

1) Introduction:

Piece of Mind, is an application that utilizes reminiscence therapy to help people with dementia to slow down cognitive deterioration and loss of personhood. This application is focused on pwd in stages 3 to 5, or any pwd that has the cognitive and motor skills to use a tablet/phone and solve a jigsaw puzzle. The app uses photos with special meanings towards the pwd, which are uploaded by the caregiver, to generate a jigsaw puzzle for the pwd to solve. The caregiver will then be given the ability to modify certain attributes of the puzzle (such as the shape or the number of tiles in the puzzle) to facilitate the puzzle-solving process for the patient, while exercising and stimulating their brain. In addition, the application will have the option for the caregiver to write a short sentence or phrase to be displayed after the puzzle is finished. Not only this will help the pwd to gain a better recognition of the image, but it will also provide positive reinforcement for them to solve more puzzles. An assistance system will also be included for the puzzle that is meant to guide the pwd during the puzzle-solving process in case they require the extra help.

2) Intended Audience List:

Our first target user is the **caregiver**. Based on the app that we are developing, we came to a realization that it would be extremely difficult for the pwd to use the application by themselves. Therefore, we are giving the caregiver the ability to use the application and set up the puzzle for the patient. We are assuming that the caregiver is comfortable with using technology and they have access to an android device. It is also essential for the caregiver to have some photos in the gallery (which have a special meaning to the pwd) to use as a puzzle for the patient to solve. The goals of the caregiver would be to keep the pwd focused on solving the puzzle for a period of time while having an enjoyable experience from solving the puzzle and the picture that will be showcased after finishing it. The caregiver wants to have the ability to adjust the difficulty of the jigsaw puzzle so that it suits the pwd's cognitive and motor skills.

The pwd will be the second user, who will be the ones to solve the puzzle. The main assumption is that the pwd that is solving the puzzle, is within stages 3 - 5 or has the cognitive and the motor skill to use a phone/table and solve a jigsaw puzzle. It is also important that the pwd has some photos from their past that can be potentially used in the application. The patient's main goal will be to use the photo as a motivation to solve the puzzle and train their brain to help them in the long run. The pwd would also want to use the pictures as a way to remember their past and somewhat gain back their sense of personhood.

3) Guidelines:

IntelliJ 2022.1.3 and Android Studio Chipmunk 2021.2.1 are the main tools for our integrated development environments. IntelliJ will be used for the Java programming of our app framework, which includes the puzzle logic, OS interaction, and interfacing with other technologies. After mocking up a model with AdobeXD, Android studio will be used to develop our frontend with XML.

Firebase version 20.0.5 will also host our database, a NoSQL database that will be used for bug reports, average time spent on solving the puzzle and other statistics that can help in improving the application. Additionally, in order to utilize GitLab continuous integration tools, we will write scripts with Yaml for managing configurations and formatting. For the final delivery of our application, we will be using Apache Maven 3.8.6 to streamline build

dependencies. Docker will also be looked into to see whether or not our product will benefit from it.

Ethical and legal issues that are important to note are data privacy, and puzzle generation. Data privacy would be the biggest concern as users not only import photos into the application, but also give our app access to the user's photo directory. We will emphasize that there is no data tracking, meaning that the photos will never be shared with any other devices - including ours (the developers). For puzzle generation we will also strive to achieve a balanced difficulty scale in order to be inclusive for different abilities of our users.

The whole list of technologies are

- Java (latest version)
- XML 1.1
- Docker version 20.10.17
- Android Studio Chipmunk version 2021.2.1
- IntelliJ version 2022.1.3
- Gitlab version 15.0.1 (SFU)
- Yaml version 1.2.2
- Firebase version 20.0.5
- Adobe XD version 44.0.12
- Apache Maven 3.8.6

4) Requirements:

<i>User Story 1: Gallery Access</i>	
Business Value	Very High
Description	As a caregiver, I want to be able to access the gallery through the application so that I can choose any photo I desire for the jigsaw puzzle.
Acceptance Criteria	<ul style="list-style-type: none">● The application has a dedicated button for accessing all the photos from the phone/tablet's gallery● The caregiver can choose any photo as long as it is available in the gallery● The photo will not be stretched or scaled automatically by the application when it is generated into a puzzle
Assumptions	<ul style="list-style-type: none">● The caregiver has some photos stored in the gallery● The caregiver has allowed the application to access their gallery
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 2: Difficulty Change</i>	
Business Value	High
Description	As a caregiver, I wish to be able to change the puzzle's difficulty so that I can choose the proper difficulty based on my patient's ability to solve a jigsaw puzzle.
Acceptance Criteria	<ul style="list-style-type: none"> • The application has a dedicated button for difficulty settings • The difficulty setting offers multiple ways of changing the difficulty such as changing the number or the shape of the puzzle pieces • The difficulty settings will not change unless the user changes them • The difficulty settings will only be accessible through the main menu
Assumptions	<ul style="list-style-type: none"> • The user does not wish to change the difficulty settings while solving a puzzle
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 3: Sentence Writing</i>	
Business Value	High
Description	As a caregiver, I want to be able to write a short sentence for each of the puzzles so that it will be displayed for my patient after they solve the puzzles.
Acceptance Criteria	<ul style="list-style-type: none"> • After choosing the photos, the caregiver will have access to a text box, where they can write their sentence/phrase to be displayed after each puzzle • Each puzzle/image will have a unique sentence/phrase attached to it • The text box will have a 100 character limit • The sentence/phrase writing will be an optional feature • After a puzzle is solved by the patient, the sentence/phrase will be displayed at the bottom of the puzzle

Assumptions	<ul style="list-style-type: none"> The caregiver does not wish to write a sentence/phrase longer than 100 characters
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 4: Assistance System</i>	
Business Value	Low
Description	As a patient with dementia, I want the application to have an assistance feature so that I get guidance on where the next puzzle piece should go when I get stuck solving the puzzle.
Acceptance Criteria	<ul style="list-style-type: none"> An “Assistance” button next to the puzzle that the pwd is solving to show the placement for the next puzzle piece The caregiver can disable/enable the assistance button
Assumptions	<ul style="list-style-type: none"> None
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 5: Continuous Experience</i>	
Business Value	Low
Description	As a caregiver, I want the application to provide a continuous experience that easily flows from one puzzle to another until the pwd no longer wishes to play.
Acceptance Criteria	<ul style="list-style-type: none"> Ability to upload multiple photos at once Once a puzzle is completed, the app moves onto the next puzzle within 5 seconds
Assumptions	<ul style="list-style-type: none"> Assume pwd has multiple photos that can be used for puzzles
Submitted By	Callum Alexander

Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 6: Image Modification</i>	
Business Value	Low
Description	As a caregiver, I want to be able to modify my image through the application, so that it can fit the outline of the puzzle.
Acceptance Criteria	<ul style="list-style-type: none"> • A dedicated button for modifying the uploaded photos • The caregiver can stretch, resize or crop the photo from this menu
Assumptions	<ul style="list-style-type: none"> • None
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 7: Reusability</i>	
Business Value	Very low
Description	As a caregiver, I wish to be able to access my previous puzzles so that I can reuse them in the future.
Acceptance Criteria	<ul style="list-style-type: none"> • A button in the main menu to access the previous puzzles • The application will save the last 10 puzzles solved by the pwd • The feature will be usable for the caregiver after the pwd has solved their first puzzle in the application
Assumptions	<ul style="list-style-type: none"> • The pwd has solved at least one puzzle in the application
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

<i>User Story 8: Enhanced Visual Clarity</i>	
Business Value	Low
Description	As a caregiver, I wish to be able to change the image's contrast and saturation so that the pwd is able to differentiate the colors more easily.
Acceptance Criteria	<ul style="list-style-type: none"> Option to change saturation and contrast in the puzzle settings section A reference image for the caregiver to see the effect of the contrast/saturation changes for the puzzle
Assumptions	<ul style="list-style-type: none"> The pwd does not possess a severe case of vision impairment
Submitted By	Sepehr Ahmadipourshirazi
Submitted On	06.07.2022
Last Modified	18.07.2022

b) Prioritizing the requirements: rank the importance of the requirements. MoSCoW (Must, Should, Could and Won't) is a common technique for Agile Project.

MoSCow Rank	Story ID & Title
Must do	#1 - Gallery Access
Should do	#2 - Difficulty Change #3 - Sentence Writing
Could do	#8 - Enhanced Visual Clarity #4 - Assistance System #5 - Continuous Experience #6 - Image Modification
Won't do	#7 - Reusability

c) Further divide a user story into individual tasks.

Story Title	Task
Gallery Access	1.1 Gaining access to gallery (app permissions) 1.2 Button to access gallery 1.3 Make photo chosen not be cropped or stretched
Difficulty Change	2.1 Button to access settings in main menu 2.2 Settings to alter number of pieces / size of pieces
Sentence Writing	3.1 After image was selected, an optional text box is prompted 3.2 Attach each text/phrase to the photo it is about 3.3 After puzzle is solved, display text underneath photo
Assistance System	4.1 An assistance button adjacent to puzzle to show placement of puzzle piece 4.2 Ability for caregiver to enable/disable assistance button in settings
Continuous Experience	5.1 Ability to select multiple photos at once 5.2 Once puzzle has been completed, move on to next puzzle
Image Modification	6.1 A prompt following choosing a photo that asks if the user would want to edit the photo in some way 6.2 A menu that allows the user to stretch, crop and/or resize the photo to the desired parameters
Reusability	7.1 A button that only appears after a puzzle has been solved that allows access to previous puzzles 7.2 After the button is pressed, it displays the previous 10 puzzles where any one of them can be selected and replayed.
Enhanced Visual Clarity	8.1 Ability to alter the contrast/saturation of the image in settings 8.2 Add reference image adjacent to the image being altered

d) Develop a release plan: a schedule for delivering working software to the users. You will be going through three implementation iterations (sprints) during this project --- Release 1, Release 2, and Release 3. Label each user stories and tasks as being delivered in various releases.

- Release 1:
 - The main goal of the team during sprint one is to have a functional jigsaw puzzle. This means that once the user opens the application, they will only be able to solve a jigsaw puzzle with a default picture that cannot be changed. The software

after sprint one will have an extremely simple UI and it will not include any additional features.

- Main tasks:
 - Working puzzle with a simple UI
 - User stories covered:
 - None
- Release 2:
 - During sprint two, the team will build a workable puzzle game and work more on the UI. The aim of the second sprint is to add puzzle features so that the caregiver can choose their desired photo from the gallery for the puzzle. Furthermore, the UI will be improved to ease the process of navigation and working with the application. The sentence writing feature of the puzzle will also be implemented during this sprint.
 - Main tasks:
 - Have a workable puzzle game
 - Improved UI
 - User stories covered:
 - #1 Gallery Access
 - #3 Sentence Writing
 - Release 3:
 - The final sprint will include two main stages. In The first stage, the team will implement the database, which will be used for features such as bug reports. The second stage is the final wrap-up where the team will go over the entire application together to ensure that no requirement is left unchecked and check whether the different functionalities of the application work as intended. During this sprint, the team will implement the difficulty feature first, then decide on whether the remaining window of time will allow the implementation of some of the extra low-priority features such as the assistance system and the image modification.
 - Main tasks:
 - Have a functioning database
 - Have a functioning settings feature
 - Check for any bugs/errors in the final version of the projects
 - Discover any unchecked requirements
 - Project review
 - User stories covered (potentially)
 - #2 Difficulty Change

5) System Architecture Diagrams

Diagram #1: Class Diagram of the puzzle

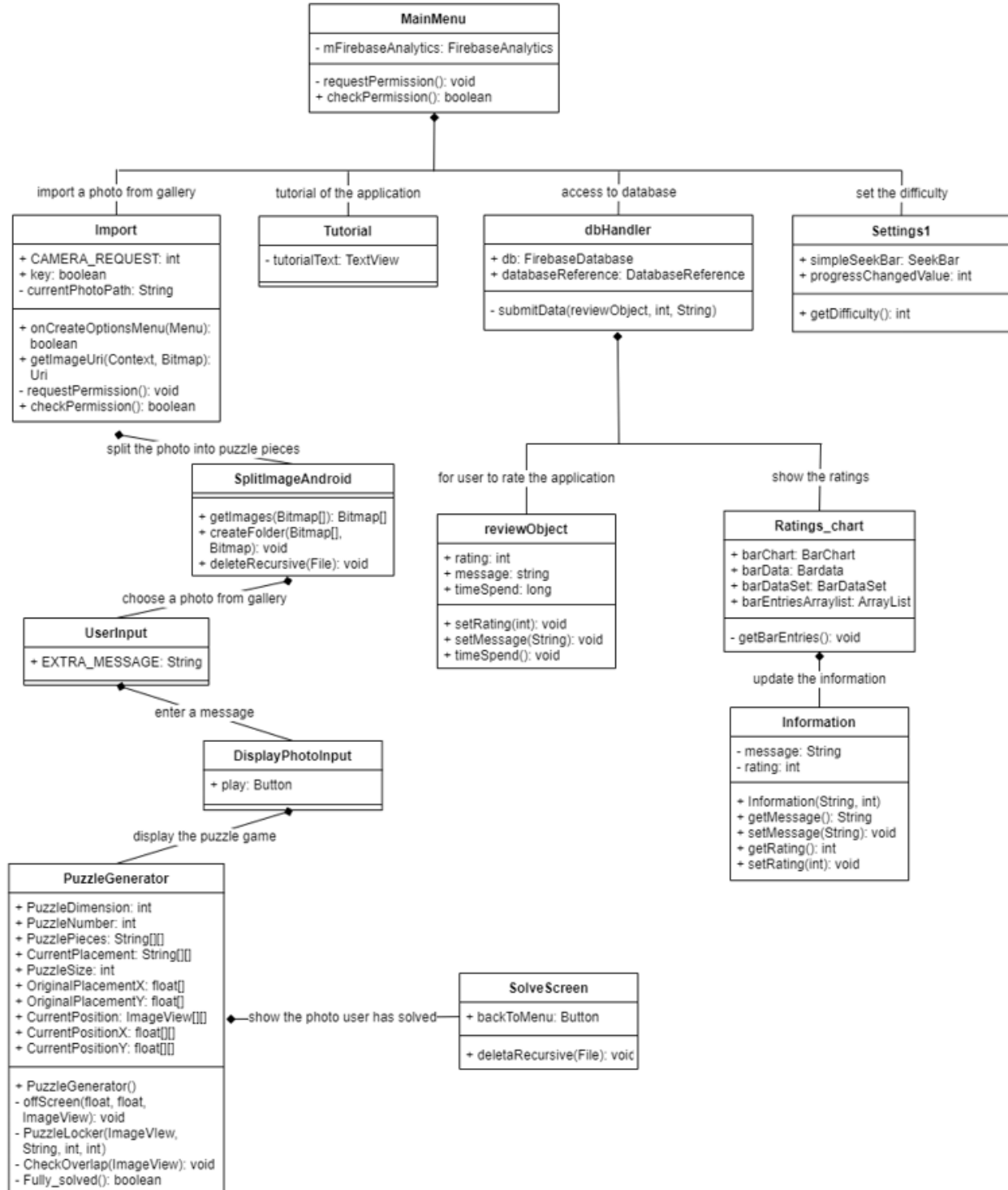
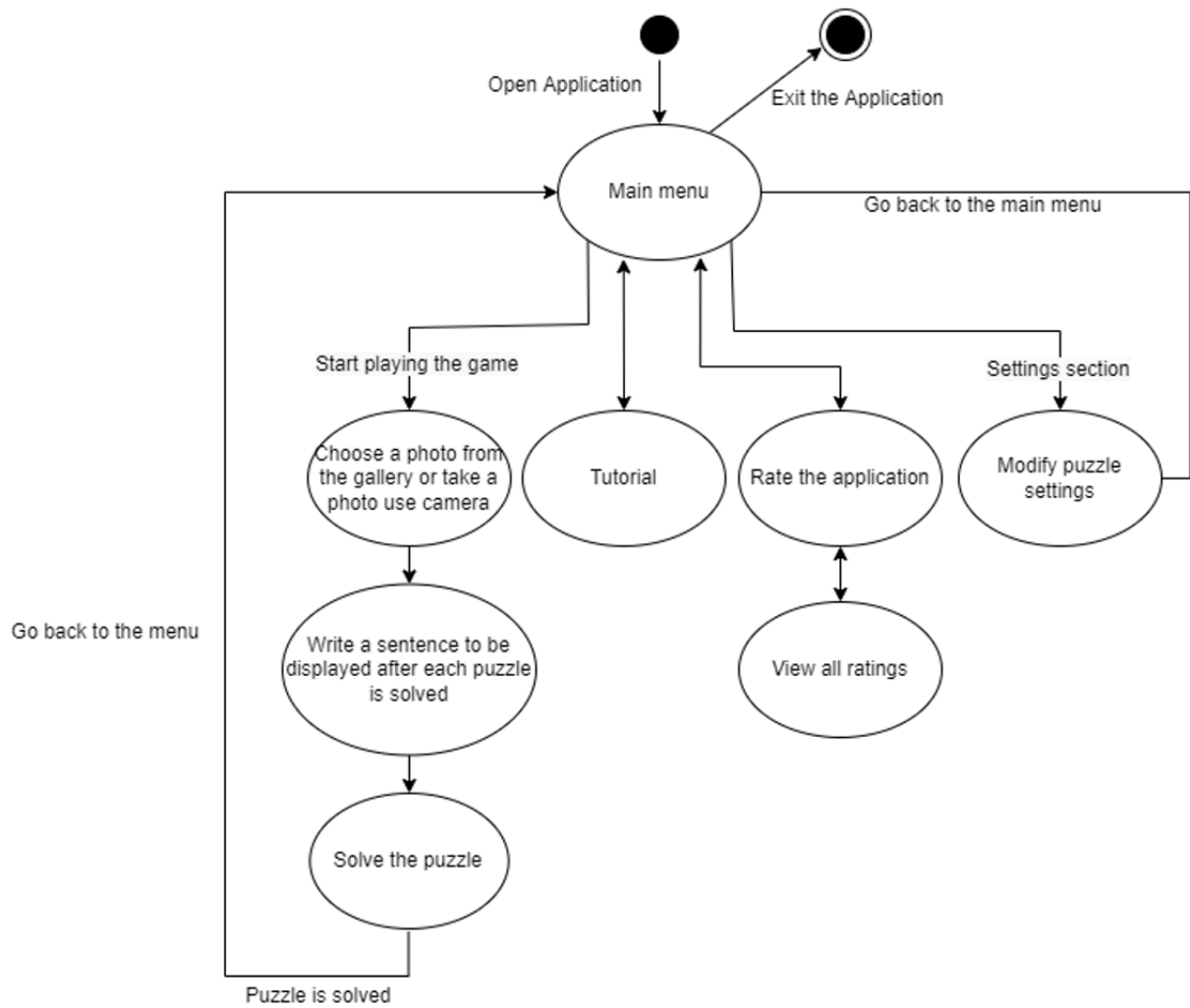


Diagram #2: Activity Diagram for the puzzle



6) Data Requirements

Main Files:

File name	Description
MainMenu.java	Displays the main menu (main activity) of the application and allows the user to navigate to the puzzle game or the application settings.
Import.java	This function allows the user to retrieve an image from his/her gallery and stores the image.
UserInput.java	Displays a blank line for the user to type a sentence based on the image chosen. The sentence is stored and transferred to the DisplayPhotoInput activity.
DisplayPhotoInput.java	Combines the chosen image and the sentence inputted by the user.
PuzzleGenerator.java	This function generates the puzzle based on the image chosen by the user.
Settings1.java	Outlines a list of options the user can modify, such as the difficulty of the game and the application color contrast.
SplitImageAndroid.java	Loads and splits the chosen image to puzzle pieces by desired columns and rows.
SolveScreen.java	This function displays the photo the user has solved and a button to go back to the main menu.
Tutorial.java	This function contains some tutorials of the game for the caregiver.
dbHandler.java	This function accesses the database to update ratings and review all past ratings.
reviewObject.java	Stores all user's rating inputs such as rating scores and comments.
Information.java	Updates the user's input to the database.
Ratings_chart.java	Show the bar chart record of all past rating

	scores.
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Database Schemas:

- Feedback(FeedBackID: int, TimeSpent: int, Report: string, UseTime: int, Rating: int)

Other systems

Android photo directory (requestPermissions())

Screen input

Android system wifi

7) Glossary

Term	Description
Caregiver	A family member or paid helper who regularly looks after a child or a sick, elderly, or disabled person
Cognitive Deterioration	Cognitive functions such as memory, language, and reasoning show declines and abnormalities.
Database	An organized collection of data, typically stored electronically in a computer system
Data Privacy	An area of data protection that deals with handling sensitive data to meet regulatory requirements
Data Tracking	The process of selecting specific metrics to track, then collecting, organizing, and analyzing the resulting data
Dementia	A chronic or persistent disorder of the mental processes caused by brain disease or injury and marked by memory disorders, personality changes, and impaired reasoning
Dependency	A file or component in the form of software packages essential for a program to run correctly
Ethical	Relating to moral principles or the branch of knowledge dealing with these
Gallery	The place where all the photos are stored in a mobile/tablet device
Jigsaw Puzzle	A puzzle where a picture is divided into pieces that must be fit together
Positive Reinforcement	The introduction of a desirable or pleasant stimulus after a behavior

Puzzle Piece	A piece of a puzzle, typically of a square shape with notches and pegs on the sides
Pwd	Person with Disabilities
Reminiscence	The enjoyable recollection of past events
UI	User Interface