The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

COMP 3040

Mobile Device Programming

ArtMind: Art Analysis Tool for Mental Health

Project Report

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Programme: Computer Science with Artificial Intelligence

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1. INTRODUCTION

1.1 Background and Motivation

Mental health is a crucial aspect of overall well-being and development for individuals across all age groups. Unfortunately, studies indicate that there is often a lack of knowledge and awareness among the general population to recognize mental health issues, which can result in delayed or inadequate support for mental health needs (Bunkham, 2023). This deficiency in knowledge and awareness is a significant concern, especially among adolescents in Malaysia, where the rising number of cases has reached a worrying. The study by Rens et al. (2022) found that one in five participants had a positive screening for mental health problems, but only half of them sought healthcare for their mental health needs. It is crucial to address this issue and improve mental health awareness through effective public mental health campaigns.

Within this context, art therapy emerges as a significant approach that can be effectively utilized not only by professionals but also by individuals of all ages, especially children. (Hutyrová, 2016). Art therapy allows individuals to externalize their problems and form a less internalized view of themselves, leading to positive changes in their self-acceptance and self-esteem (Hutyrová, 2016). For example, individuals who are experiencing despair, sadness, confusion, or fear tends to create images that can be disturbing to many people.

Moreover, as an art teacher, understanding and interpreting students' art is a vital part of our role. Artistic expression is crucial for children's development as it allows them to communicate thoughts, emotions, and experiences that can be difficult to express verbally. Observing and interpreting their artwork provides insight into their creative processes, interests, and inner world. This knowledge allows us to tailor teaching methods, offer meaningful feedback, and support their artistic and emotional development.

By leveraging a mobile app that combines artistic expertise with psychological insights derived from analysing one's art, we can create a dynamic platform. This app would empower individuals including educators and students, providing the early identification of possible mental health issues through a simple scan of drawing images, and tailoring support to individual needs. Through this technological approach, we can bridge the gap in mental health awareness, making a significant impact on the holistic development of individuals, particularly in the realm of education.

1.2 Problem Statement

Recognizing, and addressing one's mental health issues is crucial, yet there is often a gap in understanding among various individuals, including parents, caregivers, and teachers. This knowledge deficit can result in delayed or insufficient support for emotional needs (Bunkham, 2023). Furthermore, the current tools for assessing mental health are limited in scope.

Thus, the problem at hand is the lack of accessible and effective methods for individuals to immediately understand and support mental health through art. While art serves as a valuable means of communication for individuals, it presents a challenge as deciphering the intricate language of art is often complex and ambiguous. This knowledge gap can have serious consequences, as it may hinder the early identification of emotional distress or potential mental health issues.

To address this critical issue, this project seeks to empower individuals with tools to extract valuable psychological insights from artwork. Through the utilization of machine learning model, the project aims to classify artwork that may be indicative of mental health issues.

1.3 Aim & Objectives

The project aims to develop a mobile app that classify drawing based on mental health state. This platform is strategically developed for everyone with valuable tools, enabling them to gain a deeper understanding of their potential developmental aspects, and to identify any underlying mental health issues.

1. Develop a mobile app for uploading drawings and provide instant psychological insights present on the art.
2. Provide a directory or resources for mental health support websites.

1.4 Novelty

Despite the longstanding emphasis on mental health within the field of psychology, there remains a necessity for dependable technology-driven measurement instruments to assess mental health through art. This project aims to enhance computer artwork analysis by introducing a mobile app system that offers:

1. **User-centred approach:** The system breaks down barriers between professionals and non-professionals by offering a user-friendly platform for interpreting mental health through art. It categorizes artwork, determining whether the drawing is indicative of a mentally healthy or unhealthy individual.

2. **Mental health support:** The system also provides support helpline recommendations for different countries, making it a holistic solution for mental health support.
3. **Historical record:** The system retains user's past records, enabling the tracking of their mental health progression over time.
4. **Focus Timer:** The system introduces a timer function to enhance users' focus during drawing sessions, minimizing distractions, and promoting a more immersive creative experience.
5. **Scalability:** As the user base grows, scalability becomes a concern. The platform should be designed to handle an increasing number of users and a growing dataset without compromising performance or response time.
6. **Integration with Professional Support:** The app should be positioned as a supportive tool rather than a standalone diagnostic solution. It is crucial to emphasize the importance of seeking professional mental health assessments and integrating the app's insights into a broader mental health support framework.

1.5 Challenges

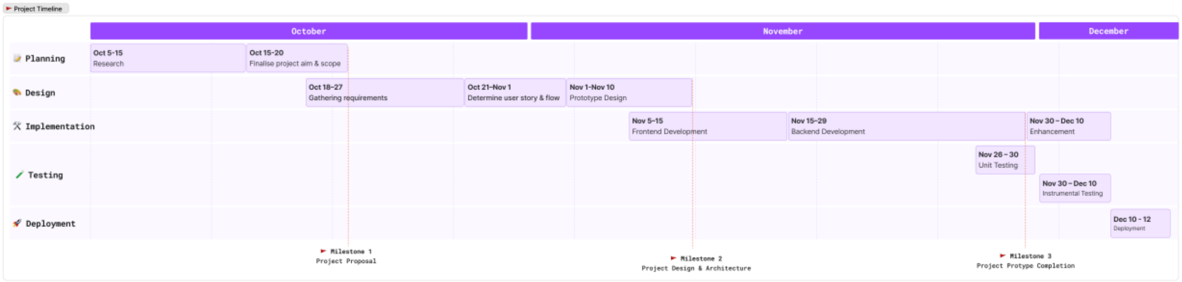
Apart from time constraints, the primary challenges of the project include:

1. **Privacy and Data Security:** Handling sensitive information related to mental health requires robust privacy measures. Ensuring the security of scanned images and associated data is crucial to protect users' confidentiality and comply with privacy regulations.
2. **Accessibility:** The app's effectiveness relies on its accessibility across various devices and platforms. Ensuring compatibility with different operating systems, screen sizes, and resolutions is vital to reach a diverse user base, especially in educational settings.
3. **Ethical Considerations:** The subjective nature of art interpretation raises ethical concerns. Ensuring that the app's insights are used responsibly and ethically is crucial. It should not stigmatize individuals or perpetuate bias based on artistic expression.
4. **Machine Learning Accuracy**: The accuracy of the machine learning model in identifying and classifying elements in artwork is pivotal. Continuous refinement and updates to the model are necessary to enhance accuracy and address potential biases in the analysis.
5. **Offline Functionality**: The application's functionality is dependable on an online connection since the machine learning model is stored remotely, and results are obtained through an online API from Roboflow. Additionally, the storage is cloud-based through Firebase, making offline usage unsupported.

2. PROJECT PLANNING & MANAGEMENT

2.1 Gantt Chart

The Gantt Chart for ArtMind project can be viewed in this Figma link.



The project adopts a **waterfall methodology**, progressing through distinct phases that align with coursework deadlines. The initial milestone involves **project planning**, which involves primary research, finalising project aim and scope. Following this, during the **system design** phase, the project underwent a comprehensive requirement analysis, resulting in the creation of essential architectural diagrams and wireframes.

Subsequently, the **implementation phase** translates the prototype designs into a functioning codebase, which involves frontend (.xml) and backend (.java) development. Rigorous unit testing and instrumental testing were completed during the **testing phase** to ensure the reliability and robustness of the implemented functionalities. Lastly, the project ended with creating .apk file for **deployment** and finalising the final report.

Over the course of the project timeline, three key milestones, symbolizing the coursework deadline submissions, encompass the completion of the project proposal, project design and architecture, and project final working prototype. Throughout these crucial stages, documentation undergoes constant updates to offer developers and end-users valuable insights.

3. REQUIREMENTS ANALYSIS

3.1 Functional Requirement

Login Page

#	User Requirements	Priority
1.	User can choose country code and enter mobile number.	Must Have
2.	User can enter OTP.	Must Have
3.	User can enter username.	Must Have
4.	User can navigate back to previous login page.	Could Have
#	**System Requirements**	**Priority**
1.	Verify valid phone number entered.	Must Have
2.	Send OTP to corresponding phone number.	Must Have
3.	Verify valid OTP entered.	Must Have
4.	Verify valid username entered.	Should Have
5.	Enable automatic log-in for subsequent attempts.	Should Have

Navigation Panel

#	User Requirements	Priority
1.	User can navigate to different pages by clicking on the icons.	Should Have
#	**System Requirements**	**Priority**
1.	Navigates to corresponding pages (Timer, History, Scan, Find Help, Settings page) when user clicked.	Should Have

Timer Page

#	User Requirements	Priority
1.	User can set duration of the timer in minutes.	Must Have
2.	User can start, stop, or reset the timer.	Must Have
3.	User can mute or unmute the background music.	Could Have
#	**System Requirements**	**Priority**
1.	Starts the countdown timer and store the updated timer in the device's storage, enabling it to operate in the background.	Must Have
2.	Display success page when the timer is complete.	Could Have
3.	Display notification when the timer is running.	Could Have
4.	Play background music when timer is running.	Could Have

History Page

#	User Requirements	Priority
1.	User can scroll to browse lists of previously analysed drawings in history cards.	Must Have
2.	User can click history card to see the corresponding result.	Must Have
#	**System Requirements**	**Priority**
1.	Load and display history cards.	Must Have
2.	Navigates to corresponding Result page when history card is clicked.	Should Have

Scan Page

#	User Requirements	Priority

1.	User can scan or upload an image for mental health analysis.	Must Have
2.	User can add author’s name for the uploaded drawing.	Should Have
3.	Users can crop the image before proceeding with the upload.	Could Have
#	**System Requirements**	**Priority**
1.	Image upload interface supports file types such as .png, .jpeg, and .jpg.	Must Have
2.	Automatically show the user's username in the author’s name edit textbox by default.	Should Have

<u>Find Help Page</u>

#	User Requirements	Priority
1.	Users can click on the country selection dropdown to choose their desired country.	Must Have
2.	User can click helpline card to view the corresponding helpline website.	Must Have
#	**System Requirements**	**Priority**
1.	Redirect to any web service, such as Google, Yahoo, etc., to view the corresponding helpline website	Must Have

<u>Result Page</u>

#	User Requirements	Priority
1.	User can browse the result of corresponding drawing uploaded.	Must Have
2.	User can download the result in image or document format.	Will Not Have
#	**System Requirements**	**Priority**

1.	Display results for corresponding drawing uploaded.	Must Have

Settings Page

#	User Requirements	Priority
1.	User can logout of the app.	Must Have
2.	User can navigate to About Us page, Guidelines page and Profile page by clicking on their respective buttons.	Should Have
#	**System Requirements**	**Priority**
1.	Logout and clear user data from the application.	Must Have
2.	Redirects user to their respective page.	Should Have

Settings Page – About Us

#	User Requirements	Priority
1.	User can view the aim and goal of the app.	Could Have
#	**System Requirements**	**Priority**
3.	Display the aim and goals of the app.	Could Have

Settings Page - Guidelines

#	User Requirements	Priority
1.	User can swipe and view the ethical guidelines while using the app.	Could Have
#	**System Requirements**	**Priority**
4.	Display all the ethical guidelines.	Could Have

Settings Page - Profile

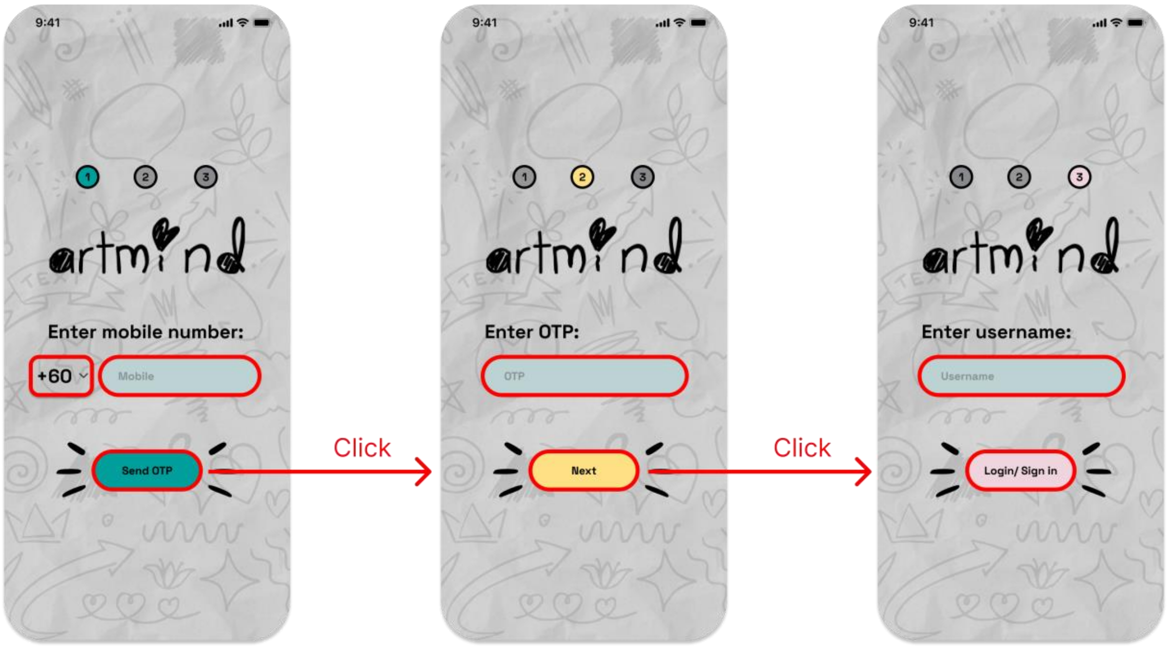
#	User Requirements	Priority
1.	User can view the profile information (username, phone number, profile picture).	Should Have
2.	User can update the profile information (username, profile picture) by clicking the “Update” button.	Should Have
#	**System Requirements**	**Priority**
5.	Verify valid username entered.	Should Have
6.	Update the new profile information to database.	Should Have

3.2 Non-functional Requirement

#	User Requirements	Priority
1.	The application should be available for Android devices (version 11.0 or below).	Must Have
2.	It should feature a responsive graphical user interface (GUI).	Should Have
3.	The mobile user interface (UI/UX) should be simple, straightforward, and easy to navigate.	Should Have
4.	The application should support various languages.	Could Have
#	**System Requirements**	**Priority**
1.	The application must be always accessible to users, 24 hours a day.	Must Have

3.3 User Story

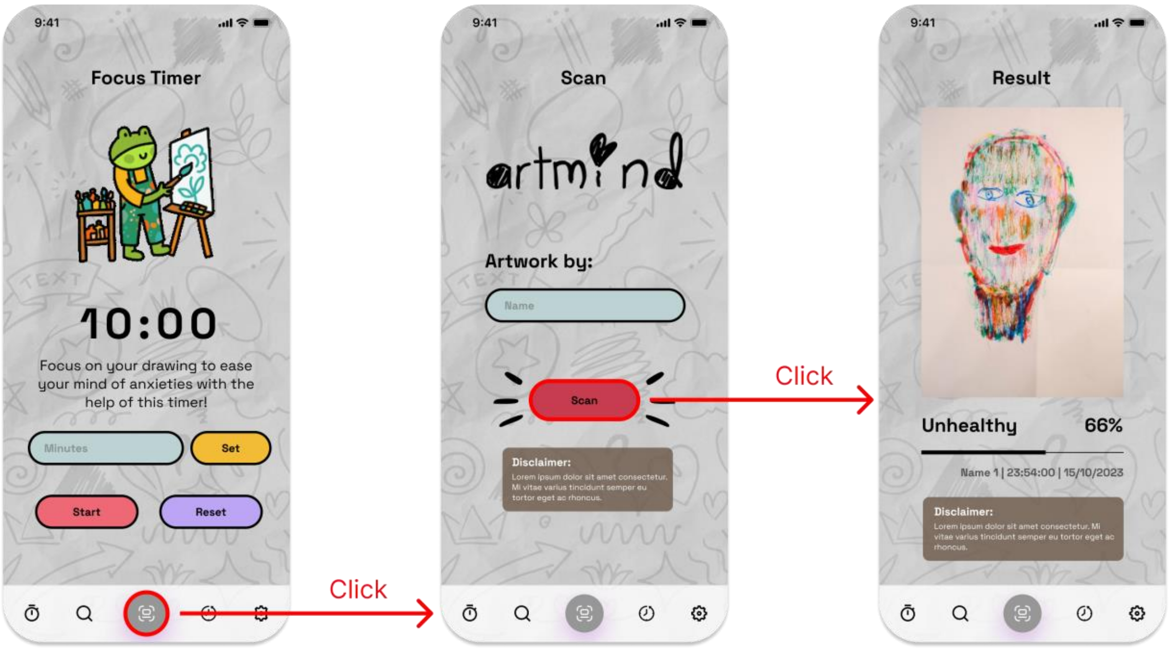
User interface for ArtMind mobile app can be found in this Figma link.

<table>
<tr><th>User Story 1</th><th>Points</th></tr>
<tr><td>As a client, I want the log-in process to be straightforward and secure through OTP, so that I can trust that my personal information is kept confidential.</td><td>2</td></tr>
<tr><td colspan="2"><b>User Flow</b></td></tr>
<tr><td colspan="2">


1) Users can select their country code, input their mobile number, and press the "Send OTP" button for OTP verification.
2) After receiving the OTP, users can input the code and press "Next" to proceed to username entry.
3) Users then enter their username and press the "Login/Sign in" button to access their account.
Only one account is allowed per phone number.
</td></tr>
</table>

User Story 2	**Points**
As a client, I want to submit drawings through the app, so that I can get results and insights on my mental health state.	13

User Flow



Focus on your drawing to ease your mind of anxieties with the help of this timer!

Disclaimer: Lorem ipsum dolor sit amet consectetur. Mi vitae varius tincidunt semper eu tortor eget ac rhoncus.

Name 1 | 23:54:00 | 15/10/2023

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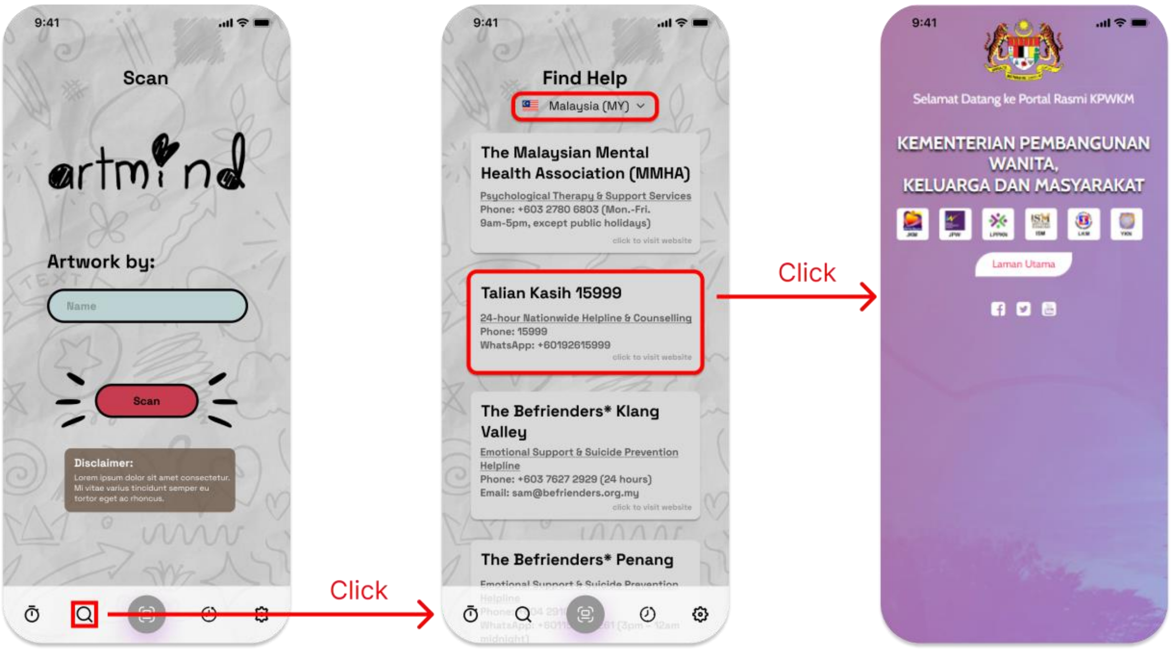
1) By clicking the Scan icon in the bottom navigation bar, users can navigate to the Scan page.
2) Users have the option to enter the artist's name and initiate the scanning process by clicking the “Scan” button to upload or take a picture of the drawing.
3) Following the upload, the system evaluates the drawing and generates the mental health result for the submitted artwork.

User Story 3	**Points**
As a client, I want to access a directory or resources for mental health support in a specific country, so that I can easily find and connect with professionals for treatment and support.	5

User Flow


9:41
Scan
artmind
Artwork by:
Name
Scan
Click
9:41
Find Help
Malaysia (MY)
Click
9:41
Selamat Datang ke Portal Rasmi KPWKM
KEMENTERIAN PEMBANGUNAN WANITA, KELUARGA DAN MASYARAKAT
Laman Utama

Disclaimer:
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The Malaysian Mental Health Association (MMHA)
Psychological Therapy & Support Services
Phone: +603 2780 6803 (Mon.-Fri. 9am-5pm, except public holidays)
click to visit website

Talian Kasih 15999
24-hour Nationwide Helpline & Counselling
Phone: 15999
WhatsApp: +60192615999
click to visit website

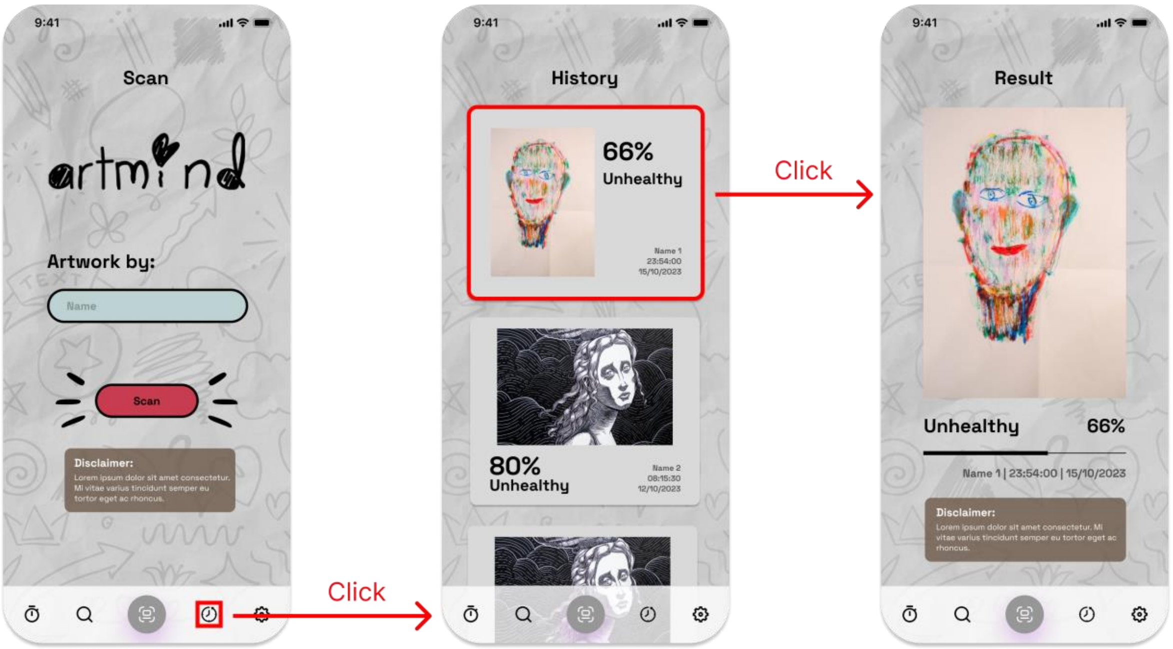
The Befrienders* Klang Valley
Emotional Support & Suicide Prevention Helpline
Phone: +603 7627 2929 (24 hours)
Email: sam@befrienders.org.my
click to visit website

The Befrienders* Penang
Emotional Support & Suicide Prevention Helpline

1) By clicking the Search icon in the bottom navigation bar, users can navigate to the Find Help page.
2) Clicking on the country code enables users to select their country, prompting the system to display a list of mental health centres on the selected country.
3) Users can click on a specific card to be directed to the corresponding mental health websites.

User Story 4	Points
As a client, I want the option to revisit and track the historical record of my submitted drawings and the corresponding mental health insights, so that I can observe my mental health development over time.	8

User Flow



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Disclaimer:
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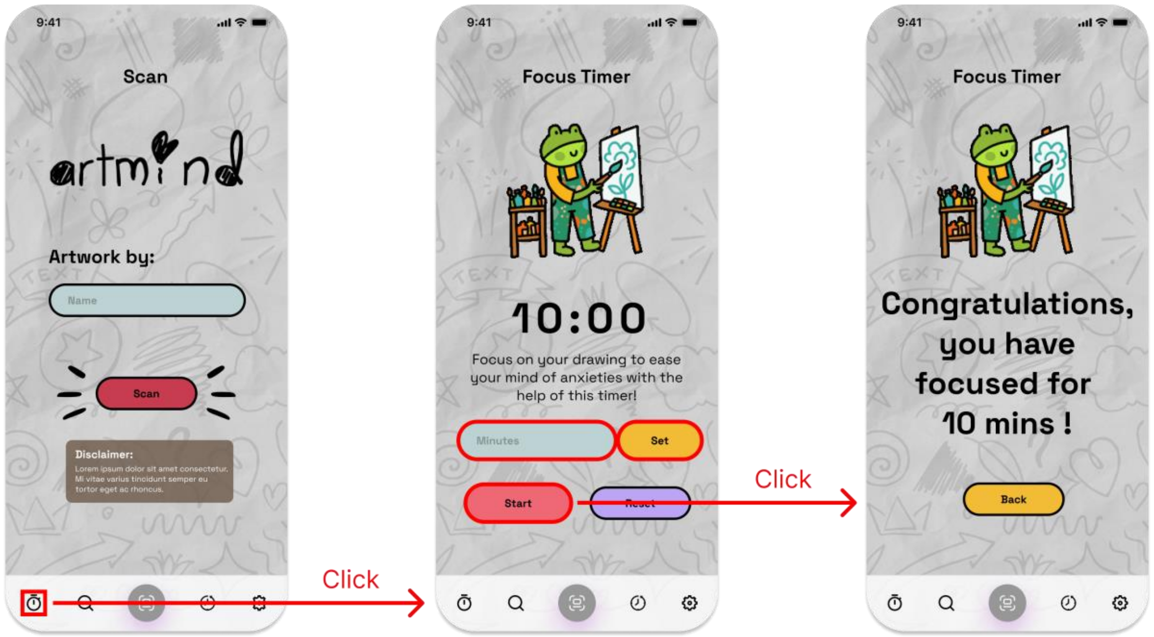
1) By clicking the History icon in the bottom navigation bar, users can navigate to the History page.
2) The system will display a history of previously scanned drawings along with their respective results.
3) Users can select a specific card to view the detailed result of the corresponding drawing.

User Story 5	Points
As a client, I want a drawing-specific timer function, so that I can focus and concentrate on my artwork, promoting a more immersive and therapeutic artistic experience.	3

User Flow



Disclaimer:
Lorem ipsum dolor sit amet consectetur. Mi vitae varius tincidunt semper eu tortor eget ac rhoncus.

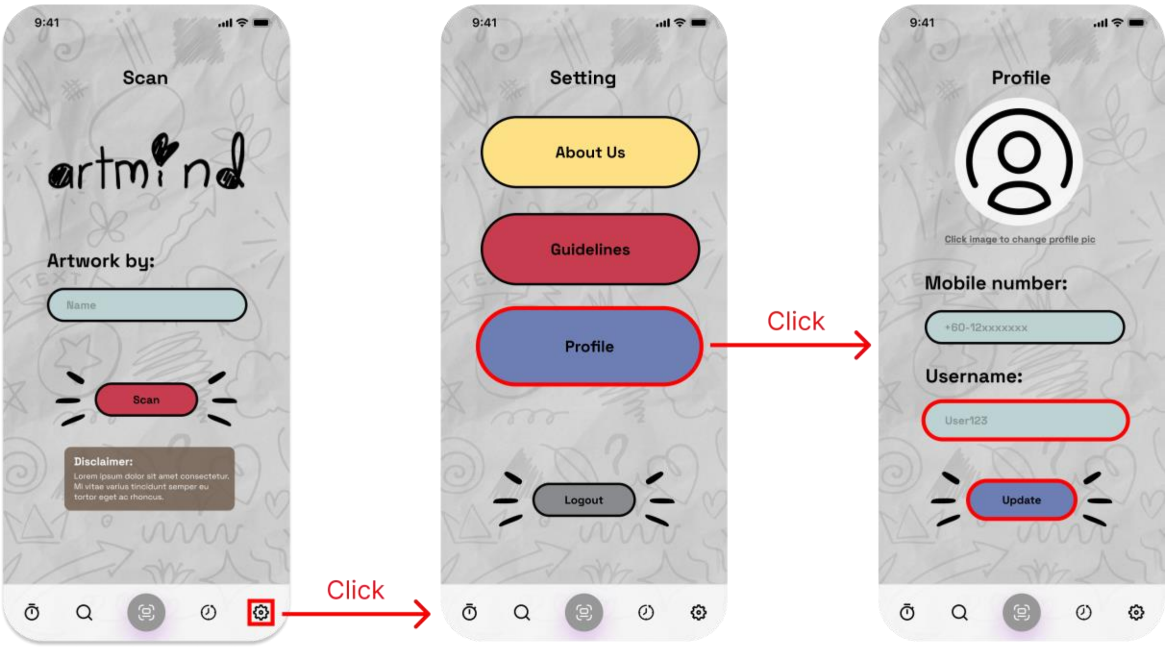
Focus on your drawing to ease your mind of anxieties with the help of this timer!

Congratulations, you have focused for 10 mins !

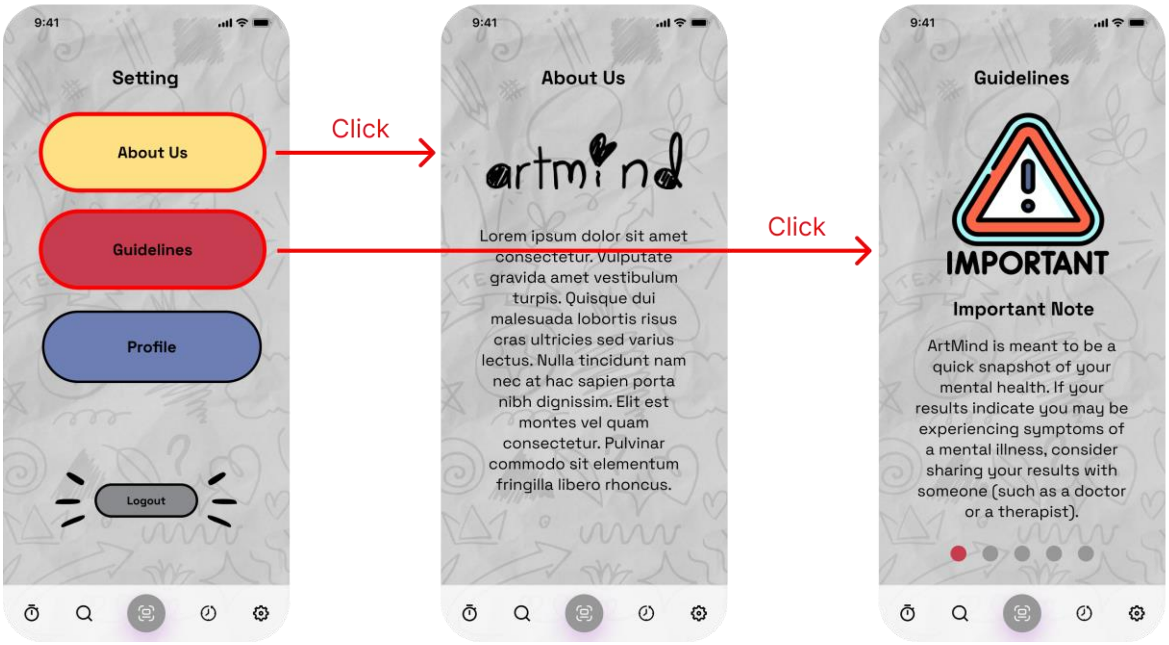
1) By clicking the Timer icon in the bottom navigation bar, users can navigate to the Focus Timer page.
2) Users can set the focus timer duration in minutes and start the timer. While the timer is running, background notifications will keep users informed, and they can choose to stop or reset the timer.
3) After completing the focus timer, a congratulatory message will be displayed in the app.

User Story 6	Points
As a client, I want to have the ability to change personal information, so that I can personalize my profile and maintain a sense of identity within the app.	2

User Flow



1) By clicking the Setting icon in the bottom navigation bar, users can navigate to the Setting page.
2) Clicking on the “Profile” button directs users to the profile page.
3) Users have the option to update both the profile picture and username.

<table>
<tr><th>User Story 7</th><th>Points</th></tr>
<tr><td>As a client, I want to gain insights into the app, so that I can understand its features and guidelines, ensuring a clear understanding of what to expect and how to use the app responsibly.</td><td>1</td></tr>
<tr><td colspan="2"><b>User Flow</b></td></tr>
<tr><td colspan="2">


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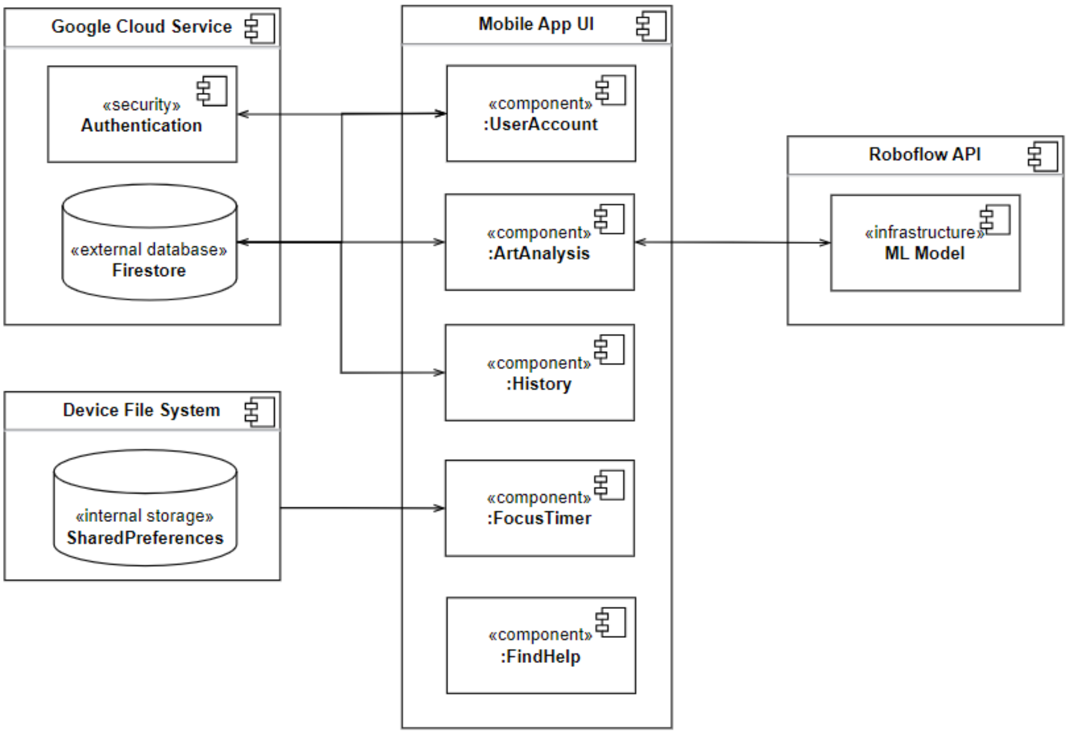
ArtMind is meant to be a quick snapshot of your mental health. If your results indicate you may be experiencing symptoms of a mental illness, consider sharing your results with someone (such as a doctor or a therapist).

1) In the settings page, users can navigate to the "About Us" and "Guidelines" pages by clicking the respective buttons.
2) Users can read the aim for developing this mobile app in About Us page.
3) In the Guidelines page, users can swipe through the content to view all the guidelines.
</td></tr>
</table>

4. DESIGN AND ARCHITECTURE

4.1 High-level Architecture Diagram



The Mobile App UI comprises five main components: ArtAnalysis, History, UserAccount, FocusTimer, and FindHelp.

- For **UserAccount** component, Firebase authentication is essential for tasks like identifying the phone number, username, providing unique user ID, and OTP services. This information is then stored in the Firestore database system for future usage.

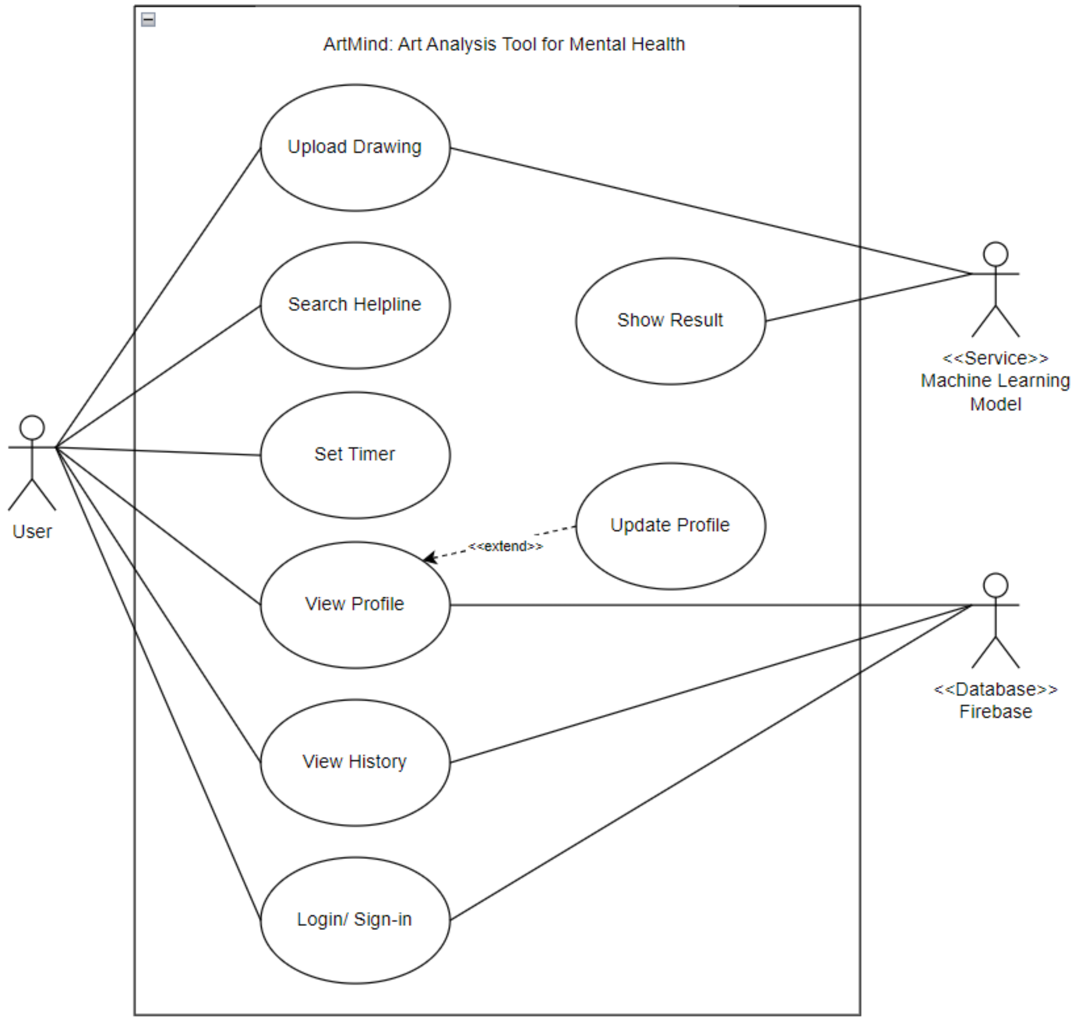
- **ArtAnalysis** component relies on the Roboflow API to access a machine learning model for drawing classification. The results, returned in JSON format, are then retrieved, and stored in an external database (Firestore). This database stores art analysis information such as author name, upload date, and the result (Healthy, Unhealthy).

- In the **History** component, information about previously uploaded drawings, including author name, upload date, and result, is retrieved from Firestore and displayed in UI.

- The **FocusTimer** component utilizes device internal storage - SharedPreferences to persist the timer, ensuring it continues running in the background even when the app is closed.

- The **FindHelp** component retrieves mental health centre data for various countries in JSON format from temporary storage within the application itself. Subsequently, it presents the mental health centres specific to the selected country in the UI.

4.2 Use Case

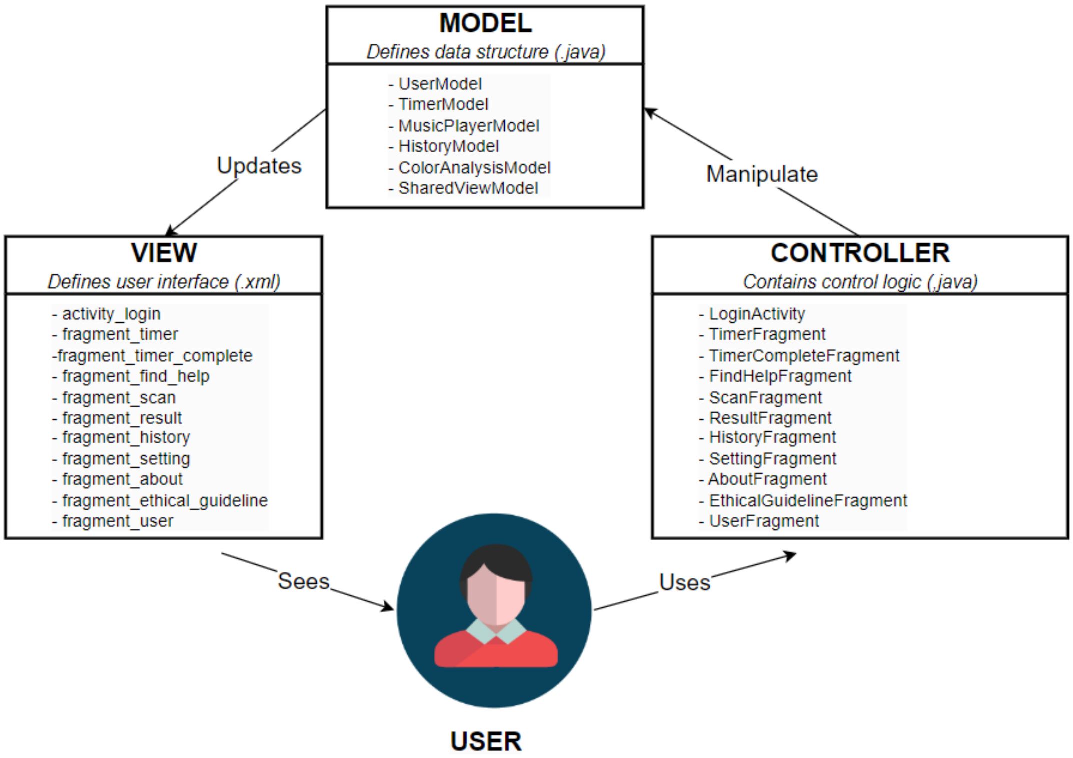


The ArtMind system involves three key actors: Users, the Machine Learning Model (service), and Firebase (database system).

1. Users uploads drawings to ArtMind, which are then forwarded to the Roboflow ML model for evaluation. The model then returns the results in JSON format to be displayed on the app.
2. Users have the ability to access a list of mental health helpline centres specific to a chosen country.
3. Users can set a focus timer to aid them in maintaining concentration while drawing for mental relief.
4. Users can view and edit their profile information, which is then updated in the database.
5. Users can review the history of their previously uploaded drawings retrieved from the database.
6. Users can log in/sign into the system, where the system validates their login credentials with the database.

4.3 Design Principles

Model View Controller (MVC)



ArtMind adopts the MVC approach for application design because it enables clear separation of concerns, facilitating modular development and enhancing maintainability.

In this design pattern, the **view** is responsible for defining all user interfaces (pages), encompassing UI components like text boxes and image views that users can see and interact with. The **controller** serves as an intermediary between the model and the view, containing the control logic behind each user interface.

The **model** defines data structures for each main component, except for the FindHelp component as it exclusively contains static information derived from a JSON file, making it non-dynamic compared to the other components. The detailed description to all models can be found in 5.5 Models section.

Single-Activity Multiple-Fragment

ArtMind also adopts single-activity multiple-fragment paradigm for the following reasons:

- **Improved Navigation:** Fragments can be swapped in and out within the same activity, making navigation of different parts of the bottom navigation in the app smoother.
- **Easier Communication:** Fragments can communicate with each other and with the hosting activity, allowing for better coordination between different parts of your app.
- **Reduced Memory Overhead:** Fragments can be added or removed without recreating the entire activity, potentially improving performance, and reducing memory usage.

4.4 Rationale Behind Design Decisions

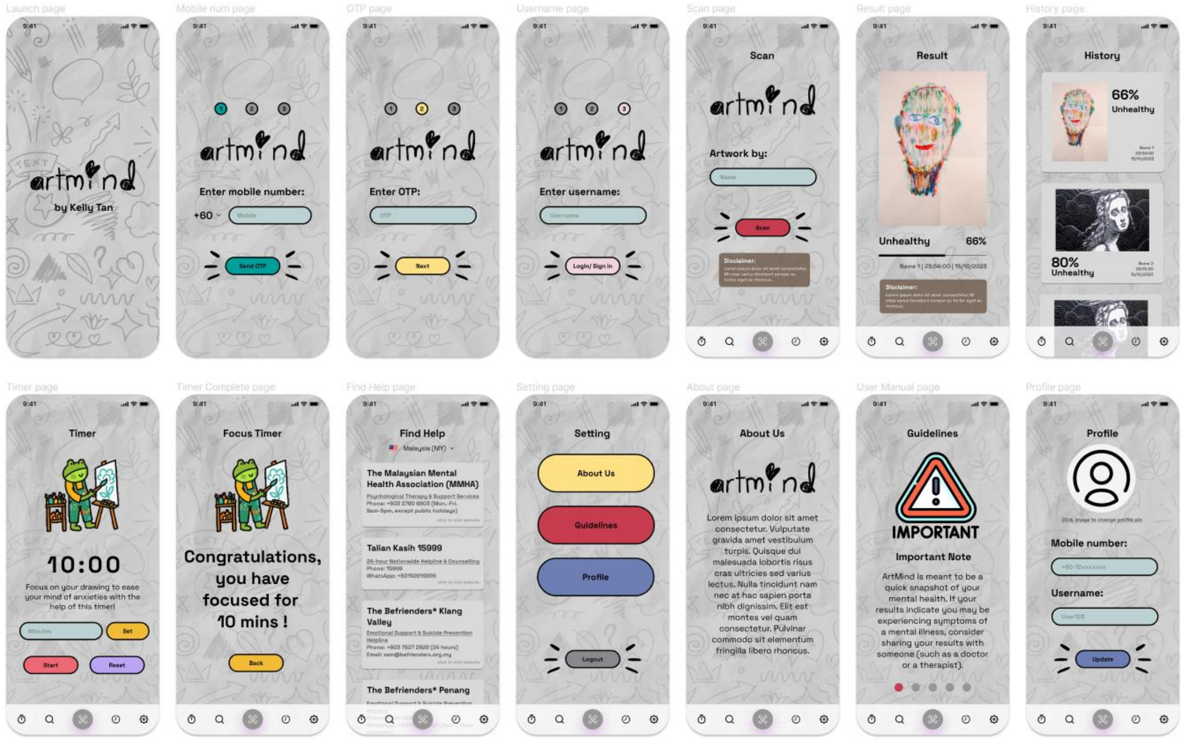
From a development perspective, the adoption of **separate models** for different components such that changes or upgrades can be performed easily without affecting the whole application.

Moreover, **Firebase** was selected as the database system due to its support for secure OTP login and its capability to store various data types, including images which matches the system’s requirements. For example, Firebase is used to store users' historical data which allow users to track an individual's mental health development over time.

Concerning **user experience**, our focus is on prioritizing content, ensuring consistency, and providing straightforward navigation. Additionally, we strive to enhance user convenience by minimizing data input through pre-filled text inputs, all while maintaining responsiveness. The app also offers support for multiple languages, including English, Chinese, and Malay.

4.5 User Interface

User interface for ArtMind mobile app can be found in this Figma link.



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The Befrienders* Klang Valley
Emotional Support & Suicide Prevention Helpline
Phone: +603 7627 2929 (24 hours)
Email: sam@befrienders.org.my

The Befrienders* Penang

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ArtMind is meant to be a quick snapshot of your mental health. If your results indicate you may be experiencing symptoms of a mental illness, consider sharing your results with someone (such as a doctor or a therapist).

The ArtMind mobile app consists of a total of 14 pages, encompassing the Launch page (splash screen), Login Phone Number page, Login OTP page, Login Username page, Scan page (main page), Result page, History page, Focus Timer page, Timer Completion page, Find Help page, Setting page, About Us page, Ethical Guidelines page, and Profile page. Each page serves different functionalities.

5. IMPLEMENTATION

5.1 Challenges

During the implementation phase, I encountered several challenges that necessitated modifications to certain aspects and the initial planned implementation of my project.

Challenges Encountered:

1) **Failed to connect with Roboflow API**: Encountered difficulties connecting to the Roboflow API, receiving a 500 internal server error. After researching in the Roboflow Community Help Page, it became apparent that Roboflow does not currently support Android SDK for deployment. (See appendix for screenshots)

Proposed Solutions:

1) **Explore Alternative APIs:** Attempted to find existing APIs with similar functionality to the ArtMind model, particularly for drawing element detection. However, no suitable free API tools for object detection specific to drawing elements were found.
2) **PyTorch Lite Implementation:** Explored implementing the machine learning model in PyTorch Lite format (.ptl), designed for running models on mobile, embedded, and edge devices. This approach faced challenges due to a limited amount of time for research and lack of experience in applying machine learning models in Android Studio. Though, the PyTorch Lite model (model.ptl) can still be found in the assets folder.
3) **Dominant Colour Analysis:** Changed the approach of drawing analysis by focusing on the dominant colour in the image instead of through image classification. This involved determining whether the dominant colour belonged to the dark or bright spectrum. If the dominant colour is on the dark category, the image is categorized as unhealthy, vice versa. While this approach did not yield highly accurate results, it served as a temporary solution given the time constraints.

Nevertheless, the source code includes the functionality to call the ArtMind model through the RoboflowAPI is in the api folder (RoboflowApi.java). If Roboflow extends support for Android deployment, this code can be utilized. Additionally, the machine learning model created during this process can be accessed and tested through this public Roboflow link.

5.2 Structure

The system is organized into four distinct directories: 'api,' model,' 'component,' and 'utils.' The 'api' directory contains code to connect with the Roboflow API. The 'model' directory houses codes associated with the six models. In the 'component' directory, all codes related to the ten components of the system are stored. Lastly, the 'utils' directory contains reusable public code that can be used across the application.

5.3 Libraries & Reference Code

To enhance the app's functionality, several libraries have been integrated to provide support:

#	Library	Explanation
1.	Country Code Picker	This library facilitates the search and selection of countries or phone codes, aligning with the needs of the Login Phone Number page and Find Help page.
2.	Image Picker	The functionality provided by this library enables users to choose an image from the gallery or capture a new image with the camera, making it ideal for the Scan page.
3.	Android Image Cropper	This library allows users to crop images before uploading them to the system, enhancing the user experience on the Scan page.
4.	Glide	The library supports image loading, an essential feature for displaying user profile pictures on the User page.
5.	Picasso	Image loading functionality provided by this library is important for the Result and History pages.

Some open-source code from GitHub has also been utilized as a reference in the development of ArtMind:

#	Example Code	Explanation
1.	Login with OTP	This code originates from a project aimed at developing an Android Chat Application. For the current project, only the OTP-based login pages are utilized as a reference.
2.	Timer	The fundamental functionality of the countdown timer in this Timer App project served as a reference, incorporating features like set, start, pause, stop, reset, and display the timer.

5.4 Front-end

The xml code for all front-end is located in `res/layout` directory. The screenshots to all pages can be found in Appendix 10.

As Android Studio was employed for project development, XML is used to create an interactive and responsive front-end design. The application comprises a total of 14 pages, encompassing 5 activity pages, with 3 login activities and 1 main activity integrating 10 fragments. Each fragment features a page title and a bottom navigation bar, facilitating seamless navigation across different fragments without necessitating a complete page reload.

The table below depicts 5 important UI widgets used in the front-end design.

#	UI Widget	Description
1.	LinearLayout	Deployed across multiple pages, this component ensures a clean and organized arrangement of other widgets, facilitating both vertical and horizontal layouts.
2.	ScrollView	Applied extensively in various pages, it enables users to scroll through content when the information exceeds the confines of a single screen.
3.	RecyclerView	Incorporated in the Find Help and History pages, this component efficiently handles the presentation of extensive lists of information.
4.	CardView	Paired with the RecyclerView, it contributes to the organized display of information, particularly in the Find Help and History pages.
5.	ViewPager	Uniquely employed in the Ethical Guidelines page, this component enables users to navigate through pages of data via left or right swiping gestures.

In addition, ArtMind extends support for landscape mode and is accessible in three languages (English, Chinese, Malay). Moreover, changing the app's orientation will not trigger a complete activity reload, improving user’s experience. The app is designed to seamlessly navigate between different fragments using the back button.

5.5 Models

The java code for all models is located in java/com/example/artmind/model directory. The table below illustrates the association of each model with its corresponding component.

#	Model	Component	Description
1.	UserModel	UserAccount, Login	Responsible for storing comprehensive user information, including phone number, username, creation timestamp, user ID, and a history list.
2.	TimerModel	FocusTimer	Manages timer-related information such as start time, time remaining, end time, and the timer's running status.
3.	MusicPlayerModel		Facilitates the loading, playing, pausing, and muting of background music in the application.
4.	HistoryModel	History	Facilitates the loading, playing, pausing, and muting of background music in the application.
5.	ColorAnalysisModel	Scan	Analyses colours in uploaded images, categorizing them as either dark or light to determine the overall healthiness of the image.
6.	SharedViewModel	Result	Serves as a shared repository for cropped images, allowing for shared views after user capture, or uploaded images for art analysis.

5.6 Components

The java code for all components is located in java/com/example/artmind/component directory. The ArtMind consist of 10 components, working together as a whole.

#	Component	Explanation
1.	Login	**LoginPhoneNumberActivity** - Allows users to select their country code, ensuring that the phone number entered are relevant to the chosen location.

		- Checks whether the entered phone number is valid. **LoginOTPActivity** - Send OTP code to entered phone number through PhoneAuthOptions.Builder and verify whether the code is sent successfully or not. - Verifies the entered OTP code is correct or not through PhoneAuthCredential. - Integrates with Firebase authentication system through SHA-1 key to enable secure login. - Allows users to resent OTP code after 60s timer. **LoginUsernameActivity** - Verifies whether the user is new or existed, then retrieve user's information from Firebase if users exist. - Checks the entered username is valid or not.
2.	Scan	**ScanFragment** - Request user's device's storage and camera permission through Manifest.permission. - Enables users to upload images either by selecting existing images or taking photos using the device's camera through ImagePicker. - Allows user to crop the uploaded image using Android Image Cropper and save to SharedViewModel before handling over for result analysis.
3.	Result	**ResultFragment** - Utilizes ColorAnalysisModel to categorize the uploaded image (healthy or unhealthy). - Retrieve the cropped image from SharedViewModel and stores the results and image to the user's history list in Firebase. - Display the corresponding result by retrieving information from Firebase and set image from Firestore through Picasso.
4.	History	**HistoryFragment** - Retrieves list of user's history information from Firebase. **HistoryAdapter** - Retrieves all history image from Firestore based on the path received from HistoryModel and display it using Glide. - Presents all histories in a visually organized card view through ViewHolder.

		- Redirects users to the specific Result fragment when the corresponding card view is clicked. **HistoryCard** - Stores information of each historical entry in a CardView.
5.	FindHelp	**FindHelpFragment** - Allows users to select their country using CountryCodePicker, ensuring that the displayed mental health centres are relevant to the chosen location. - Retrieves necessary information from help_centres.json file in assets directory, based on the selected country. **FindHelpAdapter** - Presents the contact information of mental health centres in a visually organized card view through ViewHolder. - Redirect users to the specific website of a mental health centre when the corresponding card view is clicked. **FindHelpCard** - Stores information of each help centres entry in a CardView.
6.	FocusTimer	**TimerFragment** - Allows users to set, start, pause, and stop timer. - Uses CountDownTimer to update the timer every second. - Utilizes SharedPreferences, to store timer information to ensure the timer continues running even when the app is closed or in the background. - Uses MusicPlayerModel which allows users to mute or unmute background music while the timer is active. **TimerCompleteFragment** - Display congratulatory message with the total time focused. **TimerNotificationHelper** - Generates new notification channel through NotificationManagerCompat when the timer is active. - Consistently updates the notification timer using NotificationCompat.Builder. - Cancel the notification when timer stops running.
7.	Settings	**SettingFragment** - Allows users to logout from the app by signing out through FirebaseAuth and clearing the intent.

		- Enables users to navigate to About, EthicalGuideline or Profile page through button click by switching the specific fragment.
8.	About	**AboutFragment** - Display the goals and objectives of the application.
9.	EthicalGuideline	**EthicalGuidelineFragment** - Allows users to scroll through pages. - Display respective pages on page scrolled. **EthicalGuidelineAdapter** - Presents all information on ethical guideline in a view through PageAdapter.
10.	UserAccount	**UserFragment** - Retrieves user's information from Firebase and display it. - Loads the profile picture from Firestore using Glide. - Allows users to update personal information, including the username and profile picture to UserModel. - Establishes a connection with Firebase to ensure that any edits made to user information are updated in the Firebase.

The detailed explanation to all methods and classes can be found at `javadoc/index.html`.

5.7 Utility

The utility stores all the repeated code needed for the application and is located in `java/com/example/artmind/utils` directory. The table below illustrates the description of each utility.

#	Utility	Description
1.	FirebaseUtil	Contains methods for interacting with Firebase, including data retrieval and storage operations. Examples include fetching the current user ID, user details, profile pictures, and histories. Additionally, it facilitates setting and updating user information, profile pictures, and histories.
2.	AndroidUtil	Contains public utility methods employed across various components, such as display toast messages, set images, manage progress icons etc.

5.8 Resources

Within the resources folder, there are six crucial sub-folders. The *drawable* folder houses essential images, icons, or shapes vital for the app's design. In the *font* folder, the main font, Space Grotesk, is stored in TrueType format, featuring variations like bold, light, medium, regular, and semi bold. The *layout* folder encompasses all frontend components presented in XML. The *raw* folder serves as a repository for MP3-formatted music tracks and associated credits. Lastly, the *values* folder contains colour, string, and theme values utilized consistently across the entire application.

5.9 Assumptions

Several assumptions have been made for the project's feasibility.

1. **Local Storage:** The app is assumed to utilize external cloud storage for permanent data and internal mobile device storage for temporary data.
2. **Offline functionality:** The app is assumed to primarily work online, with certain functions requiring Wi-Fi. The Find Help page, however, is assumed to function offline using local storage.
3. **Background Notification:** Background notifications are assumed to be supported to notify the users on timer reminders, even when the application is not actively in use.
4. **Access to Camera and Gallery:** Camera and gallery app are assumed to be supported to allow users to capture or upload images for drawing analysis.
5. **Accessibility:** The app is assumed to be designed for compatibility with various screen sizes and resolutions, ensuring optimal accessibility.
6. **Ethical Considerations:** Information generated by the app is assumed to be validated by professionals in art therapy and psychology for ethical interpretation.

6. TESTING

6.1 Unit Testing

The JUnit framework is employed to conduct unit testing for ArtMind application. JUnit, a widely used testing framework for Java, is used for conducting unit tests. It provides a structured and efficient way to write test cases, execute them, and assert expected outcomes.

Moreover, the ArtMind application employs the Mockito testing framework, which focuses on the testing for MusicPlayerModel class. Mockito provides additional capabilities for creating mock objects and defining their behaviours, enhancing the testing process.

The unit testing files are located within the '`test`' folder of the project structure. This testing is primarily focused on verifying the functionality and behaviour of individual model classes within the application. The table below depicts all the unit testing file and its description.

#	Testing File	Description
1.	`UserModelTest.java`	This file encompasses the unit tests for the UserModel in the application. It verifies whether the username entered is valid or not.
2.	`HistoryModelTest.java`	This file is dedicated to the unit testing of HistoryModel class. It assesses the ability of the model to map history information to/from the history model.
3.	`MusicPlayerModelTest.java`	This file contains unit testing for MusicPlayerModel class. It uses Mockito to verify whether the music has started, paused, or stopped.
4.	`TimerModelTest.java`	This file contains test cases for TimerModel class. It tests whether the timer has been converted correctly.

6.2 Instrumental Testing

For instrumental testing, the ArtMind application relies on the AndroidJUnit framework, an essential tool for conducting comprehensive testing of Android applications.

AndroidJUnit serves as the principal framework for instrumental testing in the ArtMind application. Its purpose is to facilitate the systematic evaluation of the application's behavior and functionalities in a real Android environment.

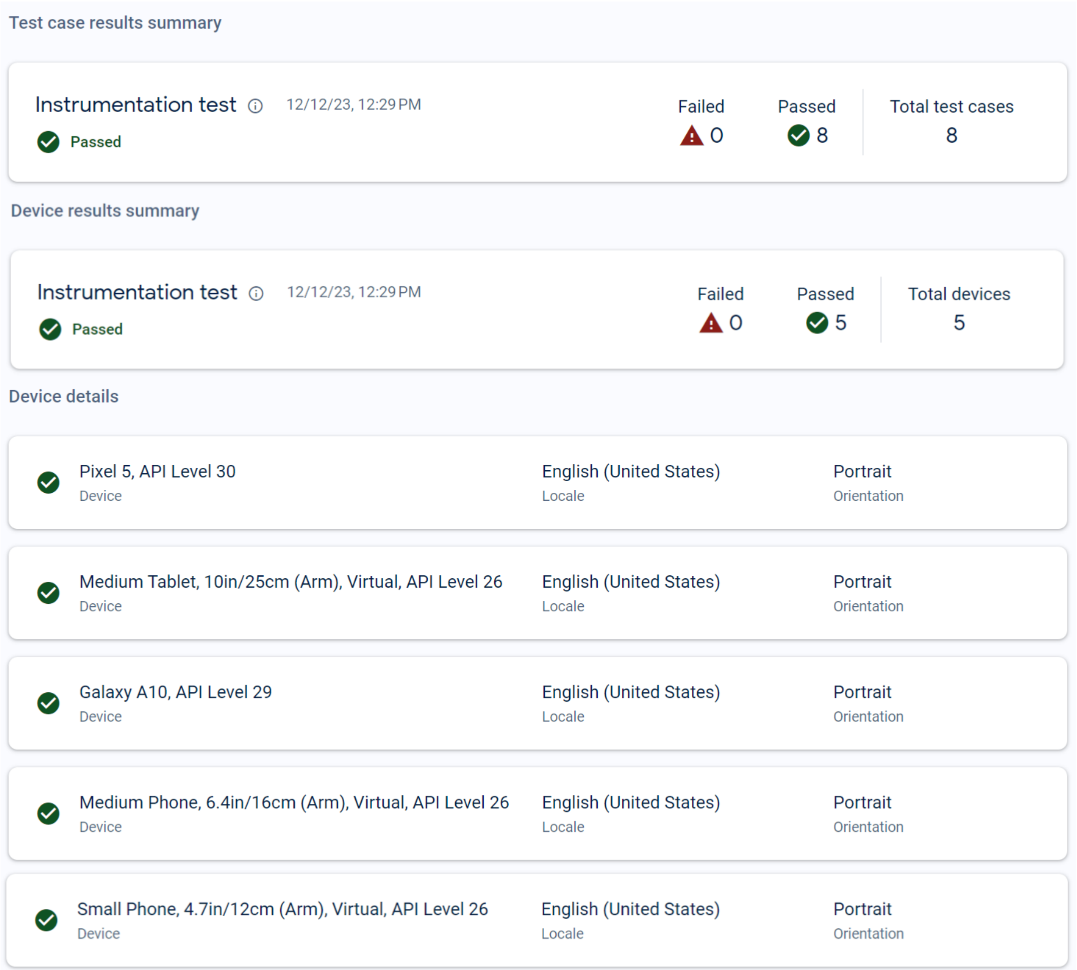
The instrumental testing encompasses 3 main key testing aspects which are user interaction scenarios, virtual device simulation and physical device simulation.

User Interaction Scenarios

The instrumental testing files are located within the '`androidTest`' folder. The table below depicts all the instrumental testing file and its description.

#	Testing File	Description
1.	`LoginPhoneNumberActivityTest.java`	This file encompasses the instrumental tests for the LoginPhoneNumberActivity. It verifies whether the phone number entered is valid or not.
2.	`SettingFragmentTest.java`	This file is dedicated to the instrumental testing of SettingFragment. It assesses the whether the correct fragment is loaded on button click.
3.	`TimerFragmentTest.java`	This file tests whether the timer will be set properly when “Set” and “Reset” button is clicked.
4.	`MainActivityTest.java`	This file contains instrumental testing for MainActivity which test if bottom navigation menu loads the correct fragment.

The outcome of Android testing is presented in the figure below, illustrating the outcomes across 5 distinct devices for total 8 test cases. This testing process was executed through the Firebase Test Lab, providing a comprehensive evaluation of the application's performance.



Test case results summary

Instrumentation test ⓘ 12/12/23, 12:29 PM

✓ Passed

Failed	Passed	Total test cases
⚠ 0	✓ 8	8

Device results summary

Instrumentation test ⓘ 12/12/23, 12:29 PM

✓ Passed

Failed	Passed	Total devices
⚠ 0	✓ 5	5

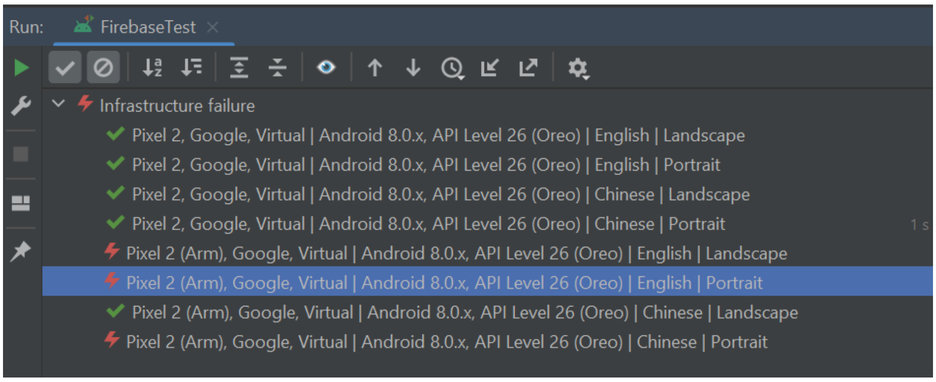
Device details

	Device	Locale	Orientation
✓	Pixel 5, API Level 30	English (United States)	Portrait
✓	Medium Tablet, 10in/25cm (Arm), Virtual, API Level 26	English (United States)	Portrait
✓	Galaxy A10, API Level 29	English (United States)	Portrait
✓	Medium Phone, 6.4in/16cm (Arm), Virtual, API Level 26	English (United States)	Portrait
✓	Small Phone, 4.7in/12cm (Arm), Virtual, API Level 26	English (United States)	Portrait

The results indicate a commendable performance, with all instrumental test cases achieving successful outcomes across all five testing devices. This implies that the application demonstrates robust functionality and consistency in diverse environments, contributing to a positive user experience.

Virtual Device Simulation with Different Orientation and Language

To ensure the robustness and adaptability of the ArtMind application, extensive testing was conducted using virtual devices with diverse configurations. Eight virtual devices were employed, encompassing two distinct device models (Pixel 2, Pixel 2 (Arm)), two languages (English, Chinese), and two orientations (Landscape, Portrait). This comprehensive testing approach aims to assess the application's performance across different device types, language localization, and screen orientations.



```
⚡ Infrastructure failure
    ✓ Pixel 2, Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | English | Landscape
    ✓ Pixel 2, Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | English | Portrait
    ✓ Pixel 2, Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | Chinese | Landscape
    ✓ Pixel 2, Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | Chinese | Portrait      1 s
    ⚡ Pixel 2 (Arm), Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | English | Landscape
    ⚡ Pixel 2 (Arm), Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | English | Portrait
    ✓ Pixel 2 (Arm), Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | Chinese | Landscape
    ⚡ Pixel 2 (Arm), Google, Virtual | Android 8.0.x, API Level 26 (Oreo) | Chinese | Portrait
```

As shown in the figure above, out of the eight simulated scenarios, five passed the testing criteria successfully. However, three tests conducted on the Pixel 2 (Arm) configuration yielded inconclusive results. This outcome highlights the necessity of further investigation and refinement in the application's compatibility with this specific device model.

While both unit testing and instrumental testing were conducted, it is imperative to acknowledge that these efforts were constrained by time limitations, particularly due to concurrent commitments to other coursework. The comprehensive nature of the application and the scope of its functionalities necessitated a meticulous testing process, and while substantial testing was achieved, certain aspects were not explored to their fullest extent.

Physical Device Simulation

During physical device simulation, the application was rigorously tested on a Xiaomi POCO X3 with default English locale.

Issues Identified:

a) When users stop the timer and rerun it, a duplication of notifications occurs.
b) Another small issue was observed – the timer stops when users leave TimerFragment. A comprehensive solution for this issue is yet to be implemented.
c) Additionally, the bgm for TimerFragment functions only when users are within the fragment. It automatically stops when users exit the fragment.

Workaround:

a) To address the duplication issue, a connection between the countdown timer in TimerFragment and the TimerNotificationHelper class. This dependency ensures that TimerNotificationHelper relies on TimerFragment, resolving the duplicated notification problem.
b) The workaround for issue (b) and (c) are yet to be solved.

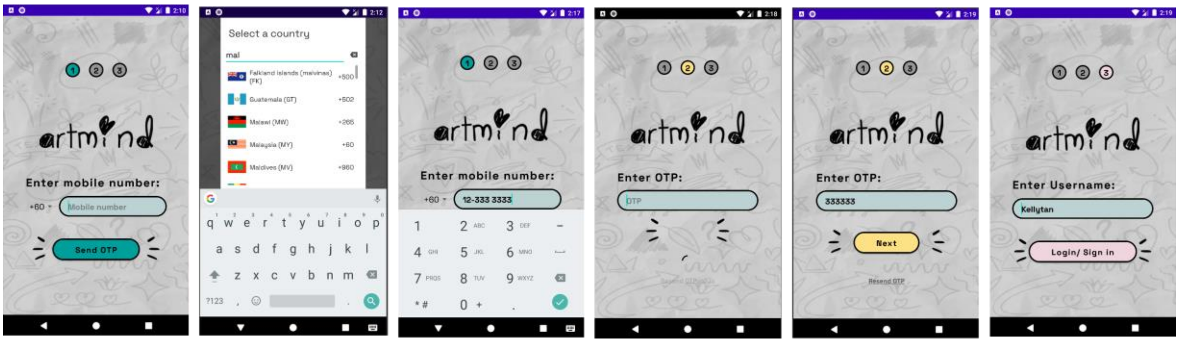
7. USER DOCUMENTATION

Full screenshots of ArtMind mobile app can be found in this Figma link.

Login Process

For new users to access the app, phone number sign-in is required. Upon successfully signing in, subsequent attempts will be automatically logged in.

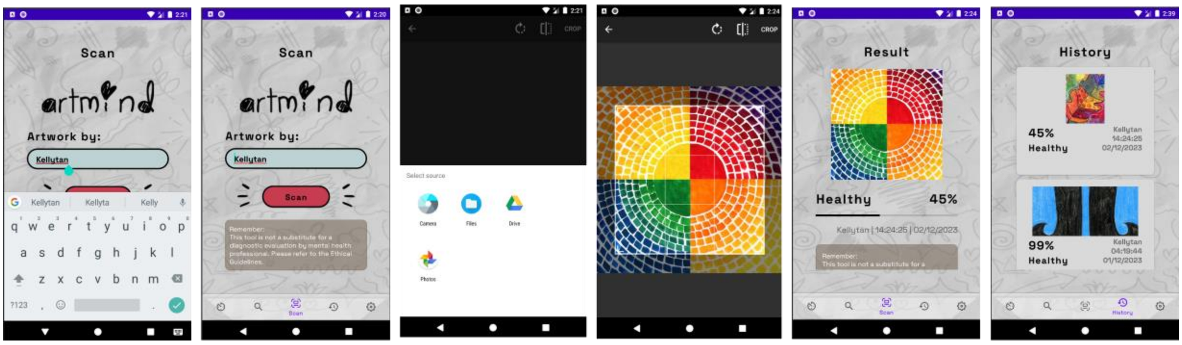
<table>
<tr><th>Successful</th><th>Unsuccessful</th></tr>
<tr><td colspan="2">Login Phone Number Page</td></tr>
<tr><td>1) Select your country code.
2) Enter your mobile number.
3) Click “Send OTP” button to navigate to Enter OTP page.</td><td>4) Check if you have selected the correct country code which matches your entered mobile number.</td></tr>
<tr><td colspan="2">Login OTP Page</td></tr>
<tr><td>5) Select your country code.
6) Enter your mobile number.
7) Click “Send OTP” button to navigate to Enter Username page.</td><td>8) Check your internet connection if you did not receive the OTP.
9) Click “Resend OTP” text to receive new OTP.</td></tr>
<tr><td colspan="2">Login Username Page</td></tr>
<tr><td>10) Select your country code.
11) Enter your mobile number.
12) Click “Send OTP” button to navigate to Scan page.</td><td>13) Make sure you have entered valid username (3-10 characters).</td></tr>
<tr><td colspan="2">Screenshots:



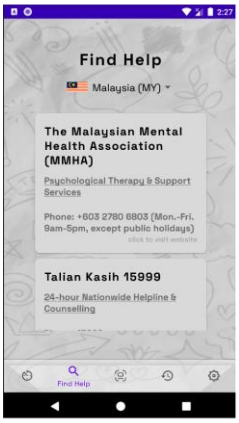
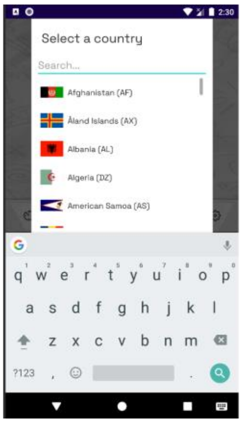
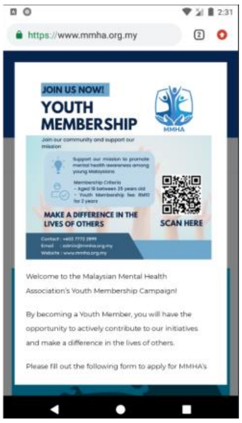
</td></tr>
</table>

Art Analysis

For users to use this functionality, permission to access camera and gallery app is needed.

Successful	Unsuccessful
Scan Page	
1) Enter your username. 2) Click “Scan” button. 3) Select source to upload image. 4) Edit the image (rotate, flip, crop). 5) Click “Crop” button and you will be redirected to Result page.	6) Check your app permission and make sure camera and gallery app is allowed.
Result Page	
7) Scroll to view the result’s information. 8) Click back to navigate to History page.	
History Page	
9) The history is arranged from latest to oldest. Scroll down to view the previous histories. 10) Click on the history card to navigate to corresponding Result page.	11) Make sure you have strong Wi-Fi connection to load the image.
Screenshots:  Artwork by: Kellytan Remember: This tool is not a substitute for a diagnostic evaluation by mental health professional. Please refer to the Ethical Guidelines. Select source Healthy 45% Kellytan | 14:24:25 | 02/12/2023 Remember: This tool is not a substitute for a 45% Healthy Kellytan 14:24:25 02/12/2023 99% Healthy Kellytan 04:19:44 01/12/2023 Scan artmind Kellytan Kellyta Kelly Scan CROP Camera Files Drive Photos Result History	

Find Help

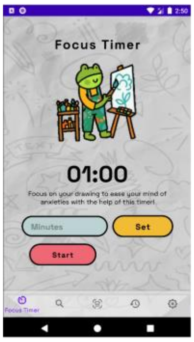
Successful	Unsuccessful
Find Help Page	
1) Select your country. 2) List of mental health centres will be shown. 3) Click on Find Help card to navigate corresponding mental health website.	4) No mental health centres found for your selected country. Please kindly wait for system update.
Screenshots:  Find Help Malaysia (MY) The Malaysian Mental Health Association (MMHA) Psychological Therapy & Support Services Phone: +603 2780 6803 (Mon.-Fri. 9am-5pm, except public holidays) click to visit website Talian Kasih 15999 24-hour Nationwide Helpline & Counselling  Select a country Search... Afghanistan (AF) Åland Islands (AX) Albania (AL) Algeria (DZ) American Samoa (AS)  https://www.mmha.org.my JOIN US NOW! YOUTH MEMBERSHIP Join our community and support our mission Support our mission to promote mental health awareness among young Malaysians Membership Criteria - Aged 18 between 25 years old - Youth Membership fee: RM10 for 2 years MAKE A DIFFERENCE IN THE LIVES OF OTHERS SCAN HERE Website : www.mmha.org.my Welcome to the Malaysian Mental Health Association's Youth Membership Campaign! By becoming a Youth Member, you will have the opportunity to actively contribute to our initiatives and make a difference in the lives of others. Please fill out the following form to apply for MMHA's	

Focus Timer

For users to use this functionality, permission to access notification is needed.

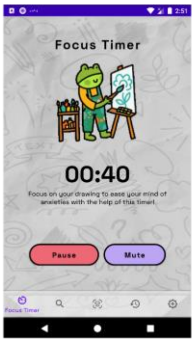
Successful	Unsuccessful
Focus Timer Page	
1) Enter your desired focus minutes. 2) Click “Set” button to set the timer. 3) Click “Start” button to start countdown timer. 4) Notification with timer will pops out. 5) Background music will start. 6) Click “Mute” button to mute the music. 7) Vice versa, click “Unmute” button to unmute the music. 8) Click “Pause” button to pause the timer. 9) Click “Reset” button to reset the timer. 10) When timer completes, you will be redirected to Timer Completion page.	11) Check your app permission and make sure pop-up notification is allowed.
Focus Timer Completion Page	
12) Click “Back” button to navigate back to Focus Timer Page.	

Screenshots:


Focus Timer

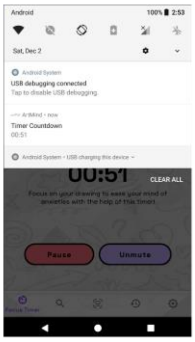
01:00

Focus on your drawing to ease your mind of anxieties with the help of this timer!


Focus Timer

00:40

Focus on your drawing to ease your mind of anxieties with the help of this timer!


Android 100% 2:53

Sat, Dec 2

Android System

USB debugging connected

Tap to disable USB debugging

ArtMind • now

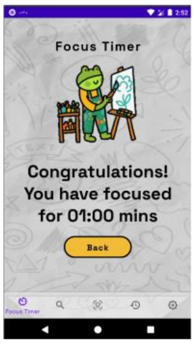
Timer Countdown

00:51

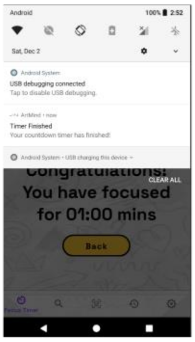
Android System • USB charging this device

00:51

Focus on your drawing to ease your mind of anxieties with the help of this timer!


Focus Timer

Congratulations! You have focused for 01:00 mins


Android 100% 2:52

Sat, Dec 2

Android System

USB debugging connected

Tap to disable USB debugging

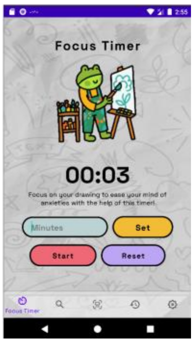
ArtMind • now

Timer Finished

Your countdown timer has finished!

Android System • USB charging this device

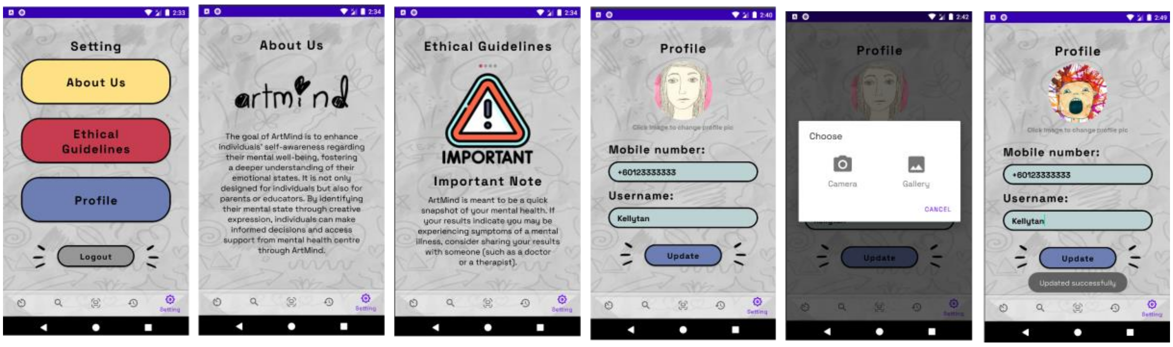
Congratulations! You have focused for 01:00 mins


Focus Timer

00:03

Focus on your drawing to ease your mind of anxieties with the help of this timer!

App Settings

Successful	Unsuccessful
Scan Page	
1) Click “About Us” button to navigate to About Us page. 2) Click “Ethical Guidelines” button to navigate to Ethical Guidelines page. 3) Click “Profile” button to navigate to Profile page. 4) Click “Logout” button to logout from the app.	
About Us Page	
5) Scroll and view the goal of the app.	
Ethical Guidelines Page	
6) Swipe left and right to view all ethical guidelines.	
Profile Page	
7) Enter new username. 8) Click on the image to change profile picture. 9) Edit the image (rotate, flip, crop). 10) Click correct icon to upload image. 11) Click “Update” button to save the new information.	12) Check your app permission and make sure camera and gallery app is allowed.
Screenshots:  The goal of ArtMind is to enhance individuals' self-awareness regarding their mental well-being, fostering a deeper understanding of their emotional states. It is not only designed for individuals but also for parents or educators. By identifying their mental state through creative expression, individuals can make informed decisions and access support from mental health centre through ArtMind. Important Note ArtMind is meant to be a quick snapshot of your mental health. If your results indicate you may be experiencing symptoms of a mental illness, consider sharing your results with someone (such as a doctor or a therapist). Mobile number: +60123333333 Username: Kellytan Updated successfully	

8. DEPLOYMENT

The GitHub for ArtMind application can be found at this link.

Below is a comprehensive guide detailing the deployment process of ArtMind application:

1. APK File:
   Use Android Studio to build the final version of the ArtMind application. Then, select the "Build" menu and choose the "Build Bundle(s) / APK(s)" option. Lastly, opt for the "Build APK(s)" selection to generate the APK file for deployment.

2. Configure APK for Production:
   Ensure that the APK is properly configured for production. Perform necessary optimizations, such as code obfuscation and minification, to enhance security and reduce file size.

3. Versioning:
   Update the version number and version code in the AndroidManifest.xml file to reflect the new version of the application.

4. Release Notes:
   Prepare release notes outlining the changes, new features, and any critical information for users. This enhances communication and transparency during the deployment.
5.
6. Firebase Configuration:
   Ensure that the Firebase configuration file (google-services.json) is updated for production use.

7. Localization and Language Support:
   Confirm that the application's localization and language support are configured appropriately. Check the language resources and translations to ensure a seamless user experience.

8. Testing in Production Mode:
   Prior to deployment, conduct thorough testing in a production-like environment or physical device to identify and address any issues specific to the deployment configuration.

9. Publish to Google Play Store:
   If using the Google Play Store, follow the guidelines for submitting and publishing applications. Provide all necessary details, screenshots, and promotional materials.

9. REFERENCES

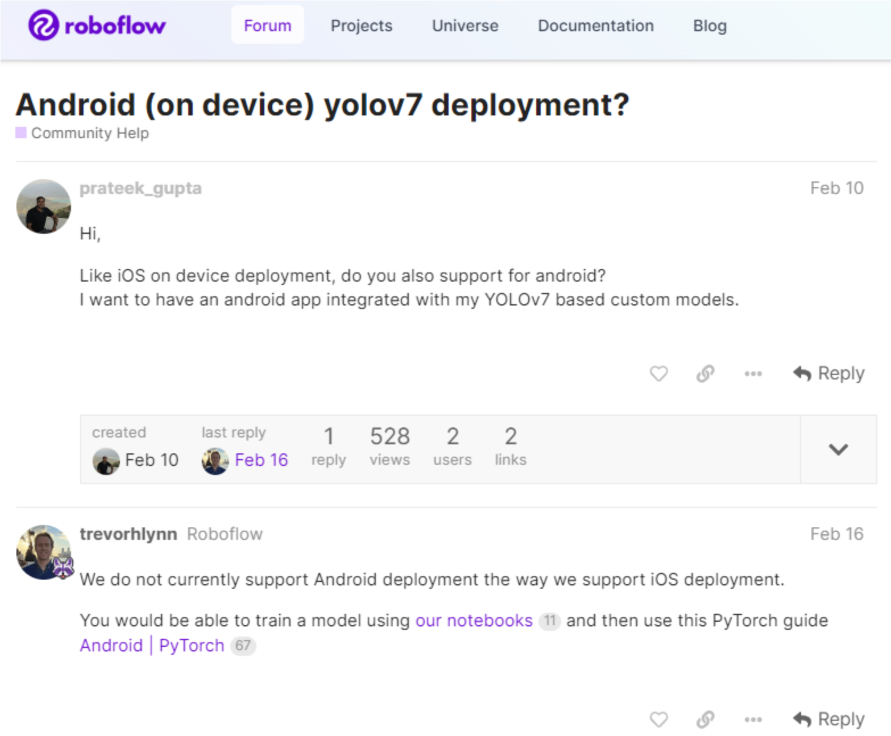
Bunkham, S. (2023). Support for mental health issues. British Journal of Midwifery, 31(6), 306–307, doi: 10.12968/bjom.2023.31.6.306

Hutyrová, M. (2016). 10. Utilization of Narrative Approach in Art Therapy in Children with Behavioural Problems. Review of Artistic Education, 12(2), 284–289, doi: 10.1515/rae-2016-0034

Rens, E., Michielsen, J., Dom, G., Remmen, R., & Van den Broeck, K. (2022). Clinically assessed and perceived unmet mental health needs, health care use and barriers to care for mental health problems in a Belgian general population sample. BMC Psychiatry, 22(1), 455, doi: 10.1186/s12888-022-04094-9

10. APPENDIX

Screenshots of Roboflow Community Forum:



Android (on device) yolov7 deployment?

Community Help

prateek_gupta — Feb 10

Hi,

Like iOS on device deployment, do you also support for android?
I want to have an android app integrated with my YOLOv7 based custom models.

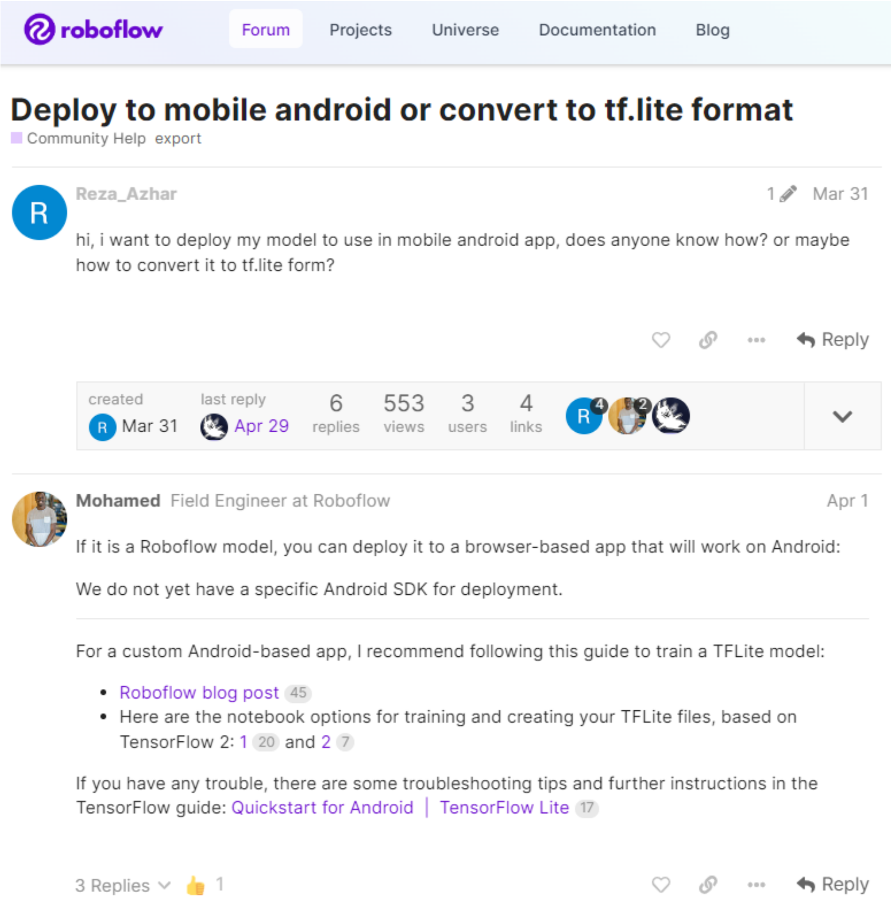
created Feb 10 · last reply Feb 16 · 1 reply · 528 views · 2 users · 2 links

trevorhlynn Roboflow — Feb 16

We do not currently support Android deployment the way we support iOS deployment.

You would be able to train a model using our notebooks 11 and then use this PyTorch guide Android | PyTorch 67

[Source]



Deploy to mobile android or convert to tf.lite format

Community Help export

Reza_Azhar — 1 — Mar 31

hi, i want to deploy my model to use in mobile android app, does anyone know how? or maybe how to convert it to tf.lite form?

created Mar 31 · last reply Apr 29 · 6 replies · 553 views · 3 users · 4 links

Mohamed Field Engineer at Roboflow — Apr 1

If it is a Roboflow model, you can deploy it to a browser-based app that will work on Android:

We do not yet have a specific Android SDK for deployment.

For a custom Android-based app, I recommend following this guide to train a TFLite model:

- Roboflow blog post 45
- Here are the notebook options for training and creating your TFLite files, based on TensorFlow 2: 1 20 and 2 7

If you have any trouble, there are some troubleshooting tips and further instructions in the TensorFlow guide: Quickstart for Android | TensorFlow Lite 17

3 Replies 👍 1

[Source]

Important Links:

GitHub: https://github.com/kellyzen/ArtMind

User Interface Design: https://www.figma.com/file/uUu6NdPb0CwrO8vay4IAPz/ArtMind--Mobile-App-for-Mental-Health?type=design&node-id=0%3A1&mode=design&t=7ilRWOcOzJsiEPjq-1

Screenshots: https://www.figma.com/file/uUu6NdPb0CwrO8vay4IAPz/ArtMind--Mobile-App-for-Mental-Health?type=design&node-id=338%3A2239&mode=design&t=7ilRWOcOzJsiEPjq-1

Gantt Chart: https://www.figma.com/file/ZuuxaGTxxyjKgyimctLQmU/Mobile--Gantt-Chart?type=whiteboard&node-id=1%3A376&t=8HsWt4XlJfCCsNaS-1

ArtMind Roboflow ML Model: https://universe.roboflow.com/artmind/mental-health-drawing/model/1