, text summarization, chatbot, etc. This model is used for sequence-based problems where inputs and outputs have different sizes.

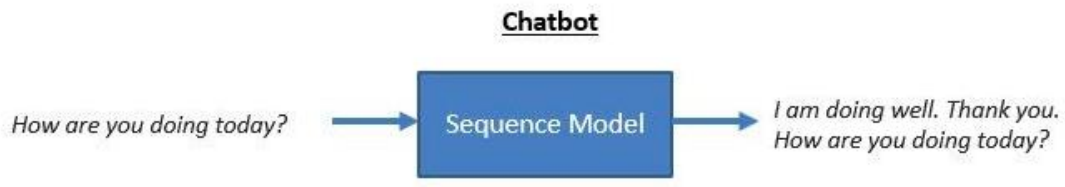


Figure 10 Seq2seq chatbot model

The encoder processes the input sequence and tries to understand, and the information about the input sequence into a context vector, which is a fixed length vector. Context vector encapsulates the meaning of input and it helps decoder in making predictions. This context vector is passed to the decoder. The decoder predicts the output sequence token by token.

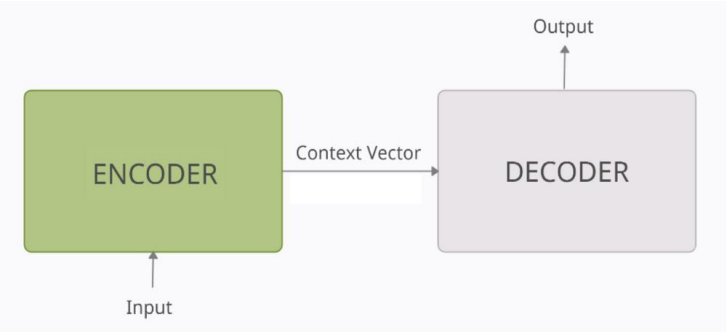


Figure 11 Seq2seq model

Keras API was used to build the model architecture and train the model. The data was first preprocessed and cleaned after which the word-index mapping was created and the texts were converted into sequences and fed to the model. Training was performed for around 200

epochs after which the model accuracy was quite satisfactory on the training set but it performed poorly in new dataset. The problem was this chatbot also had to be trained with small number of conversations due to the resource constraints and it over fitted and hence could not deliver good results. Due to poor output, this model was also discarded.

Finally, we decided to perform the fine tuning of conversational AI chatbot using Microsoft Azure, while previously we had tried training in Google colab free subscription and local machine. Now it's possible to train the model using a larger dataset than what was possible previously and also it is taking comparatively less time to train.

Figure 12 Training of chatbot

The model is saved after each training epoch and we have used the model for which the running loss is minimum.

Initially, we loaded the simple transformer Conversational AI with the gpt_personachat model type which was previously initialized for a better performance. Later, gpt_personachat_cache was replaced with a new model for utilizing the new model.

```
# Single interaction
history = [
    "Hello, what's your name?",
    "My name is Dr. Gilbert",

]

response, history = model.interact_single(
    "I am feeling sad.",
    history,
    personality=personality
)
```

```
response
```

```
'why is that? what is wrong?'
```

Figure 13 Single Prediction using Conversational AI

```
>>> hi
hello! i'm geralt. i am a therapist.
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
>>> i am feeling sad
why are you sad? i'm sure it is not your fault.
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
>>> i lost a game
what do you play? i'm a therapist.
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
>>> chess
i play a lot of chess. do you like to play?
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
>>> yes
i love to play too. i've a good therapist.
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
>>> what should i do then?
i'm a therapist. i'm trying to get to know you better.
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
>>> i know
what is your favorite thing to do?
[[3569], [3570, 267, 249, 256, 258, 2273, 25950, 239, 2
```

Figure 14 Complete Conversation with Chatbot

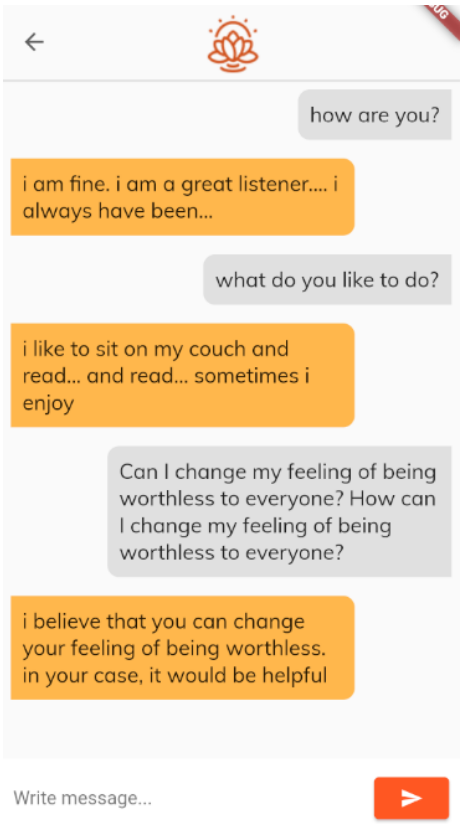


Figure 15 Chatbot Integration into mobile app

The chatbot has been deployed with the rest of the backend in Azure app service.

4. RESULT AND DISCUSSION

Sentiment analysis using LSTM:

The application implemented a deep learning model using LSTM and trained the model using supervised learning on the labelled IMDB movie reviews datasets to classify the sentiment of the text into two categories which are positive and negative. The dataset consisted of 50,000 rows and it was processed to get the dataset with two columns i.e. review and sentiment. Dataset was balanced as it contains 25,000 texts with positive sentiment and another 25,000 texts with negative sentiment. Stratified train-test-split was performed on the data to divide the data into train set and test set in the ratio 80%-20%.

Data preprocessing was performed where the text was converted to lowercase, punctuations were removed, html tags were identified using regular expression and replaced, special characters were removed, the short forms of English grammar were replaced with the proper full forms and finally the stop words were removed to generate clean and filtered sentences from the original review data.

Tokenization is the process of encoding the words from the sentences into a proper numerical or vector form to be understood and processed by the neural network. Then, tokenization was performed and a word-index mapping dictionary was created. The words and labels were encoded. The text was represented as a sequence of encoded numbers and the sequences were padded and truncated to make them of desired equal length to be fed as the input to the neural network.

After that, The LSTM model architecture was created. Keras API was used with tensorflow backend to build a model. Embedding layer was used first to generate the embedding as dense vectors of fixed size. Then, hidden layers and output layers were added. Random Search

was performed to search the best hyper parameters for the model. Binary cross entropy loss function and adam optimizer were used.

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, None, 128)         256000

 lstm (LSTM)                 (None, 50)                35800

 dense (Dense)               (None, 105)               5355

 dropout (Dropout)           (None, 105)               0

 dense_1 (Dense)             (None, 50)                5300

 dropout_1 (Dropout)         (None, 50)                0

 dense_2 (Dense)             (None, 40)                2040

 dropout_2 (Dropout)         (None, 40)                0

 dense_3 (Dense)             (None, 1)                 41

=================================================================
Total params: 304,536
Trainable params: 304,536
Non-trainable params: 0
_________________________________________________________________
```

Figure 16 LSTM Sequential model summary

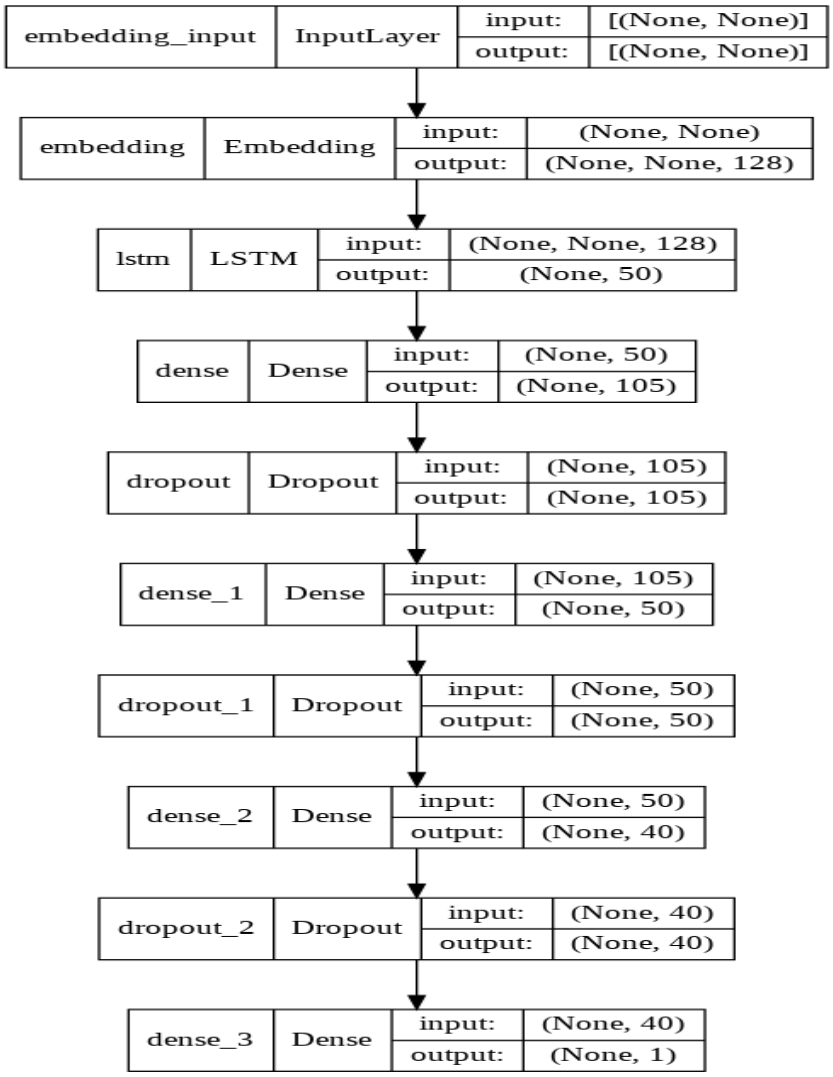


Figure 17 Model plot

Since the dataset was balanced, accuracy was used as the main metric for evaluating the model. The accuracy in the training set was 92.58% and the accuracy in the test set was 88.11%.

Figure 18 Accuracy and loss of model after each training epoch

	Positive	Negative	
Positive	True Positive 18060	False Negative 1940	Sensitivity 0.903
Negative	False Positive 1028	True Negative 18972	Specificity 0.9486
	Precision 0.9461	Negative Predictive Value 0.9072	Accuracy 0.9258

Figure 19 Confusion matrix for training set

	Positive	Negative	
Positive	True Positive 4375	False Negative 625	Sensitivity 0.875
Negative	False Positive 564	True Negative 4436	Specificity 0.8872
	Precision 0.8858	Negative Predictive Value 0.8765	Accuracy 0.8811

Figure 20 Confusion matrix for test set

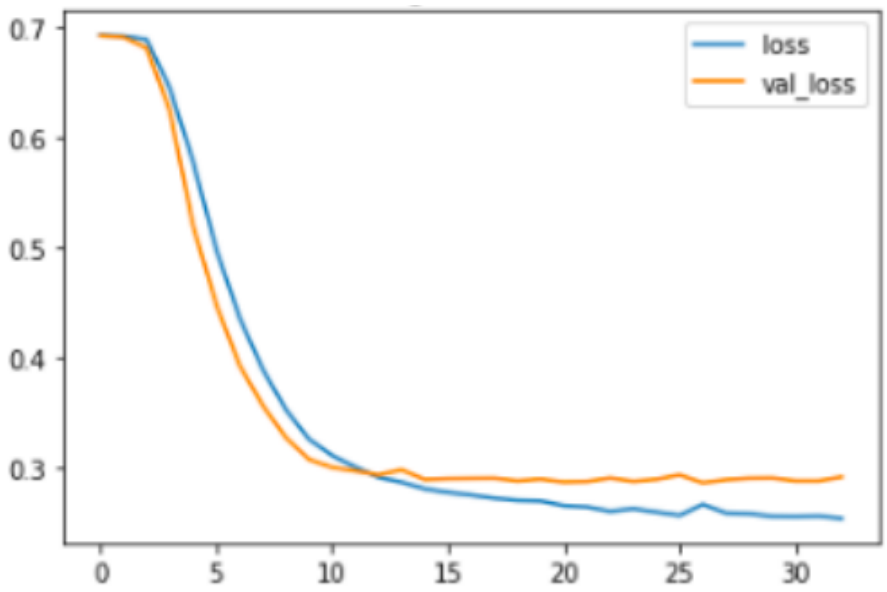


Figure 21 Training loss vs Validation loss

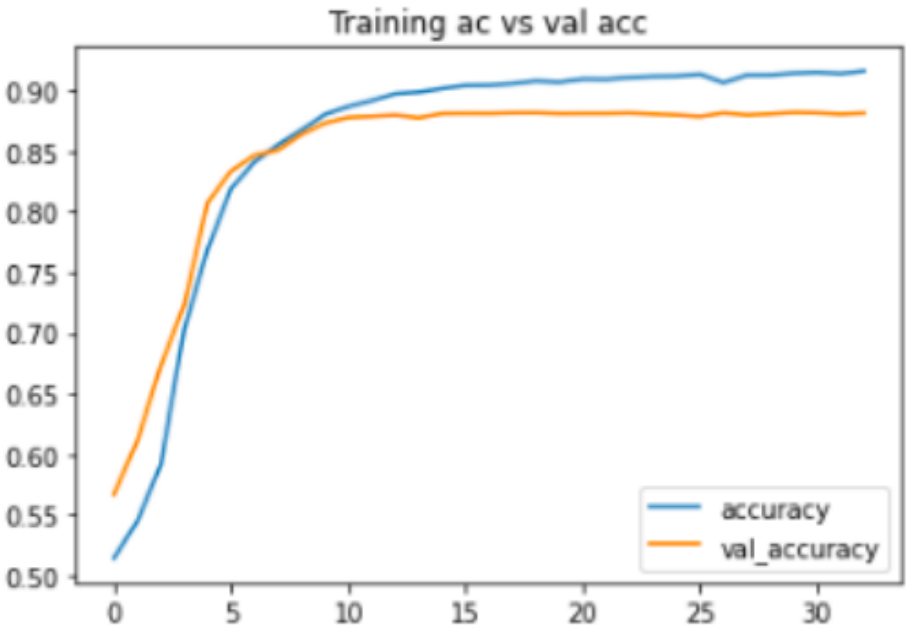


Figure 22 Training accuracy vs Validation accuracy

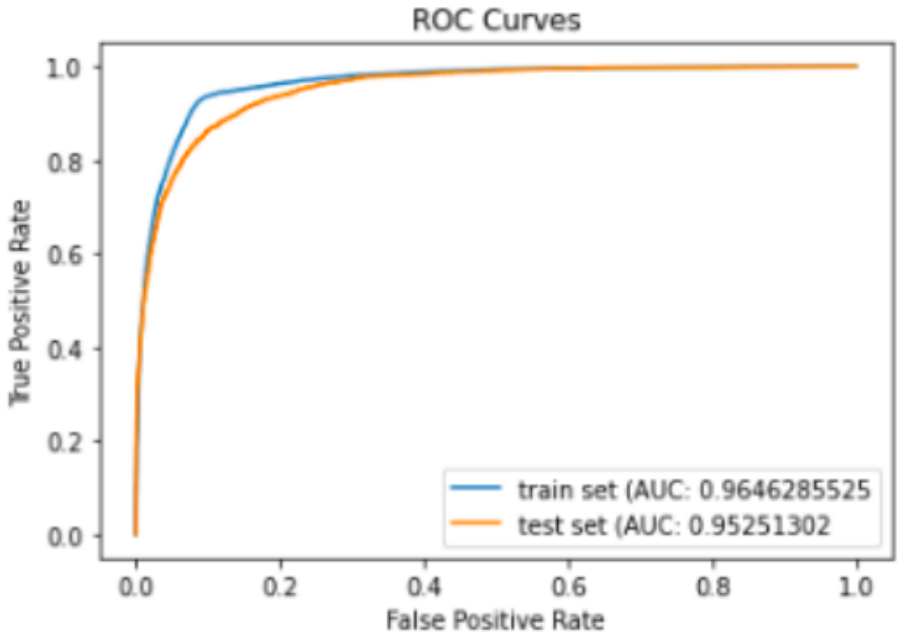


Figure 23 ROC Curves

EarlyStopping was used to stop training when the model has stopped improving. The tokenizer was saved and the model was first saved as .h5 file and converted into tflite for use in mobile app. The tokenizer and trained model were then used in the flutter app.

Furthermore, K-fold cross validation was performed to evaluate the performance of model. In this method, data was divided into k subsets and k number of models were trained each using (k-1) subsets for training and 1 subset for validation. The results below show training and test accuracy in different folds of k.

Table 5 K-fold validation accuracy

K-fold	Training Accuracy	Test Accuracy
3	92.006	87.80
5	91.57	88.002
10	91.43	87.94

Chatbot Model:

Chatbot is a software that simulates a human being like conversation in a chat via messages. It is a very complex deep learning task as it deals with natural language processing which is very hard for a computer device to understand and manipulate according to it. The main task of the bot is to talk with the users like a human being and listen to their problems, interact, console them and provide some suggestions to a minor extent. For this purpose, we required the best chatbot. Thus, for this we have used the simple transformer library for the Conversational AI model. Conversational AI model is the model that performs natural language based conversation tasks with input of its type and variations in personality of how the bot talks and handles messages. Conversational AI blends machine learning with natural language processing in such a way that it performs the automatic replying of messages, understanding of messages and answering accordingly in natural language. The main reason behind choosing conversational AI is that it is dynamic in nature which understands the language more nicely than simple deep learning chatbots that perform only the task they are given and nothing more. The replies of the simple chatbot are also redundant in nature but using Conversational AI, the replies are more dynamic. Hence, because of all these benefits we had chosen Conversational AI as the best for our application right now rather than simple chatbot.

6 CONCLUSION

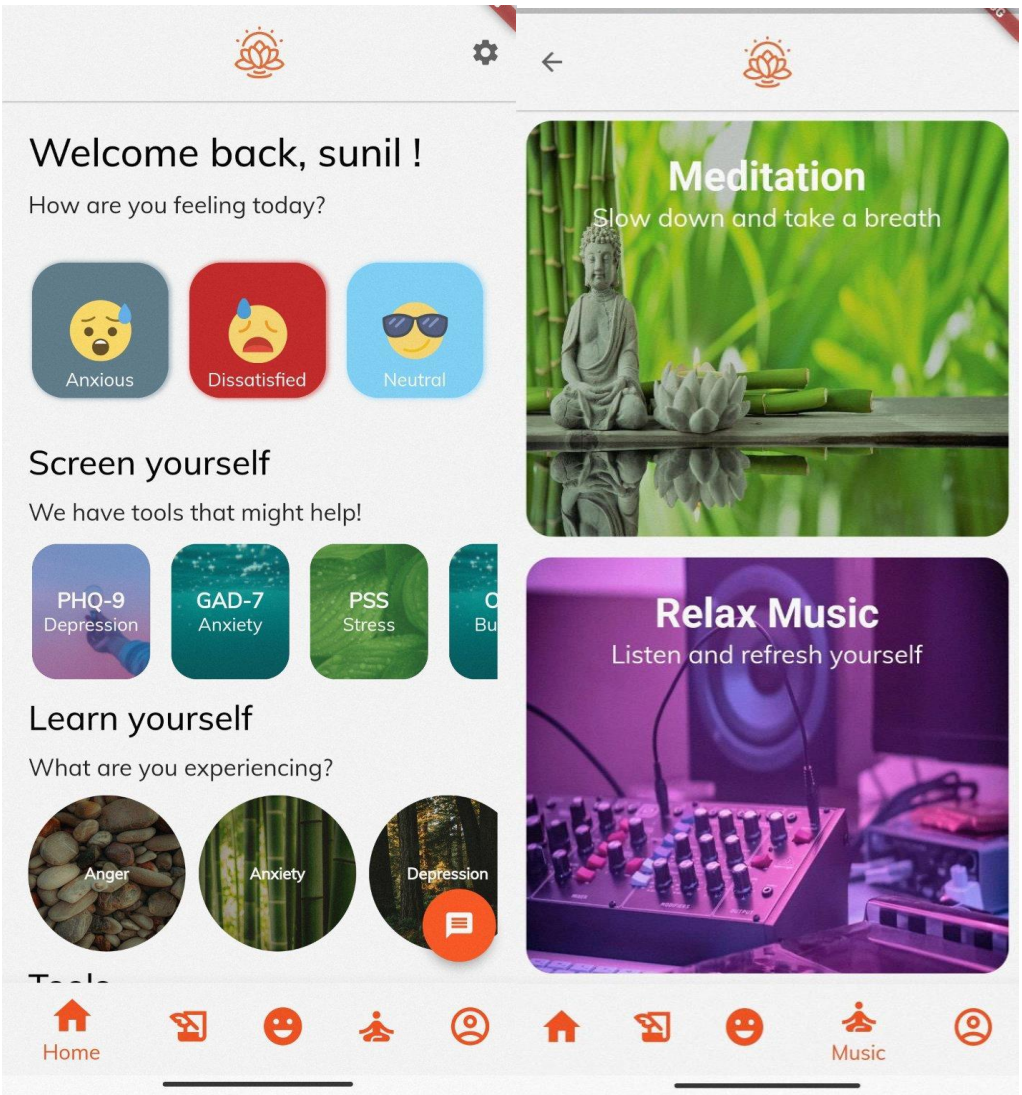
Therefore, in this project we explored the use and implementation of computer technologies and field of AI and ML and applied it to create a Mental Health Application. We constructed an Artificial Neural Network model for performing Sentimental Analysis from text, which is one of the application dimensions of AI. Using the computing power of sentimental analysis, we were able to achieve a suitable model that can be used for evaluating the sentiments that are carried by a text field or paragraph. We then applied the model to finally determine the user sentiments stored in the journal texts that are recorded by our application users. This also improved the user's sentimental and mental status tracking while also promoting the security of user's privacy by bring the appropriate model into the user device.

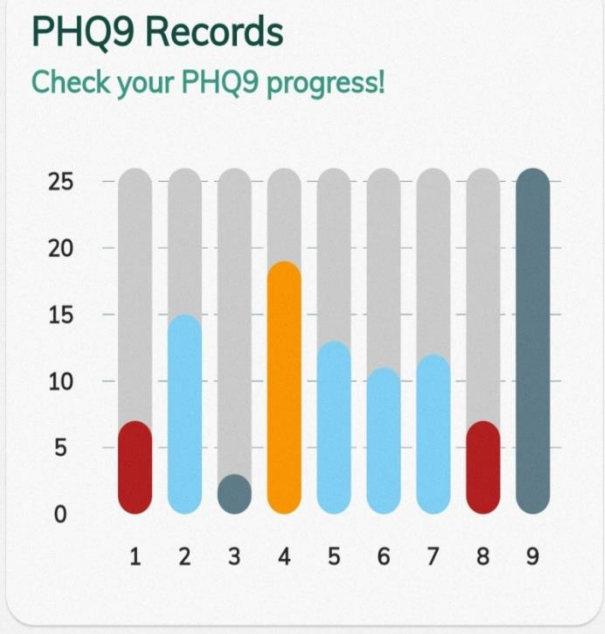
In addition to that we also explored the space of Conversational AI that uses the generative transformer models to create chat bot application. We implemented a therapist chat bot model that can converse with the user by simulating the responses of an actual therapist. This provides a convenient and easier means of accessing the mental health services to common users.

Moreover, to integrate all these services and make them portable to every user's hand we programmed a mobile application using flutter as the programming tool. Using these tools, we can perform self-screening and mood tracking. The benefits of mood charts in screening and overall mental hygiene are important. We can also incorporate different techniques that can be used for screening as well which can benefit users in self-analyzing their state. We can recommend different tasks and changes as well which they need to make to improve their state.

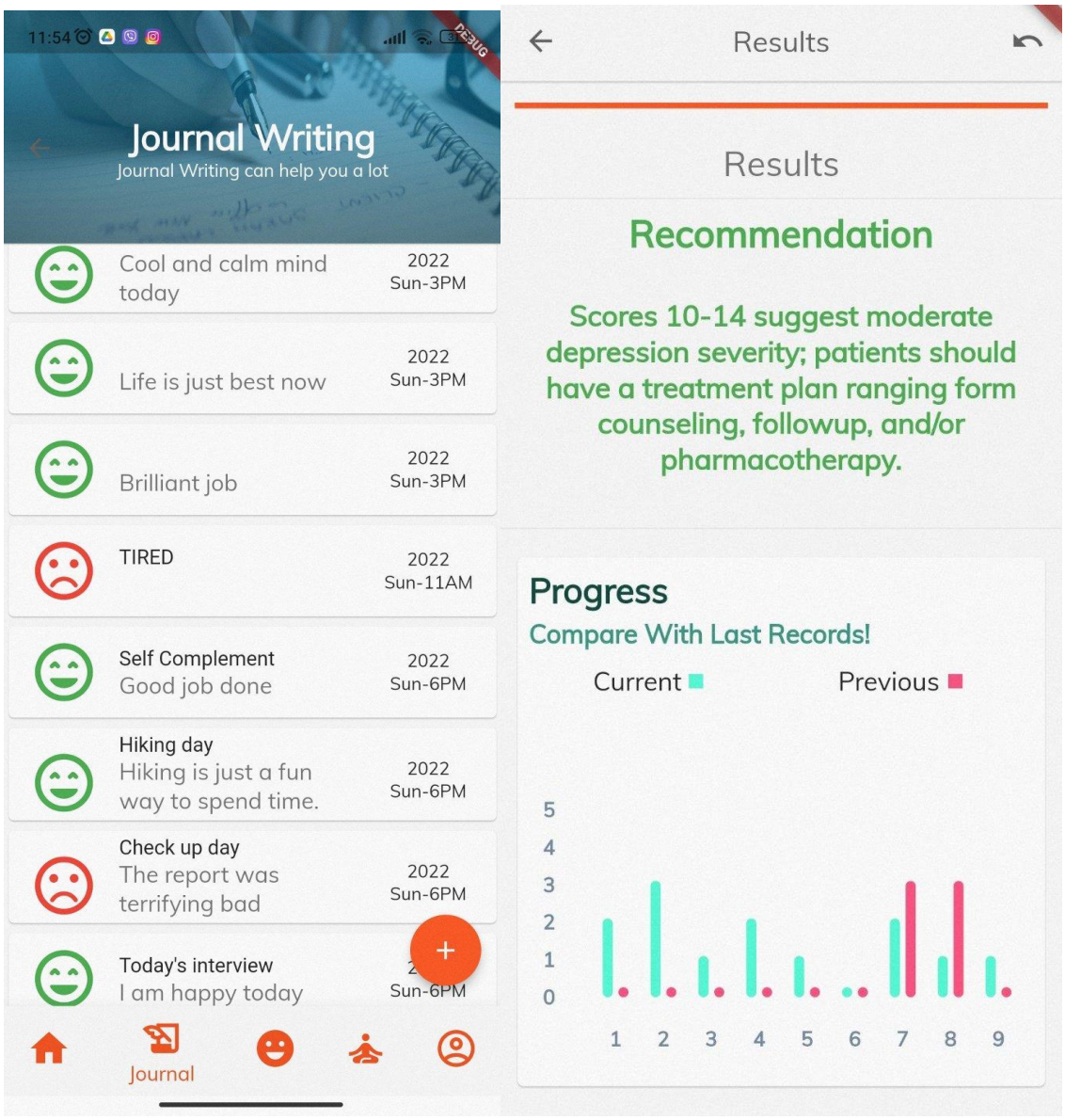
7 APPENDIX

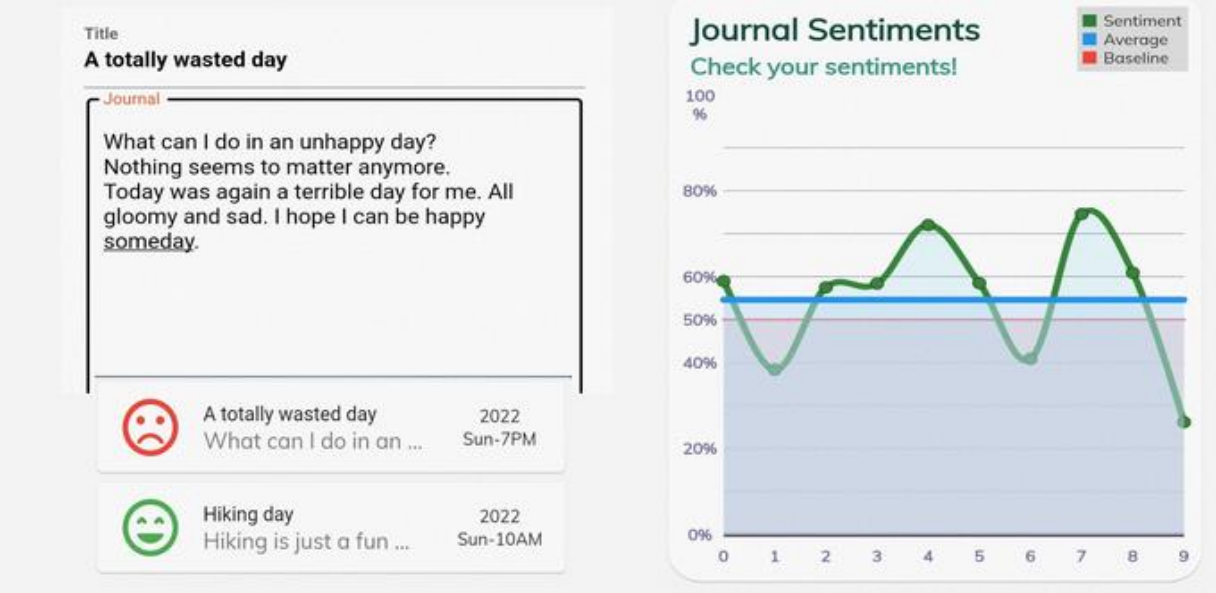
7.1 Screenshots of End Product

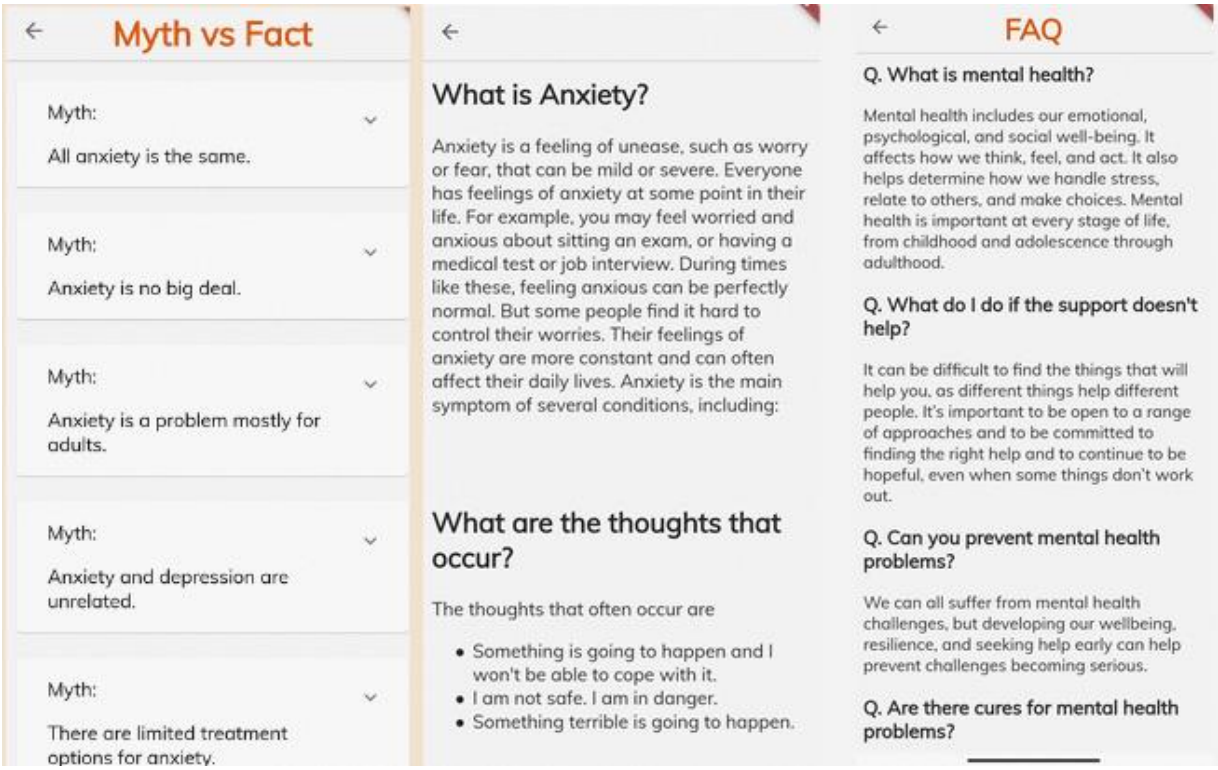


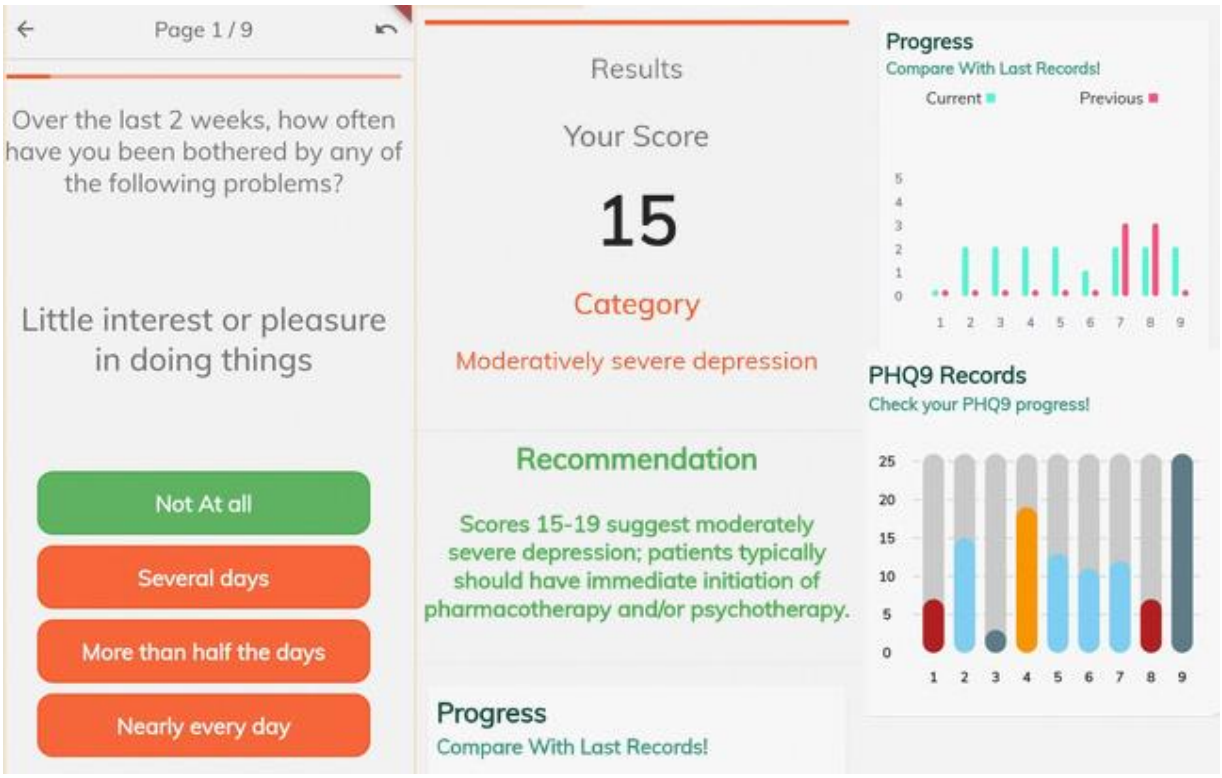

PHQ9 Records
Check your PHQ9 progress!
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9


Mood Diary Summary
Check your summary!
19%
23%
19%
23%
15%


11:54
DEBUG
Journal Writing
Journal Writing can help you a lot
Cool and calm mind today
2022 Sun-3PM
Life is just best now
2022 Sun-3PM
Brilliant job
2022 Sun-3PM
TIRED
2022 Sun-11AM
Self Complement
Good job done
2022 Sun-6PM
Hiking day
Hiking is just a fun way to spend time.
2022 Sun-6PM
Check up day
The report was terrifying bad
2022 Sun-6PM
Today's interview
I am happy today
Sun-6PM
Journal
Results
Results
Recommendation
Scores 10-14 suggest moderate depression severity; patients should have a treatment plan ranging form counseling, followup, and/or pharmacotherapy.
Progress
Compare With Last Records!
Current
Previous
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9


Title
A totally wasted day
Journal
What can I do in an unhappy day?
Nothing seems to matter anymore.
Today was again a terrible day for me. All gloomy and sad. I hope I can be happy someday.
A totally wasted day
What can I do in an ...
2022
Sun-7PM
Hiking day
Hiking is just a fun ...
2022
Sun-10AM
Journal Sentiments
Check your sentiments!
Sentiment
Average
Baseline
100 %
80%
60%
50%
40%
20%
0%
0 1 2 3 4 5 6 7 8 9


Myth vs Fact
Myth:
All anxiety is the same.
Myth:
Anxiety is no big deal.
Myth:
Anxiety is a problem mostly for adults.
Myth:
Anxiety and depression are unrelated.
Myth:
There are limited treatment options for anxiety.
What is Anxiety?
Anxiety is a feeling of unease, such as worry or fear, that can be mild or severe. Everyone has feelings of anxiety at some point in their life. For example, you may feel worried and anxious about sitting an exam, or having a medical test or job interview. During times like these, feeling anxious can be perfectly normal. But some people find it hard to control their worries. Their feelings of anxiety are more constant and can often affect their daily lives. Anxiety is the main symptom of several conditions, including:
What are the thoughts that occur?
The thoughts that often occur are
• Something is going to happen and I won't be able to cope with it.
• I am not safe. I am in danger.
• Something terrible is going to happen.
FAQ
Q. What is mental health?
Mental health includes our emotional, psychological, and social well-being. It affects how we think, feel, and act. It also helps determine how we handle stress, relate to others, and make choices. Mental health is important at every stage of life, from childhood and adolescence through adulthood.
Q. What do I do if the support doesn't help?
It can be difficult to find the things that will help you, as different things help different people. It's important to be open to a range of approaches and to be committed to finding the right help and to continue to be hopeful, even when some things don't work out.
Q. Can you prevent mental health problems?
We can all suffer from mental health challenges, but developing our wellbeing, resilience, and seeking help early can help prevent challenges becoming serious.
Q. Are there cures for mental health problems?



Panic Attacks

Introduction

A panic attack is a brief period of intense anxiety that results in physical fear sensations. A racing heart, shortness of breath, dizziness, trembling, and muscle tension are some of the symptoms. Panic attacks happen frequently and unexpectedly, and they are frequently unrelated to any external threat.

A panic attack can last anywhere from a few minutes to a half hour. The physical and emotional effects of the attack, on the other hand, may last for a few hours.

What are the common worry themes?

- Fearing Consequences

Assuming something horrible is going

What are the signs or symptoms?

Symptoms of a panic attack can include:

- Heightened vigilance for danger and physical symptoms
- Anxious and irrational thinking
- A strong feeling of dread, danger or foreboding
- Fear of going mad, losing control, or dying
- Feeling lightheaded and dizzy
- Tingling and chills, particularly in the arms and hands
- Trembling or shaking, sweating
- Hot flushes
- Accelerated heart rate
- A feeling of constriction in the chest
- Breathing difficulties, including shortness of breath
- Nausea or abdominal distress
- Tense muscles
- Dry mouth
- Feelings of unreality and detachment from the environment.
- Fears about losing control or going crazy
- Concerns about fainting
- Worries about embarrassing oneself

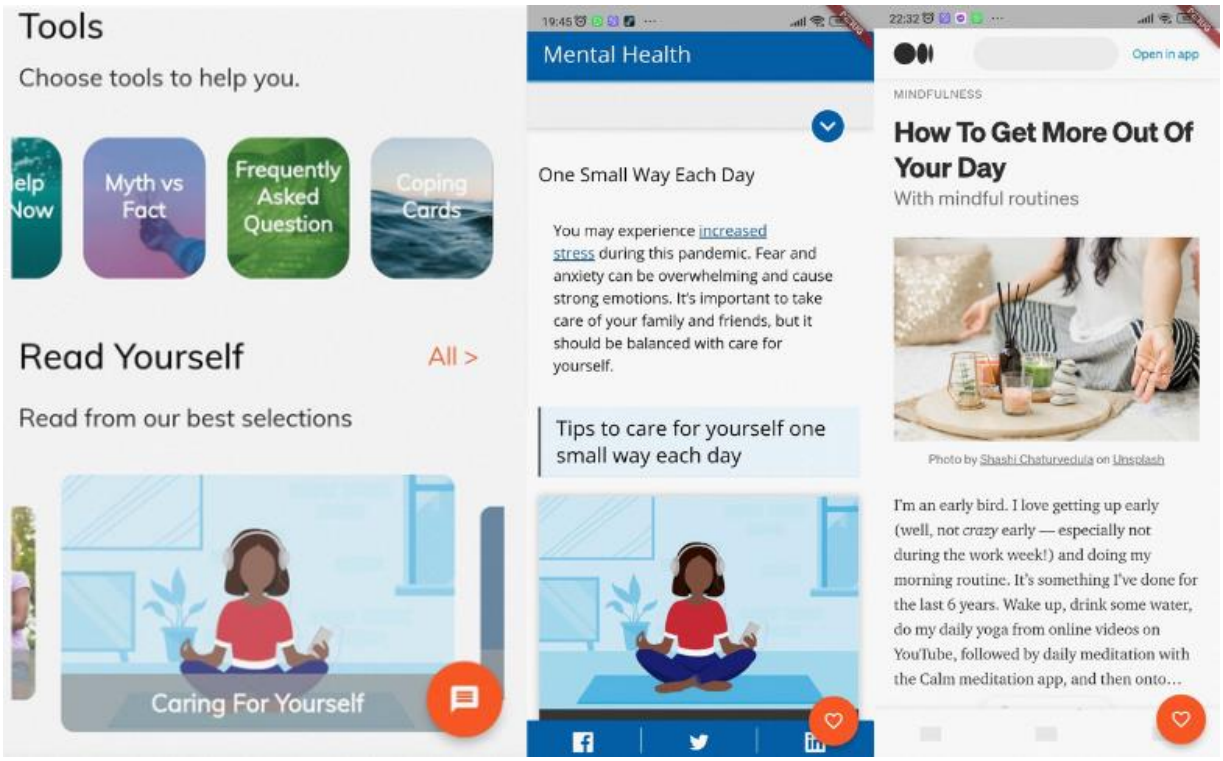
Tips to help with panic attacks

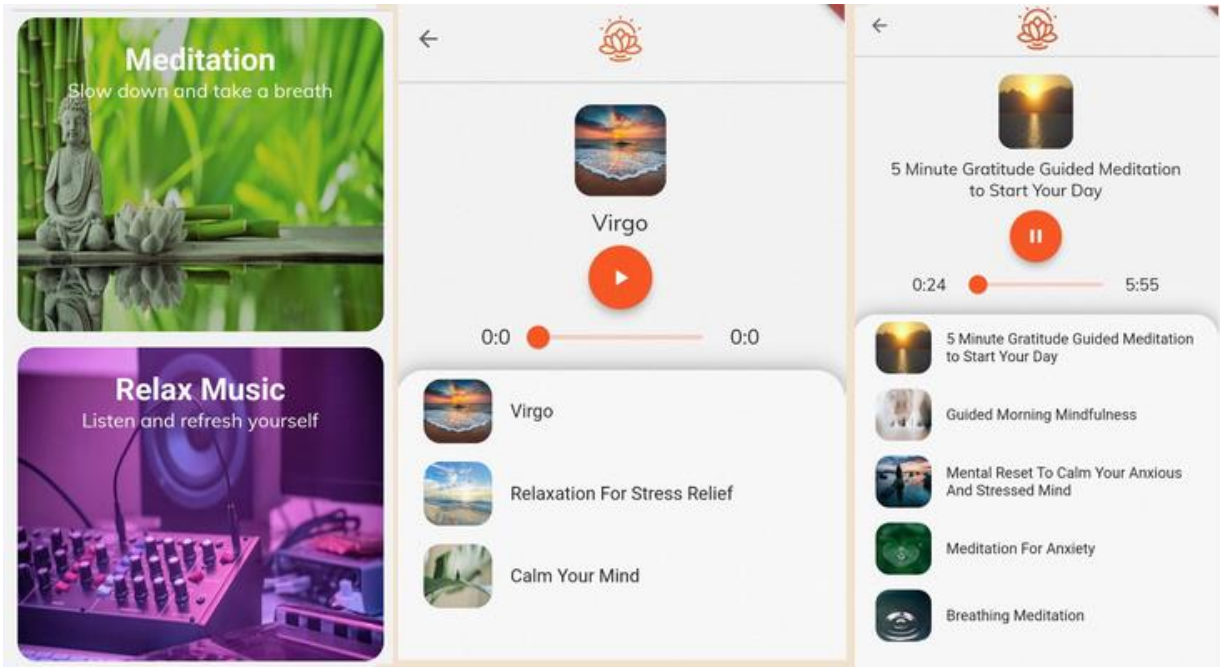
Here are 10 key strategies for managing panic:

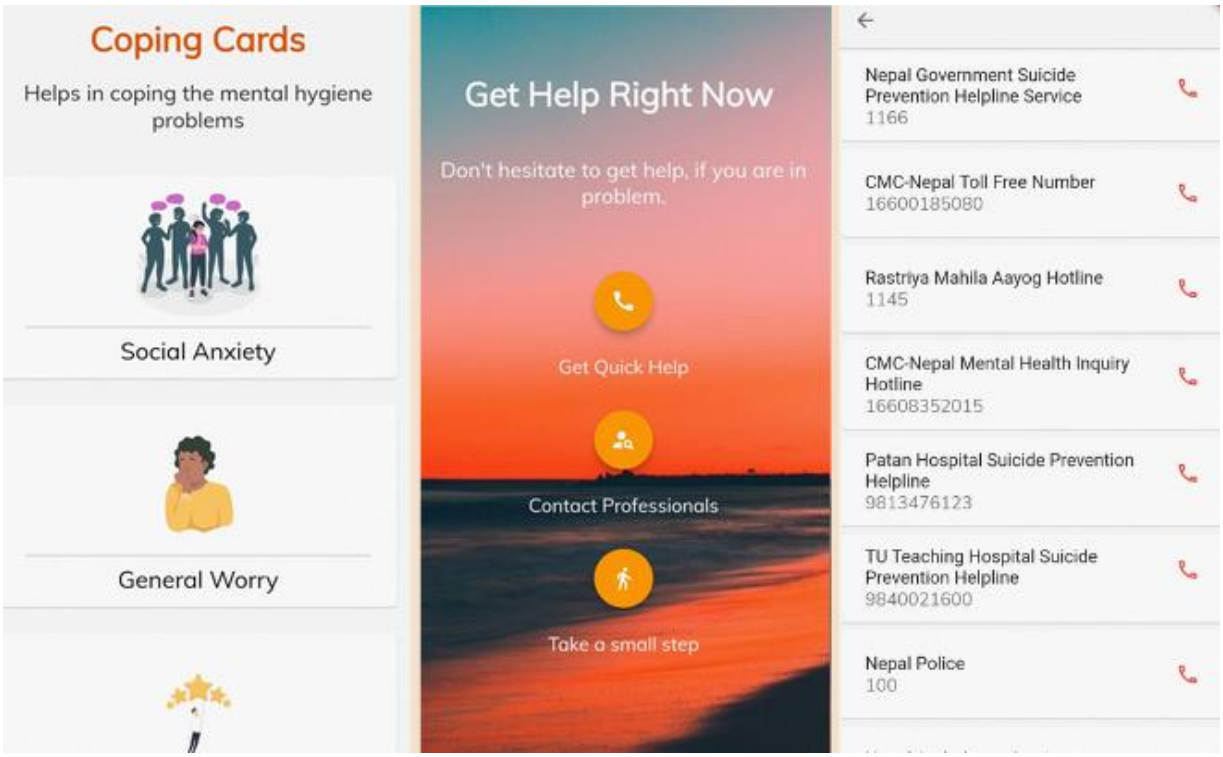
- Check in with yourself.
- Recognize and avoid common thinking traps that fuel panic.
- Develop more realistic and helpful thoughtsrelated to panic.
- Remind yourself about the facts about panic attacks.
- Test out your beliefs about panic.
- Learn to dial down physical symptoms to help you ride out panic.
- Prioritize self-care.
- Seek professional help.

Medical Treatment Options

If the physical anxiety symptoms are caused by physical illnesses, such as diabetes or hyperthyroidism, proper treatment for these illnesses should stop the panic-like symptoms from recurring. If the panic attacks are due to


Tools
Choose tools to help you.
Myth vs Fact
Frequently Asked Question
Coping Cards
Read Yourself
All >
Read from our best selections
Caring For Yourself
Mental Health
One Small Way Each Day
You may experience increased stress during this pandemic. Fear and anxiety can be overwhelming and cause strong emotions. It's important to take care of your family and friends, but it should be balanced with care for yourself.
Tips to care for yourself one small way each day
Open in app
MINDFULNESS
How To Get More Out Of Your Day
With mindful routines
Photo by Shashi Chaturvedula on Unsplash
I'm an early bird. I love getting up early (well, not crazy early — especially not during the work week!) and doing my morning routine. It's something I've done for the last 6 years. Wake up, drink some water, do my daily yoga from online videos on YouTube, followed by daily meditation with the Calm meditation app, and then onto…


Meditation
Slow down and take a breath
Relax Music
Listen and refresh yourself
Virgo
0:0
0:0
Virgo
Relaxation For Stress Relief
Calm Your Mind
5 Minute Gratitude Guided Meditation to Start Your Day
0:24
5:55
5 Minute Gratitude Guided Meditation to Start Your Day
Guided Morning Mindfulness
Mental Reset To Calm Your Anxious And Stressed Mind
Meditation For Anxiety
Breathing Meditation


Coping Cards
Helps in coping the mental hygiene problems
Social Anxiety
General Worry
Get Help Right Now
Don't hesitate to get help, if you are in problem.
Get Quick Help
Contact Professionals
Take a small step
Nepal Government Suicide Prevention Helpline Service
1166
CMC-Nepal Toll Free Number
16600185080
Rastriya Mahila Aayog Hotline
1145
CMC-Nepal Mental Health Inquiry Hotline
16608352015
Patan Hospital Suicide Prevention Helpline
9813476123
TU Teaching Hospital Suicide Prevention Helpline
9840021600
Nepal Police
100

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