

QURAN MEMORIZING INTERACTIVE  
APPLICATION FOR AUTISTIC CHILDREN

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Bachelor Of Computer Science (Software  
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CHILDREN

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## **ABSTRAK**

Projek yang dicadangkan ini bertujuan untuk membangunkan aplikasi interaktif untuk membantu kanak-kanak autisme menghafal Al-Quran. Aplikasi ini akan menggunakan bantuan visual, rakaman audio, dan latihan pengulangan yang disesuaikan dengan keperluan pembelajaran kanak-kanak autisme. Melalui penggunaan ciri interaktif, aplikasi ini bertujuan meningkatkan penglibatan, pengingatan, dan pemahaman terhadap pengajaran Al-Quran. Projek ini juga melibatkan ujian dan penilaian untuk memastikan keberkesanannya, dengan potensi memberikan pandangan berharga kepada bidang pendidikan Islam dan penyelidikan autisme. Pada akhirnya, projek ini berusaha menyediakan alat yang unik dan berkesan bagi kanak-kanak autisme untuk belajar dan menghafal Al-Quran, meningkatkan keterlibatan keagamaan mereka dan memperkembangkan perkembangan pendidikan mereka.

## **ABSTRACT**

This proposed project aims to develop an interactive application to assist autistic children in memorizing the Quran. The application will utilize visual aids, audio recordings, and repetition exercises tailored to the learning needs of autistic children. Through the use of interactive features, the application seeks to enhance engagement, recall, and comprehension of the Quranic teachings. The project will involve testing and evaluation to ensure its effectiveness, with the potential to contribute valuable insights to the fields of Islamic education and autism research. Ultimately, this project strives to provide a unique and effective tool for autistic children to learn and memorize the Quran, promoting their religious involvement and fostering their educational development.



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## LIST OF SYMBOLS



## LIST OF ABBREVIATIONS

<b>AAC</b>	Augmented and alternative communication
<b>AR</b>	Augmented Reality
<b>ASA</b>	Autism Society of America
<b>ASD</b>	Autism Spectrum Disorders
<b>ASD-WID</b>	ASD without intellectual disabilities
<b>GUI</b>	Graphical User Interface
<b>HFA</b>	High Functioning Autism
<b>HMM</b>	Hidden Markov Model
<b>LFA</b>	Low Functioning Autism
<b>M-CHAT</b>	Modified Checklist for Autism in Toddlers
<b>MOH</b>	Ministry of Health
<b>UAT</b>	User Acceptance Test

## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

The purpose of this study is to examine how using a Quran memorization app may benefit certain autistic youngsters. Several options for implementing a certain functionality are available within this app. In contrast, the methods of incorporating the autistic children's talents, which include their sensors and actuation, will be the main focus of this research. Focusing ability and the memory strategy employed by the Quran memorising app provide the basis for this investigation. Children who have autism may have experienced a delay in the development of their communication and social relationships as a result of the mental growth and development retardation that they have. As a result, these children's involvement in social activities may have been restricted as a result of this delay (Chung et al., 2007). On the other hand, they are proficient in school- and life-related abilities. Individuals with high-functioning autism have an amazing rote memory in some areas and exceptional talents in numerous subjects (Crane et al., 2012).

For the sake of helping youngsters on the autism spectrum memorise the Quran, a variety of apps and tools have recently been developed. It offers a wide range of memorization strategies. However, after a while, some of these kids lose interest and stop using it. Their focus will suffer if they keep utilizing the same tools or reading the same sentence. It's also not uncommon for autistic children to struggle with the memorization methods typically used to learn Quranic verses. This may slow down their efforts to memorize the Quran. Most autistic children cannot read Arabic-written verses of the Quran. When learning Quran verses, they like listening to their teacher's recitation or Quranic audio via applications or devices. Since students do not always glance at the verses of the Quran

while listening, it may be difficult for teachers to determine whether their students are still concentrating on memorization.

## **1.2 Problem Statement**

Human infants with autism have been demonstrated to receive less attention than typically developing infants and toddlers (Patten & Watson, 2011). Their inability to focus could hinder their education. As a result, some autistic student populations may fall behind because their teachers aren't making the necessary methods to ensure they fully grasp the material. The autistic kids have trouble memorizing the Quran over the long run. The children with this mental retardation may have exceptional rote memory (Crane & Goddard, 2008) but, children are easily swayed by the surroundings in which things are occurring. If the tasks allocated to them are uninteresting, it will worsen. Numerous software learning application systems and technical teaching aids have been created to assist individuals in memorization of Quranic verses. However, the current applications are not suitable for autistic children with high functioning, who are beginning learners. After a timeframe, the majority of autistic pupils lost interest in memorization when using the same applications throughout the memorization session. Therefore, electronic teaching tools should be developed specifically for kids with autism (Ploog et al., 2013).

The autistic kids did not use known memorization techniques such as the tally method, listening to their own Quran recitation, and pointing one-by-one the Quran verses using a digital pen to efficiently memorize the Quran verses. Several pupils, when using the tally method to memorise Quran verses, are eager to complete the assignment as quickly as feasible. Consequently, they checked between two and three boxes for each spoken verse. Consequently this project will develop an app for Quran memorising that includes a game-like app in which users must fill in the blanks of Quran verses by dragging and dropping the words while listening to the audio of the verses. The audio will continue to play even if the autistic children enter the words incorrectly, making it easier for them to recall Quran passages.

### **1.3 Application Objectives**

1. To take the interest of ASD children for digital technology
2. To facilitate ASD children in eye focusing and be patient in competing the task
3. Repetitive auditory and visual displays of the verses are suitable to their repetitive behaviour.
4. To help them with the Quran memorization

### **1.4 Research Objectives**

1. To study the background of autistic children how the autistic children memorize the Quran verses with full attention.
2. To design and develop a system for the autistic children so they can memorize Quran verses while paying full attention
3. To measure the effectiveness of the Quran Memorization Interactive Application toward the performance and attention of the autism kids.

### **1.5 Scope**

This project focuses on the development of a new application that will serve as a more effective technological teaching aid for autistic children, specifically to aid in their memorization of Quran verses. In this project, the first chapter of the Quran which is the chapter of Al-Fatihah, would be analysed for system evaluation purposes. The chapter (sura) was chosen on purpose for evaluation, as Muslims are required to memorise and recite it in every prayer as reciting Sura Al-Fatihah is one of the pillars (*rukun*) of prayer, and to test students who have not yet learned it and this app will be developed for Android platform only.

Classifications of autism are extremely broad. This study would only recruit students with a love for memorization of Sura Al-Fatihah and exceptional listening skills. As stated previously, some autistic children have the ability to remember information fast, be occasionally less hyperactive, listen to instruction, and communicate using simple communication language (Siti Iradah & Rabiah, 2011). Since the conditions are met by the students, it is a pleasure to enhance their memorization skills of Quran verses. To determine whether or not the students have effectively remembered the verses of the Quran, their ability to repeat the recited sura Al-Fatihah without looking at the verses or listening to the audio of the Quran will be evaluated. A few children have literacy difficulties that hinder their ability to recite effectively. They will be deemed to have successfully memorized the verses if they can articulate or write a few words at the beginning or end of each verse.

## **1.6 Summary**

This study is divided into three chapters, which are described in the following chapters:

Chapter 1: Provides the introduction, problem statement of the autistic children that need to memorize Quran, the objectives, and the scope of this study.

Chapter 2: A discussion of the project's literature review is included here. Understandings are also provided regarding the behaviour of children with autism while they are learning, as well as their learning styles and their capacities to learn verses from the Quran. The currently available Quran memorization technique as well as the currently available memorization apps for autistic children were also explained.

Chapter 3: Describes the project methodology for identifying the attention performance of autistic youngsters when memorising Quran verses. It also describes the project management framework, the project requirements, the suggested app design, the data design, the proof of initial idea, the testing strategy, the proposed solution, and the project's Gantt chart.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Autistic children that have mental dysfunction and associated with cognitive deficits are called Autism Spectrum Disorders (ASD) (Bölte et al., 2007). This autistic children has cognitive deficiencies that include language ability, perception and memory (Prior et al., 2016). All these kind of difficulties can affect autism people and normal people in having problems in social relationship, communication skills, and behaviour (Barendse et al., 2013; Bouvet et al., 2014; Silverman et al., 2010). The American Psychiatric defined three form of ASD using the diagnostic manual version four which called DSM-IV that was revised and reviewed until DSM-V was issued. Asperger's syndrome, Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), and autistic disorder are the three basic types of disorders (Mandy et al., 2011). Previous study has shown that disorders disease can affect people of different races. The majority of them are male with ratio 4:3 (J A Lamb, G Barnby, E Bonora, N Sykes, E Bacchelli, F Blasi, E Maestrini, J Broxholme, J Tzenova, D Weeks, A J Bailey, n.d.). Figure 1 demonstrates the regularity

rates for this disease among all children in the population with an incidences of n per ten thousand (Gillberg et al., 2006).

Age cohort		Boys	Girls	Total
1989–1994	ASD cases	205	57	262
	Total population	16644	15924	32568
	<b>ASD prevalence</b>	<b>123.2</b>	<b>35.8</b>	<b>80.4</b>
	Autistic disorder	54.1	15.7	35.3
	Asperger syndrome	10.8	2.5	6.8
	Disintegrative disorder	0.6	0	0.3
1983–1988	PDD NOS	57.6	17.5	38.1
	ASD cases	141	34	175
	Total population	14822	13685	28507
	<b>ASD prevalence</b>	<b>95.1</b>	<b>24.8</b>	<b>61.4</b>
	Autistic disorder	25.0	10.2	17.9
	Asperger syndrome	27.0	2.2	15.1
1977–1982	Disintegrative disorder	0	0	0
	PDD NOS	43.2	12.4	28.4
	ASD cases	82	27	109
	Total population	20052	21358	41410
	<b>ASD prevalence</b>	<b>40.9</b>	<b>12.6</b>	<b>26.3</b>
	Autistic disorder	14.0	7.0	10.4
1977–1994	Asperger syndrome	14.0	0.5	7.0
	Disintegrative disorder	0	0.5	0.2
	PDD NOS	13.0	4.6	8.7
	ASD cases	428	118	546
	Total population	51518	50967	102485
	<b>ASD prevalence</b>	<b>83.1</b>	<b>23.2</b>	<b>53.3</b>
	Autistic disorder	30.1	10.6	20.5
	Asperger syndrome	16.7	1.6	9.2
	Disintegrative disorder	0.2	0.2	0.2
	PDD NOS	36.1	10.8	23.5

**Figure 1 Regularity rates for ASD**

The number of ASD diagnoses in Malaysia has consistently increased over the past decade, according to Ministry of Health (MOH) data. In 2021, an estimated 589 children under the age of 18 would be diagnosed with ASD, a five percent increase from the 562 youngsters in 2020. According to a 2005 study conducted by the Malaysian Ministry of Health using the Modified Checklist for Autism in Toddlers (M-CHAT) screening tool for ASD, the rate of ASD in 18- to 3-month-old children in Malaysia is between one and two per 1,000. The study also revealed that male children are four times more likely than female children to have ASD (CodeBlue, 2022).

These children have more health care needs than the average pediatric population. Autism Society of America (ASA) estimates that the average lifetime healthcare costs for an autistic child in the United States is USD 2,400,000 (approximately RM 9.6 million) (Chandran, 2016; Knapp, 2011). Numerous studies have indicated that people with ASD who do not have intellectual disability (ASD-WID) excel at decoding compared to reading comprehension. In general, therefore, students with ASD-WID appear to grasp the pathways involved in automatic language comprehension performance (Jones et al., 2009; Norbury & Nation, 2010), which is below what

is expected for their stated age or reading overall accuracy (Brown et al., 2014). To explain this gap, it has been suggested that superior memory abilities contribute to accurate word recognition.

As with academic achievement, the heterogeneity in reading skills has led to the identification of reading profiles among groups of youth with ASD. (Johnels et al., 2018) was able to identify three groupings through chronic and retrospective research. A first grouping, "poor reading ability," which was the most common profile (about fifty percent of participants), had below-average grades on both words reading and language comprehension. The "skilled readers" subgroup performed above ordinary on both reading operations. The third class, consisted of persons with "hyper lexical/low understanding," was the least prevalent (20%). Following a similar methodology, namely principal component analysis, (McIntyre et al., 2017) identified four distinct profiles in a group of 8 to 16-year-old students with high-functioning autism. Modifications in the interpretation and comprehension processes characterize the first profile of readers (32,2 percent of the population). Second, readers with extreme global disruption (14.1%). Third, readers with comprehension difficulties (20.6 %). Fourthly, the typical reader (32.1%). In other words, about 70% of the participants reported reading difficulties, and most of them had comprehension issues. Even in high-achieving subgroups of students with ASD, other research employing a cluster analysis methodology have indicated that reading comprehension scores are lower than word reading scores. (Chen et al., 2019) stated this is the case regardless of the method used.

## **2.2 Characteristics of ASD**

A person with autism spectrum disorder has a developmental condition or impairment of the brain that impairs social communication skills, social interaction capacity, and sensory difficulties. In addition, individuals with ASD have repetitive and restricted behaviours, which limit their imagination and cause the majority of them to constantly repeat themselves. Due to a lack of social interaction abilities, they are perpetually incapable of interacting with others in an appropriate manner. In addition, because they are in their own universe, they were formerly quite active in some situations. With these restrictions, the majority of individuals with ASD suffer from learning impairments. As for social communication skills, the cognitive capacities of people with autism vary and



can be roughly classified into two categories: Low Functioning Autism (LFA) and High Functioning Autism (HFA).

### **2.3 LFA and HFA**

Children with High-Functioning Autism developed linguistic and cognitive skills more quickly than children compared to Low-Functioning Autism. The majority of HFA children have a high level of intellect and are capable of engaging in many elements of everyday life virtually as well as typical normal children (Paul et al., 2009). From an educational standpoint, children with HFA have the ability to write, talk, and read. In addition, their brains are able to digest information fast, and they are able to comprehend quickly while learning something thanks to their strong visualisation skills, and they have an excellent long-term memory when they memorise something. However, because to their behavioural issues, they think and learn differently than typical children. Due to difficulties in interpreting and comprehending gestures, facial expressions, and tone of voice, they frequently struggle with appropriately interacting and communicating with their educators and peers, understanding the instruction, and giving their full attention to learning and teaching activities. In order to increase their learning performance, individuals require a unique treatment and strategy in learning activities, including the use of visual aids such as laminated images or illustrations and computer software that can display both text and image concurrently.

### **2.4 Existing System**

Each year, app developers and makers will introduce new applications for children with autism. These applications are designed to serve the autism community, the communication, language, emotional, and organisational requirements of autistic children. Encounter to the appropriate quality of application for children with autism can benefit one of these children in multiple ways. Additionally, a high-quality application can aid young children in developing social interaction, communication, decision-making, and the motivation to study and grow. This section will discuss the advantages, features, and platforms for the operating system of some of the greatest applications for autistic children.

### 2.4.1 iHafaz

*iHafaz* is developed on for mobile platform with the simple interfaces design concept with less graphic and animation. The objective of developing *iHafaz* is to catch the attention of autistic children so that they can concentrate on crucial information without being distracted by irrelevant material. To enhance the use of *iHafaz*, all instructions and content are supplied by voice, and the content is shown in a large font size and is well-organized. This application consists of three modules which are *Hafaz* (Memorize), *Latihan* (Exercise), and Audit as shown in the figure below (Senan et al., 2017).



Figure 2 Main Interface

In *Hafaz* module, Sura Al-Fatihah and the last nine chapters in Juz Amma which is the last Juz in Quran is provided for this application. Each chapter (sura) button is assigned a number from 1 to 10 to help the ASD children easily recognize the sequence of the chapter and select the desired chapter. Quran text with Uthmani scripts is utilized since it is the default text font of the Quran in Malaysia and since the ASD children were familiar with this text which used in printed version. Figure below shows the interface of *Hafaz* module.



Figure 3 A list of chapters in Hafaz module

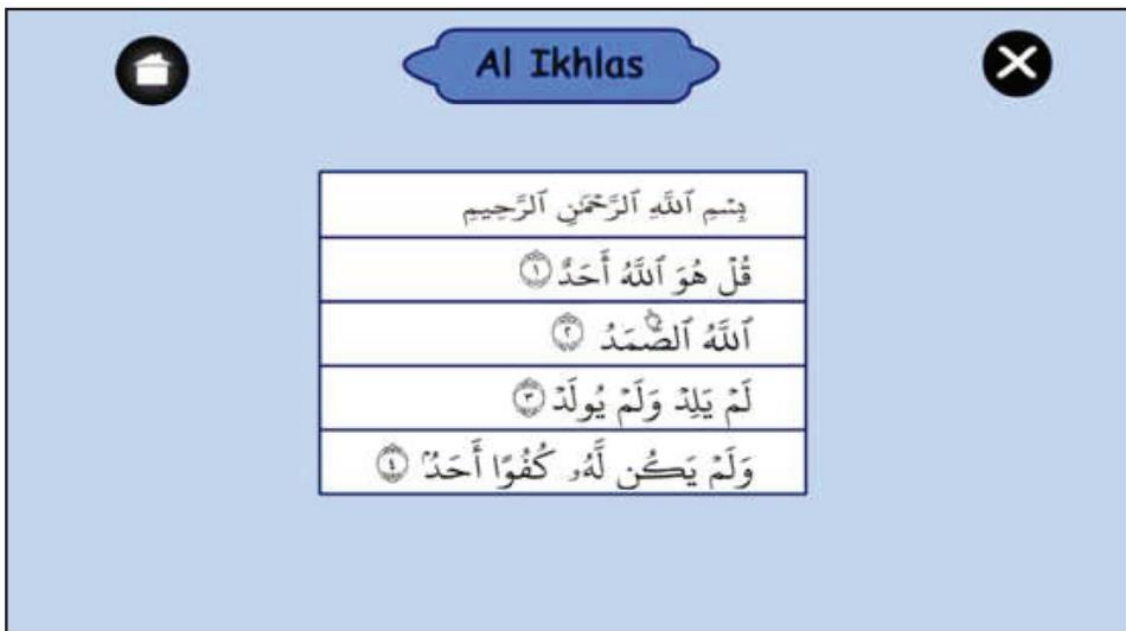


Figure 4 Verses of Sura Al-Ikhlās is displayed line by line

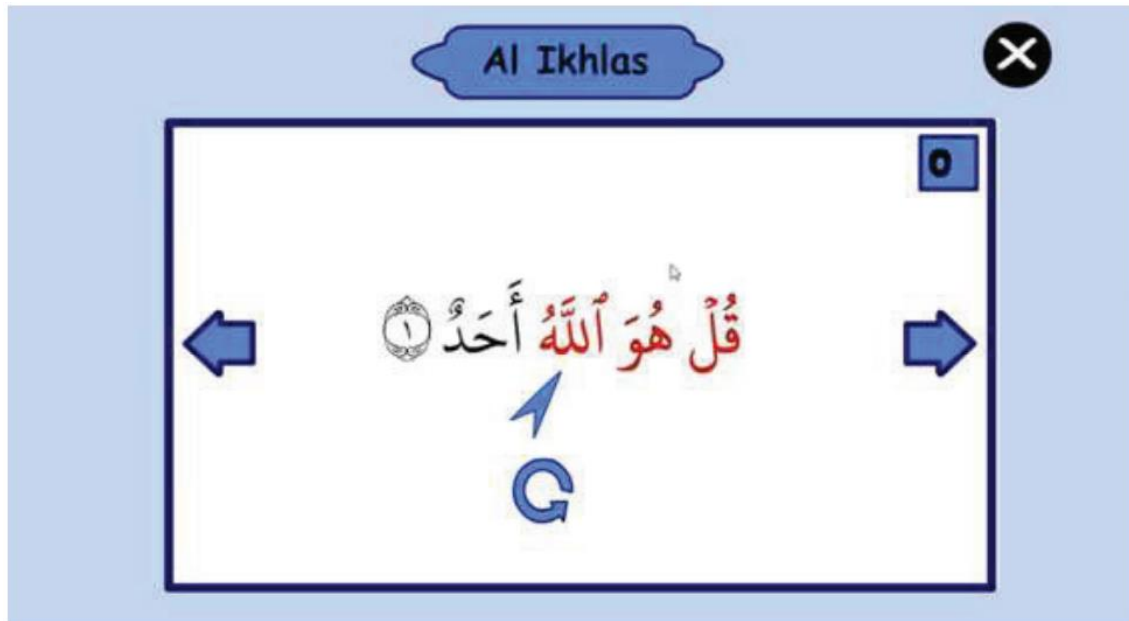


Figure 5 Embedding *Takrir* technique by highlighting the verses

As shown in Figure 5, a *takrir* approach is incorporated to help ASD children memorize and recite the chapter. This is accomplished by presenting audio of the verse being recited and a repetition button for each verse. To aid ASD children in paying attention and concentrating on the recitation, a pointer on the highlighted verse is displayed simultaneously with the audio. Next, the user must press the repeat button, and the number of repetitions will be displayed in the interface's upper-right corner as an indicator. According to the subject matter expert, the maximum number of repetitions for this application is 60.

#### 2.4.2 EzHifz Application

The EzHifz application is a standalone application that was developed for the Android platform. In this app, sura Al-Insan which is the 76<sup>th</sup> from the Quran verse 1-31 is used as the content of this application. This app is an offline application to facilitate individual

students to freely access the application without an Internet connection. This application is using the VARK learning style (Mustafa et al., 2021).

The VARK program is a collection of learning styles that include several senses (ND Fleming, Neil D. Fleming, N. FLEMING, 2001). This model contained four learning styles which is V is for visual, A is for auditory, R is for reading, and K is for kinesthetics.

This application contains several graphical user interfaces (GUI) such as home screen, main menu, profile menu, memorization menu, and others.



**Figure 6 EzHifz's Home Screen**

Figure 6 above shows the home screen of EzHifz application when the application is first activated. This application's content was built in Bahasa Malaysia, the national language of Malaysia. Students can access the main menu by clicking on the screen.



**Figure 7 EzHifz's Main Menu**

Figure 7 above shows the main menu of EzHifz application. In this interface, students will have access to four menus: menu of memorising (HAFAZAN), menu of student performance (PRESTASI), menu for "tasmik" (TASMIK), and menu for profiles (PROFAIL).



**Figure 8 EzHifz's Memorization Menu**

Figure 8 above shows the memorization menu of EzHifz application. The interface shows the verse of Quran with a full learning mode which is (V, A, R, and K) being activated. It includes multimedia elements such as images, video, text, and audio. This is where the idea of VARK learning style and memorizing techniques is being integrated.

### 2.4.3 Okuma Yazma

Okuma Yazma is a mobile educational application developed in the Turkish language to enhance the reading and writing skills development of children with ASD. This programme is designed to ensure that children with ASD learn, recognise, and use letters that repeat in different words, as opposed to merely supporting their skill development. In addition, this application is designed to help ASD youngsters learn to correlate letters with sounds in order to access the information represented by print and to involve them in the reading process(Turhan, 2015).



Figure 9 Okuma Yazma's Main Menu

Figure 9 above shows the main menu user interface when the application after the first launch. This application contents were built in Turkey Language which is the national language of Turkey. Students may access the application by clicking the “BASLAT” button.



Figure 10 Okuma Yazma's Module Screen

Figure 10 above shows the modules screen from Okuma Yazma application. Students can choose one of three modules by clicking the yellow button. The first module is for the alphabet module (ALFABE), the second module is for the reading module (OKUMA), and the last module is for the writing module (YAZMA).

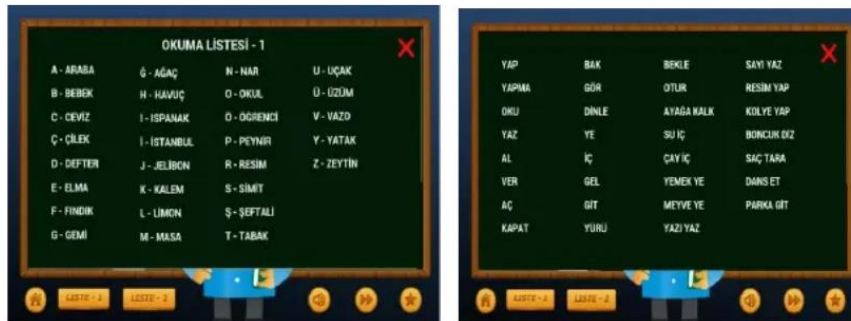


Figure 11 Okuma Yazma's Reading Mode

**Error! Reference source not found.** above shows the reading module of the Okuma Yazma application. In this module, there are three different reading lists which are the words match with daily activities, the words match with the alphabets and the thematic group vocabulary list.



## 2.5 Comparing of existing system towards ASD students

### 2.5.1 Tools

iHafaz	<ul style="list-style-type: none"> <li>Using the visualisation and the auditory elements of the ASD children</li> <li>Using the human senses elements such as audio, image, and text for the ASD children</li> </ul>
EzHifz Application	<ul style="list-style-type: none"> <li>ASD students will use multimedia presentation elements such as audio, video, image, and text to the interactivity</li> </ul>
Okuma Yazma	<ul style="list-style-type: none"> <li>Using a student's index finger while a teacher gives emotional, instructional, and physical support to the ASD students. Using three modules include alphabet, reading, and writing</li> </ul>

Table 1 Comparison of tool used in existing system

### 2.5.2 Methods/Techniques

iHafaz	<ul style="list-style-type: none"> <li>Using <i>takrir</i> technique and recitation audio in assisting ASD children memorizing the Al-Quran</li> <li>Using eye movement of the ASD children where pointer at the verses move simultaneously with the audio</li> </ul>
EzHifz Application	<ul style="list-style-type: none"> <li>Using the VARK learning methods. Visual, Auditory, Reading, and Kinesthetics. Using these methods that adopts appropriate learning strategies and techniques may successfully engage the student's learning.</li> </ul>
Okuma Yazma	<ul style="list-style-type: none"> <li>Using Patricia Oelwein's method to solve word decoding problems and increase their comprehension through the stages of recognition, naming, selecting, and matching.</li> </ul>

Table 2 Comparison of methods/technique used in existing systems

### 2.5.3 Advantages

iHafaz	<ul style="list-style-type: none"><li>• The displayed content in the large size makes the ASD children easier to recite the verse</li><li>• The repetition of audio assist makes the ASD children easier to memorize the Quran verses.</li></ul>
EzHifz Application	<ul style="list-style-type: none"><li>• By using the VARK methods, the memorizer will find it easier to memorize the Quran.</li><li>• ASD students can gradually find their own method to memorize the Quran verses</li><li>• ASD students recognize that they do not need to be stuck in one mode of learning</li></ul>
Okuma Yazma	<ul style="list-style-type: none"><li>• The ASD found it easier to learn the modules</li><li>• The in-app character has special approach to the students which will make good two-way communication</li></ul>

**Table 3 Advantages of the existing system**

#### 2.5.4 Disadvantages

iHafaz	<ul style="list-style-type: none"><li>• ASD students could feel stress after memorizing the Quran verses as there are no games implemented in the application</li><li>• The audio of the recitation is too fast for the ASD children with the LFA</li></ul>
EzHifz Application	<ul style="list-style-type: none"><li>• VARK is known for not giving enough direction to ASD on how to implement the model through specifics</li><li>• ASD students need to be able to recite the Quran properly before can utilize this app</li></ul>
Okuma Yazma	<ul style="list-style-type: none"><li>• Too many displayed words in small size in the reading module that make it difficult for ASD to read</li></ul>

Table 4 Disadvantages of existing systems

#### 2.6 Summary

From the comparison review in the Chapter 2, it can conclude that the ASD user mostly finds easier about the methods or techniques to learn about new knowledge so that they can view their results based on their performance. The ASD student mostly did not care about the user interface of the system due to their disease. However, the teacher that teach the ASD students concern about the user interface of the system so the teacher can teach the ASD students easier. Therefore, the findings that have been discovered in this chapter will be used to develop the Quran Memorizing Interactive Application

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

This chapter will describe the project methodology for identifying the attention performance of autistic youngsters when memorizing Quran verses. This chapter also describes the project management framework, the project requirements, the suggested app design, the proof of initial data, the testing strategy, the proposed solution, and the project's Gantt chart. This project will use scrum methodology to finish the project.

#### **3.2 Scrum Model**

Scrum is precisely an evolution of Agile Management (Digité, 2022). Scrum methodology is built on a set of roles and behaviours that must be incorporated into the software development process. It is a flexible technique that rewards the adoption of the 12 agile principles within an agreed-upon framework by all product team members. Sprints, which typically last between 2 and 4 weeks and are the phrase for feedback and reflection, are the transitory, periodic chunks in which Scrum is implemented. Each sprint is an entity unto itself, in that it produces a full result, a variant of the end product that must be deliverable to the client with minimal effort upon request.

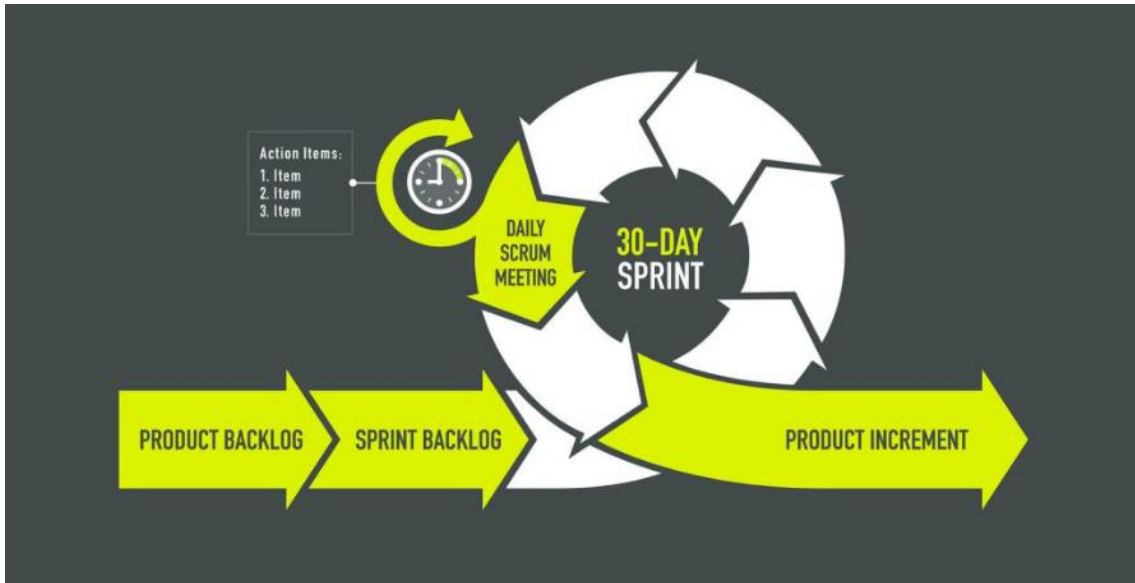


Figure 12 Scrum Development Process

### 3.2.1 Product Backlog

The product backlog is a list that compiles all that the project needs to accomplish in order to fulfil the requirements of the ASD prospective users. The product owner is the one who puts everything together, and the functions are ranked in order of importance according to how vital they are to the operation of the company. A student at UMP was advised to construct this project with MZR company. They gather all of the requirements into a document and then conduct an online meeting with the UMP student to discuss and present the document.

### 3.2.2 Sprint Backlog

The Sprint Backlog is a subset of the Product Backlog that is comprised of things that the team has decided to prioritize for completion during the upcoming sprint on which they will be working. The length of time allotted to each Sprint is decided by the team. The sprint backlog is typically presented on physical boards known as Scrum boards. The purpose of these boards is to make the development process apparent to anybody who

visits the workspace. As for this project, the people involved in this project must present the past activities of the project and must give the future activities plan in the next sprint.

### 3.2.3 Weekly scrum meetings

The weekly scrum meeting is a brief meeting held each day with the purpose of allowing the team to plan out its work for the day and identify any potential impediments that could have an impact on the work. In regard to this project, the meeting will take place once every two weeks on a Wednesday evening, and its duration will be capped at ten or fifteen minutes at most.

### 3.2.4 Product Increment

The increment is the sum of all of the tasks, user stories, use cases, and product backlogs as well as any other element that was built during the sprint and that will be made available to the end user in the form of software. The people involved in this project will present all the tasks and documents in the scrum meeting including the proposal, the methodology and the prototype of this project.

## 3.3 Hardware and Software Requirement

The hardware and software requirements for Quran Memorizing Interactive Application for Autistic Children are described in Table 5 and Table 6

### 3.3.1 Hardware Requirement

Hardware	Purpose
Laptop Asus Tuf FX501DT	To develop the system
Android Tablet API 28	To run and test the system
Printer Brother DCP-T510W	To print all the related document

Table 5 Hardware Requirement

### 3.3.2 Software Requirement

Software	Purpose
Microsoft Word 365	To edit and prepare all the related documentation
Microsoft Excel 365	To design the Gantt Chart
Draw.io	To design the use case diagram, context diagram, flowchart, and other diagrams
Figma	To design the user interface and the prototype of the system
Unity/VS Code	To develop the system

**Table 6 Software Requirement**

### **3.4 Project Requirement**

This part will describe the functional and non-functional requirement of Quran Memorizing Interactive Application for Autistic Children

#### **3.4.1 Functional Requirement**

- i. The system should allow the user to register their name as a player
- ii. The system should allow the user to change the player
- iii. The system should allow the user to choose the unlocked level
- iv. The system should allow the AR features to scan the original physical Al-Quran
- v. The system should be able to play the voice of the Quran verses
- vi. The system should be able to display the meaning of the Quran verses
- vii. The system should allow the user to drag and drop the cut-pieces of Quran verses

#### **3.4.2 Non-Functional Requirement**

- i. Availability  
All the registered player name will be saved in the system even the user close and start again the system
- ii. Performance  
The system should load initial screen of the system not more than 3 second
- iii. Scalability  
The system will be capable of handling the user data such as caches without delay by optimizing the way storage is done and accessed

#### **3.4.3 Constraint**

- i. Network  
The users does not need to have Internet connection because this system will be run in offline mode



ii. Voice

The voice of the Quran verse will be use from the person who have good voice and expert in reciting Quran. The system will stick to one tone of the voice

iii. Resources

One hundred percent of the system's material, such as verses and interpretations of the Quran, will be derived from the Quran and the content will be confirmed by the person who have official education in Quran.

### 3.5 Propose Design

#### 3.5.1 Flowchart

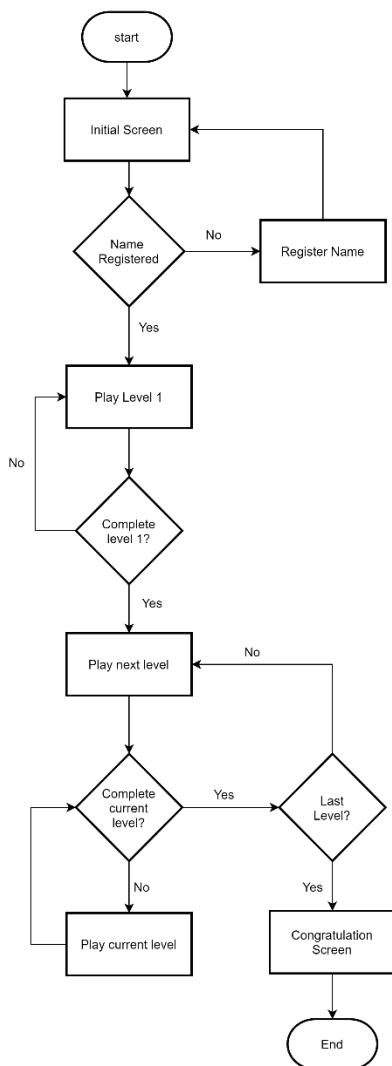
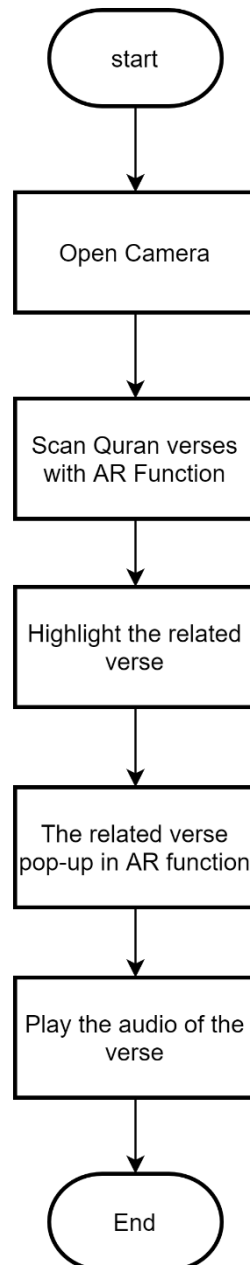


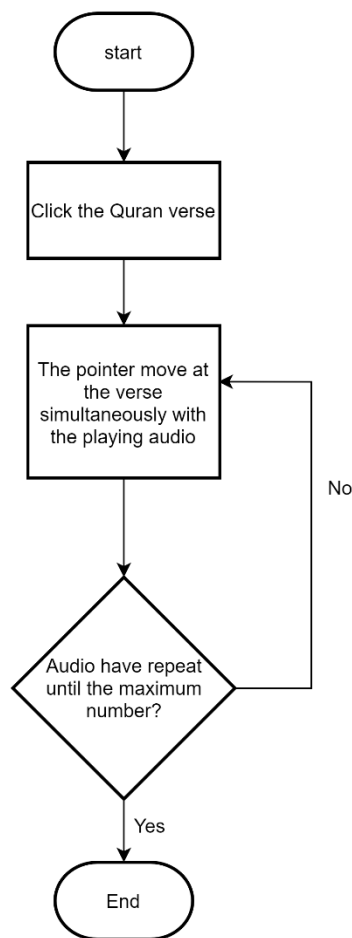
Figure 13 Flowchart of Quran Memorizing Interactive Application

Figure above shows the main flowchart Quran Memorizing Interactive Application. However, to complete a certain level, the user needs to do a few steps in that level. A level consists of one verse of Quran which the user needs to memorize the verse, do some exercises, and complete a simple game in that level. There are six steps in one level that the ASD children need to pass to unlock a new level or new Quran verse. The figures below will show the flowchart of each step in a level.



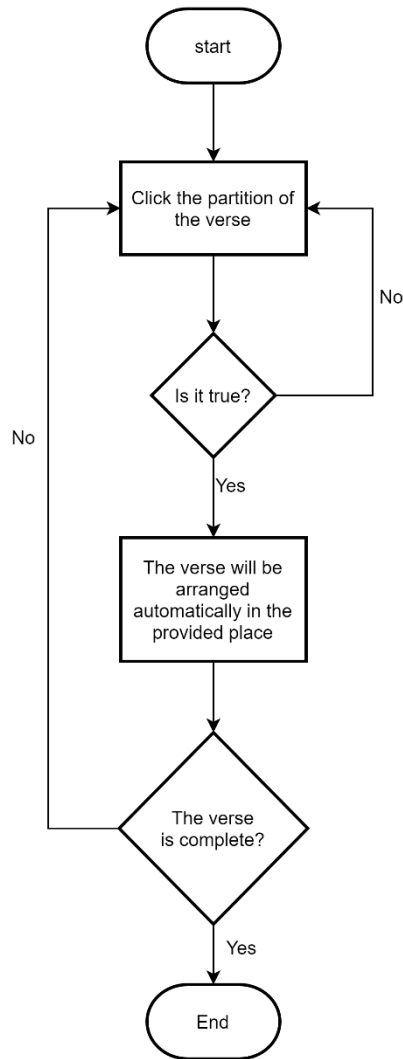
**Figure 14 Flowchart of step 1**

Figure 14 shows the flowchart of step 1 in a level. In this step, as soon as the user presses the button level, the system will navigate to the interface that has Augmented Reality (AR) functionality. The system will open the device camera to scan the related page of the Quran. Then, the AR function will highlight the related verse in that level and the verse will pop-up in AR multimedia then the audio will be played according to the highlighted verse.



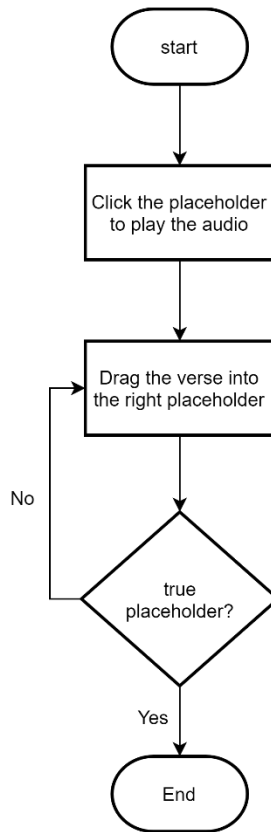
**Figure 15 Flowchart of step 2**

Figure 15 shows the flowchart of step 2 in a level. In this step, the user needs to click the Quran verse to play the audio and start memorizing the verse. Once the user clicks the verse, the pointer will move at the verse simultaneously according to the playing audio until the maximum total of repetition of the audio to make the ASD children easier to memorize the verse.



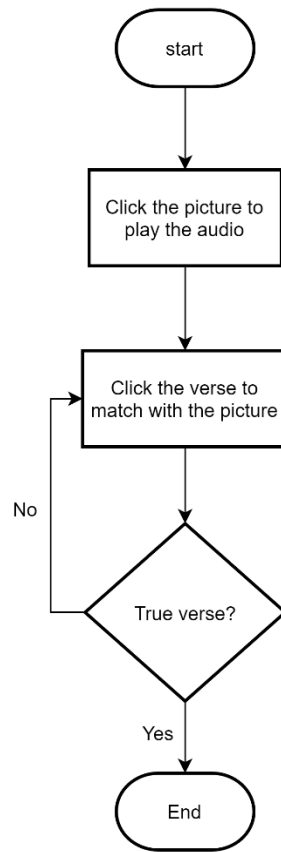
**Figure 16 Flowchart of step 3**

Figure 16 shows the flowchart of step 3 in a level. In the third step, the user needs to click the chunk of the verse to play the audio. If the verse is incorrect, the user needs to click the verse again until the user clicks the right one. After find the right verse, the verse will be arranged automatically in the provided place. This activity needs to be repeated until the verse is complete as one verse to go to the next step.



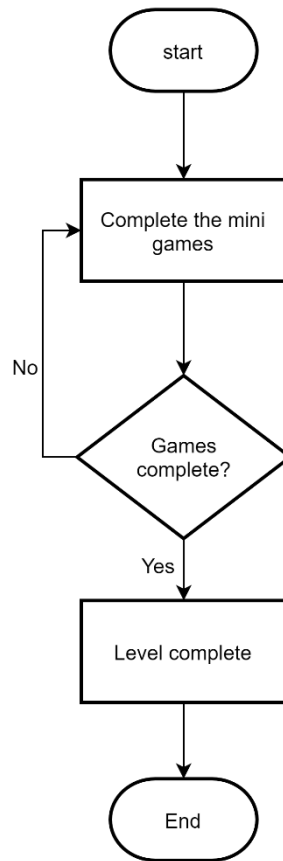
**Figure 17 Flowchart of step 4**

Figure 17 shows the flowchart of step 4 in a level. In the fourth step, the user needs to click the placeholders to play the verse audio, then the user needs to drag the verse into the right placeholder. If the user drags the verse into the wrong placeholder, the user needs to drag the verse again into the right placeholder.



**Figure 18 Flowchart of step 5**

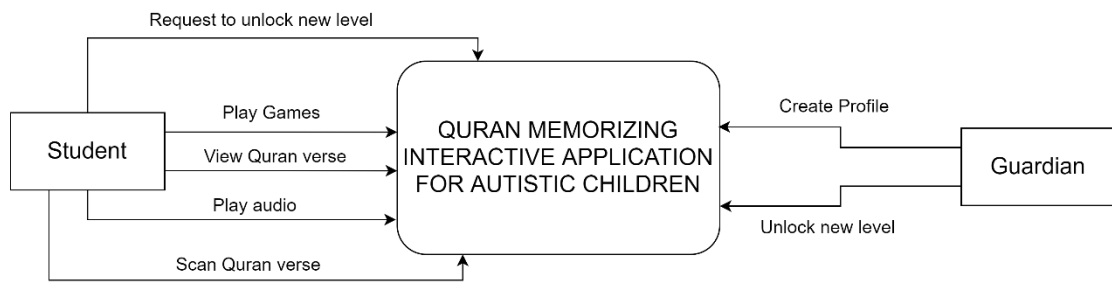
Figure 18 shows the flowchart of step 5. In this step, the user needs to click the picture to play and hear the playing audio. After that, the user needs to click the right verse according to the played audio from the picture to match with the picture. If the user matches the picture with the wrong verse, the user needs to do it again until find the right verse.



**Figure 19 Flowchart of step 6**

Figure 19 shows the last step in a level. In the last step, the user needs to complete the simple mini games to unlock into the next level or next verse. The purpose of this mini game is to give the ASD children to feel relax and release their stress after memorizing the Quran verse.

### 3.5.2 Context Diagram

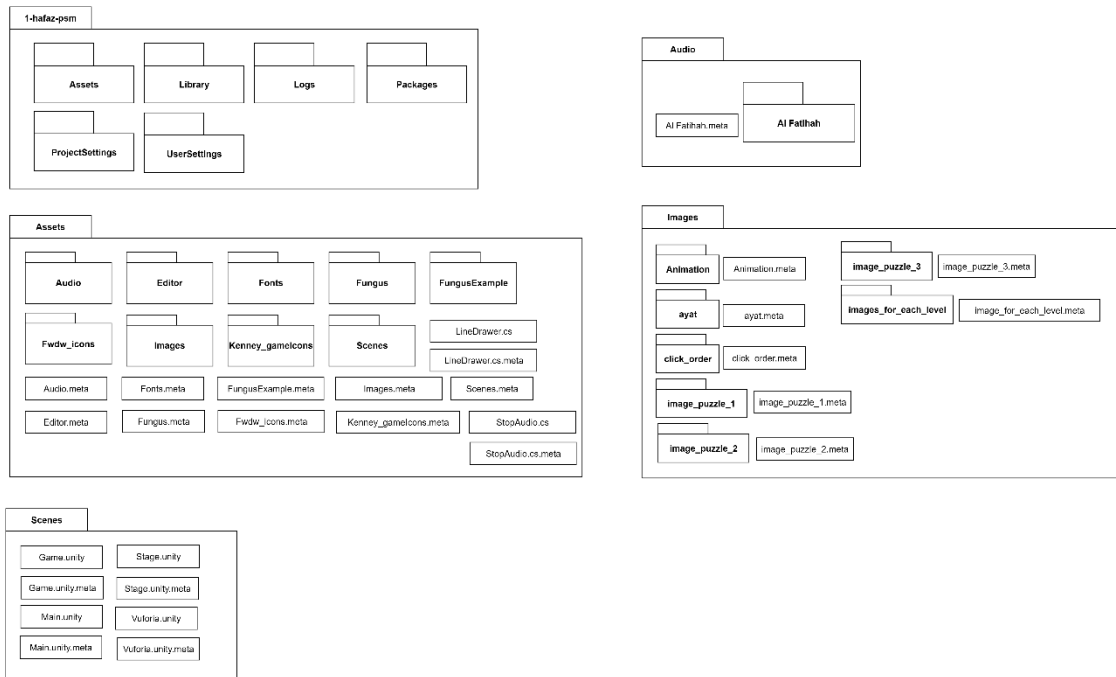


**Figure 20 Context Diagram of the application**

Figure 20 shows the context diagram of the Quran Memorizing Interactive Application for autistic children. The diagram comprises two actors which represent the different user rights which are the Guardian and the Student. The guardian applies the role of the administrator in which only they can create a new profile for each student and unlock a new level for the student, while the students which are children who has ASD can play the games, view Quran verse, play the Quran audio, scan Quran verse and request to unlock new level after they complete a level.



### 3.5.3 Package Management



The figure above provides a visual representation of the package management system within the root folder of the Unity project environment. It showcases the important folders that are essential for organizing and storing various assets and resources used in the project. Each folder is accompanied by files with the "meta" extension, which hold important metadata information related to the associated files. These metadata files play a vital role in Unity's asset import process, allowing for proper handling of dependencies, import settings, and other relevant data. This organized structure aids in efficient project management, ensuring easy access and smooth collaboration among team members.

### 3.5.4 Storyboard

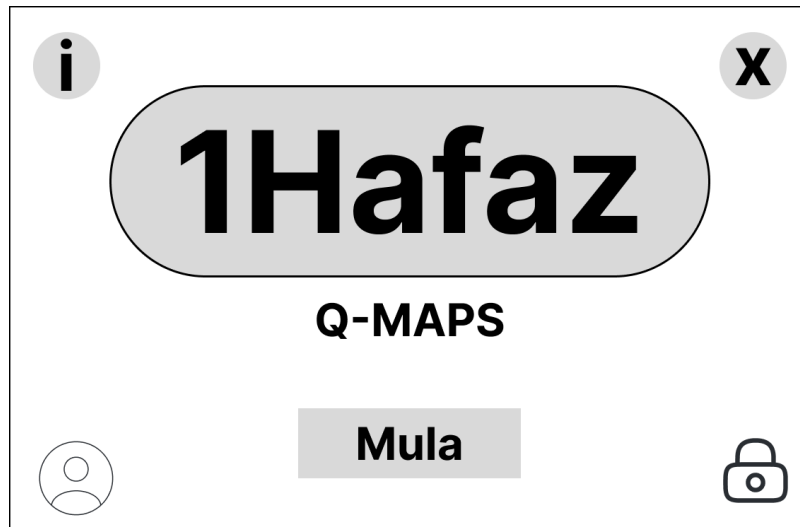
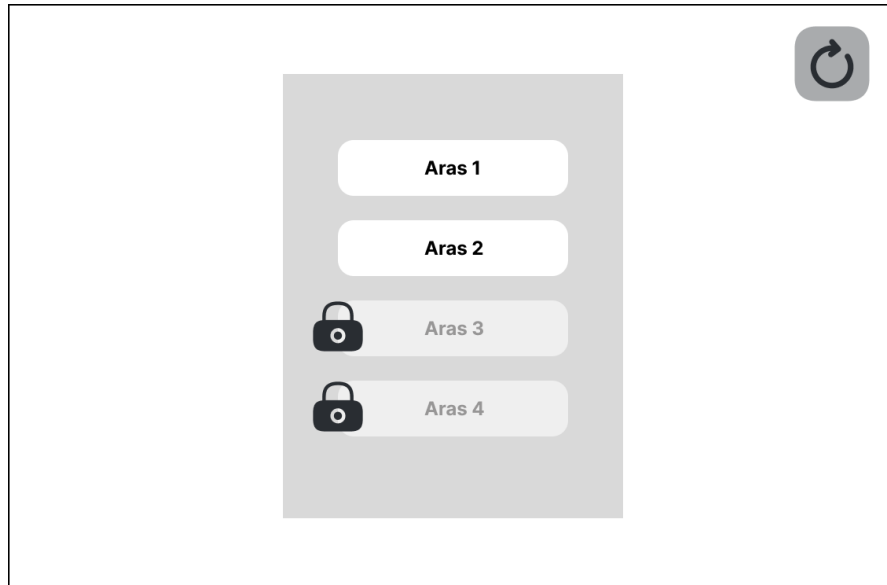


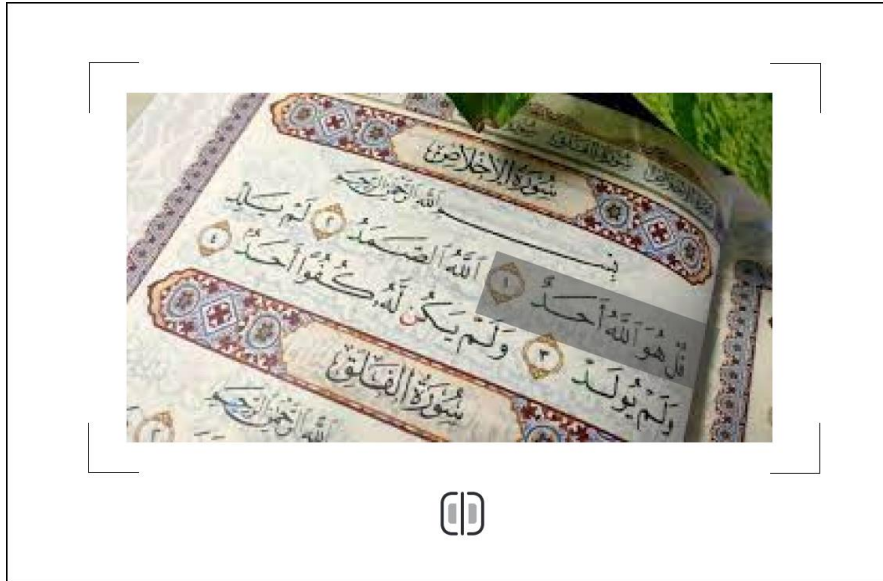
Figure 21 Storyboard - Initial Screen

Figure above shows the initial screen of the storyboard. This screen will appear once the user start using the application. The logo of the app is located at the centre of the screen. There are five icon buttons that user can click. First, the information icon that is located at the top left screen. The user will see the information of this application that warped in the dialogue bubble. Second, the close icon that is located at the top right screen. When the user wants to close this application, the user can click this icon to close the application. Third, the lock icon that is located at the bottom right of the screen. The user can see the levels or stage of the game after click this icon. Forth, the “Mula” button that is located at the bottom centre of the screen. The user will be navigate to the next screen to start the activity that in this application Lastly, the profile icon that is located at the bottom left of the screen. The user will see his/her name in the dialogue bubble when the icon is clicked.



**Figure 22 Storyboard - Levels Screen**

Figure above shows the storyboard of the levels screen. In this screen, the user only can choose the levels that are unlocked by the application or unlocked by the educator or teacher using a code. To unlock the level without using the code, the user needs to pass all the games and activity from the current level. The levels with the bright colour are unlocked while the levels with the dim colour are locked from being access.



**Figure 23 Storyboard - AR Screen**

Figure above shows the storyboard of the AR functionality screen. In this screen, the application will need a permission to access the device camera to use the AR functionality. The user needs to scan the chapter (sura) from the Quran, and the AR functionality will detect the verse according to the level and scan it. The verse will be scanned, then the verse will be pop up in the screen as an AR text object and the audio of the verse will be play automatically.

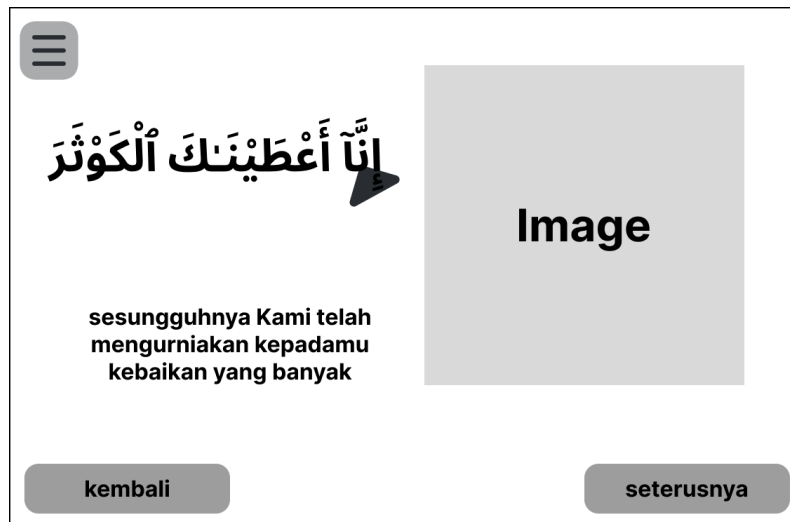


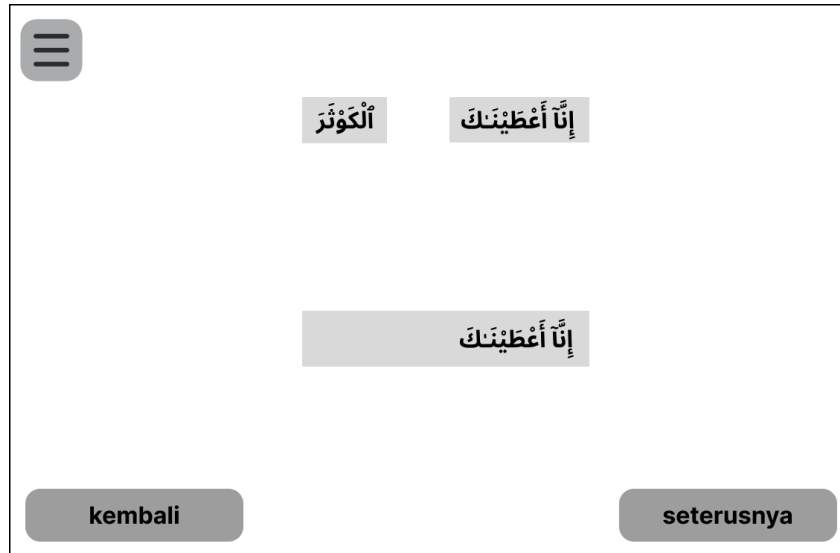
Figure 24 Storyboard - Activity Screen 1

Figure above shows the storyboard of the activity screen 1. In this screen, the user needs to click the verse to play the audio of the verse. Once the user clicks the verse to play the audio, a cursor will move in sync with the audio simultaneously with the verse. An image based on the verse is located at the right side of the screen to be used as a reference of the verse.



Figure 25 Storyboard – Activity Screen 2

Figure above shows the storyboard of the activity screen 2. In this screen, the user must drag the verse from the top of the screen into the empty box that has been produced based on the audio reference. Before moving the verse, the user must click the sound icon to play the verse's audio, and then drag the verse to the correct location depending on the audio.



**Figure 26 Storyboard - Activity Screen 3**

Figure above shows the storyboard of the activity screen 3. This screen requires the user to select the appropriate words from the original stanza in order to rearrange the verse. If the user selects or clicks the incorrect words, nothing will occur. However, if the user selects or clicks the correct words, those words will automatically move to the prepared place.

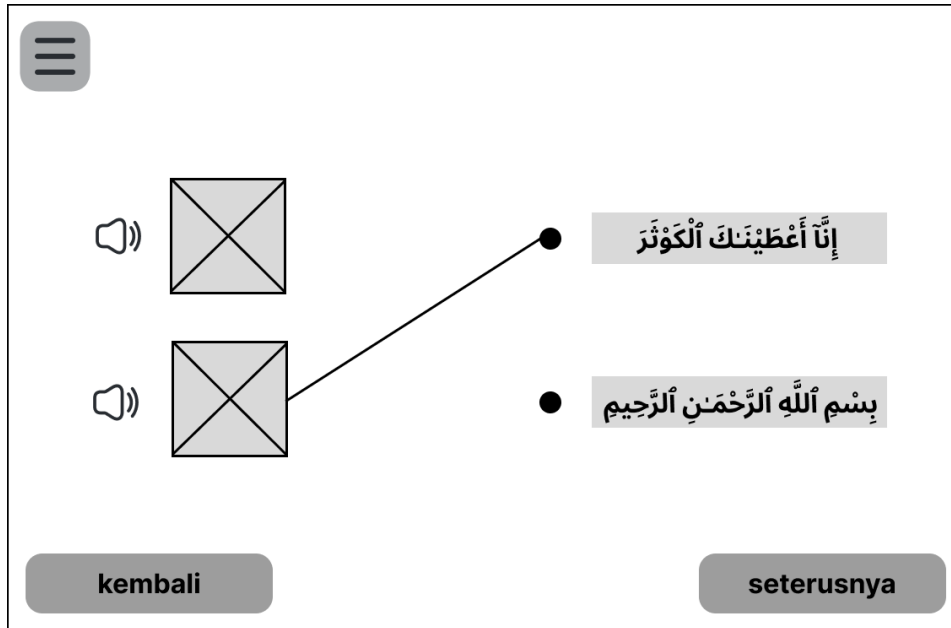
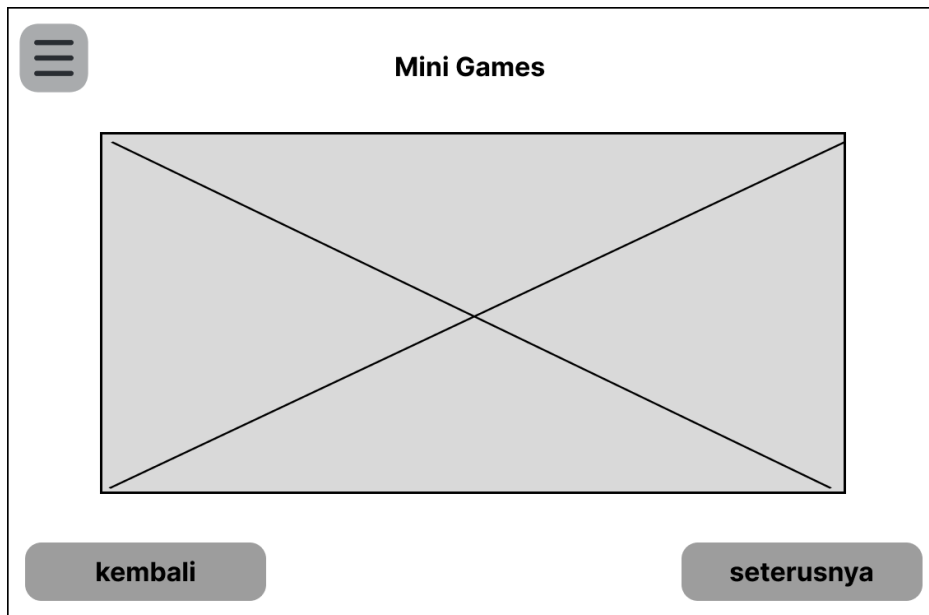


Figure 27 Storyboard - Activity Screen 4

Figure above shows the storyboard of the activity screen 4. In this screen, the user must match the verse to its corresponding image reference. Before matching the verse with the image, the user can click the sound icon to play the audio of the verse that has been placed next to the image. If the user incorrectly matches the verse with the image, nothing will occur. However, if the user matches with the correct pair, a line will connect the verse to the corresponding image. To perform the pairing, the user must first click the verse, and then click the image.





**Figure 28 Storyboard - Mini Games Screen**

Figure above shows the storyboard of the mini games screen. The user will play minigames on this screen to calm their mind after completing an activity. The user must finish these minigames while having fun in order to unlock new levels.

### 3.5.5 User Interface

The proposed user interface of this application, 1Hafaz, is built utilizing Figma software on a mobile platform. This prototype employs a minimalist interface design approach with fewer visuals and animation. The objective is to catch the attention of individuals with ASD so that they can concentrate on crucial information without being distracted by irrelevant material. In addition, to increase the usability of this mobile application, all instructions and content are displayed in a large font size and structured in a logical manner. In general, this prototype is comprised of two categories: a portion of memorization and a portion of exercise that will be available in the easy game level. The user interfaces are shown below.



Figure 29 Initial Screen



Figure 30 Level Screen



Figure 31 Game Screen 1

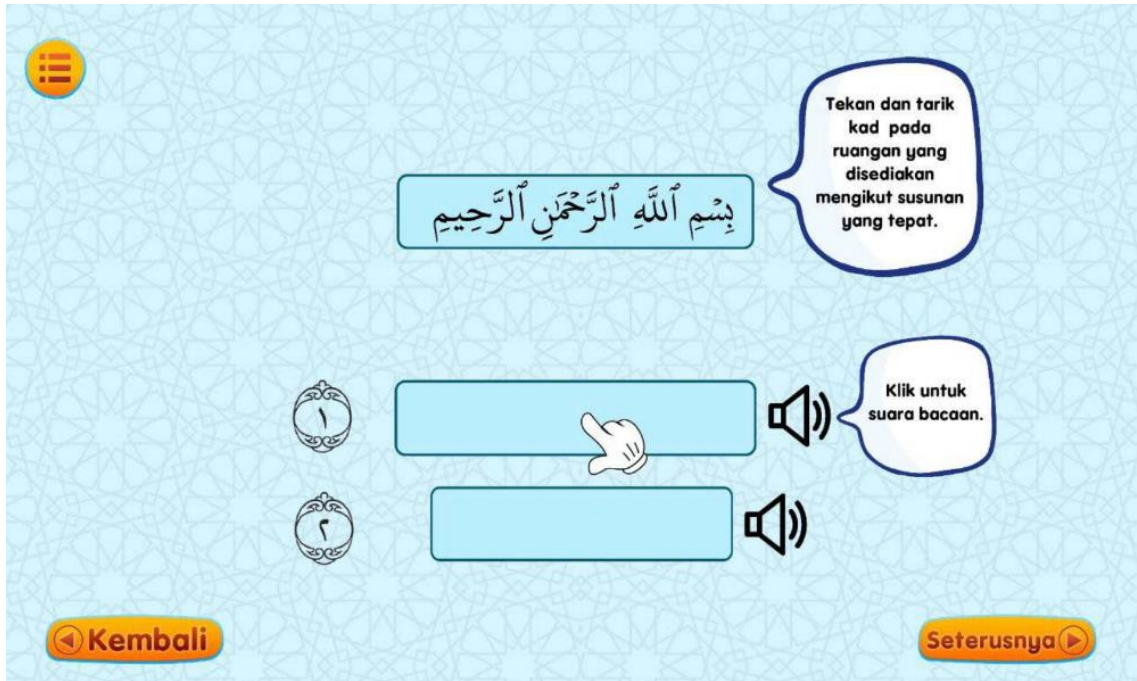


Figure 32 Game Screen 2

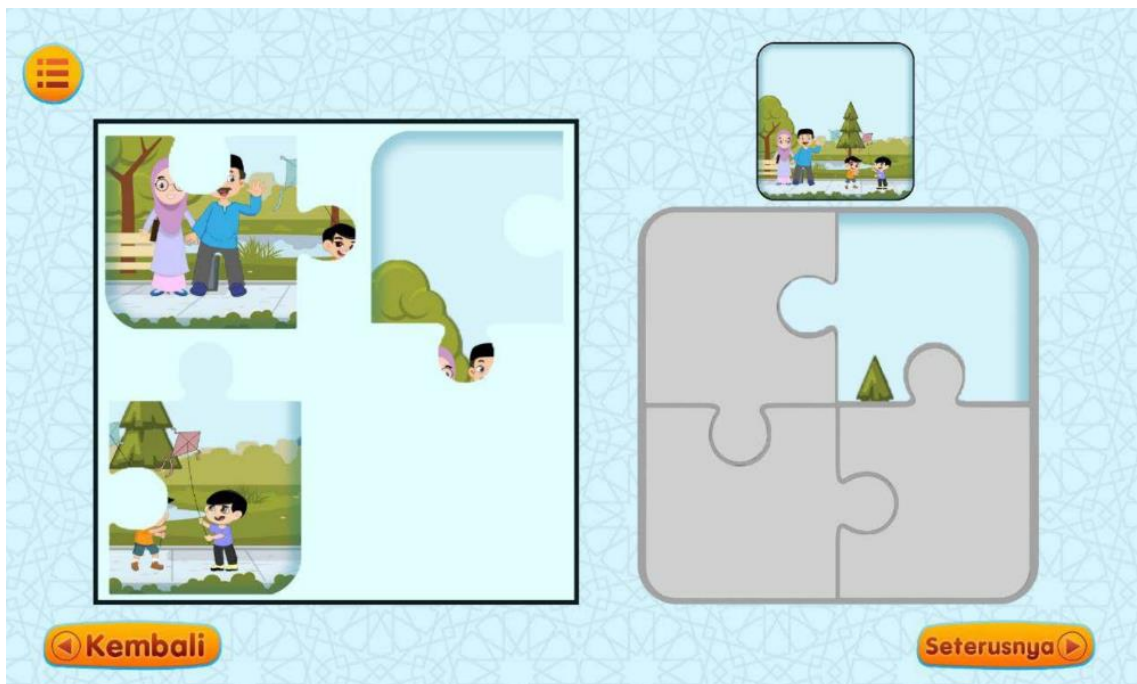


Figure 33 Game Screen 3



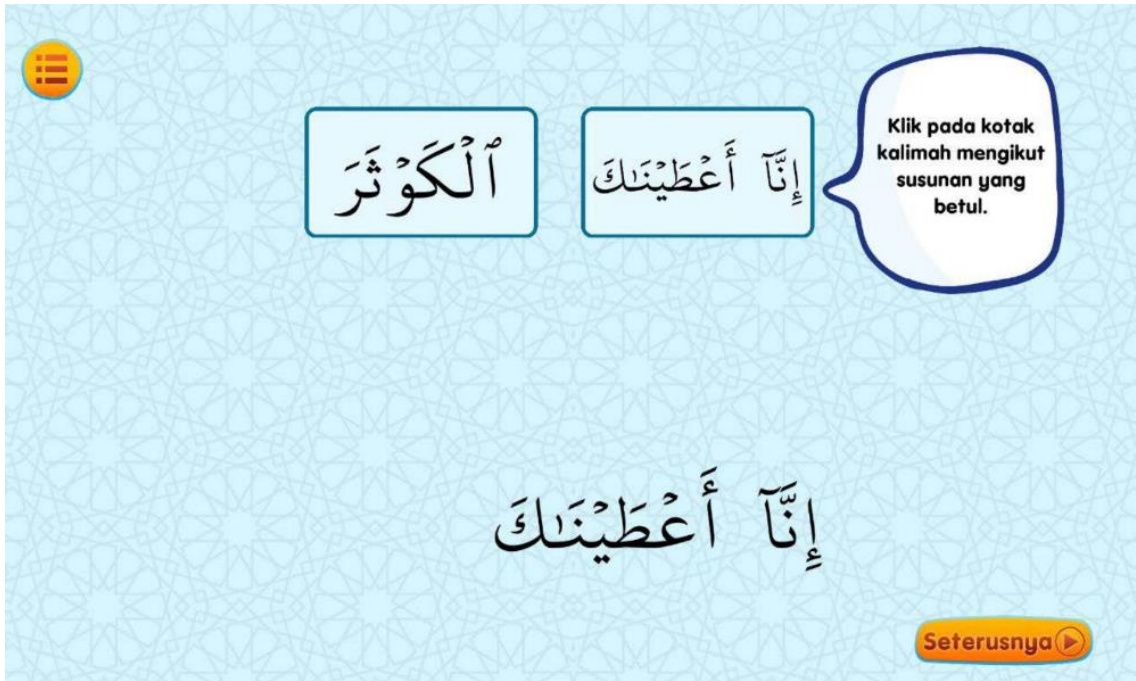


Figure 34 Game Screen 4

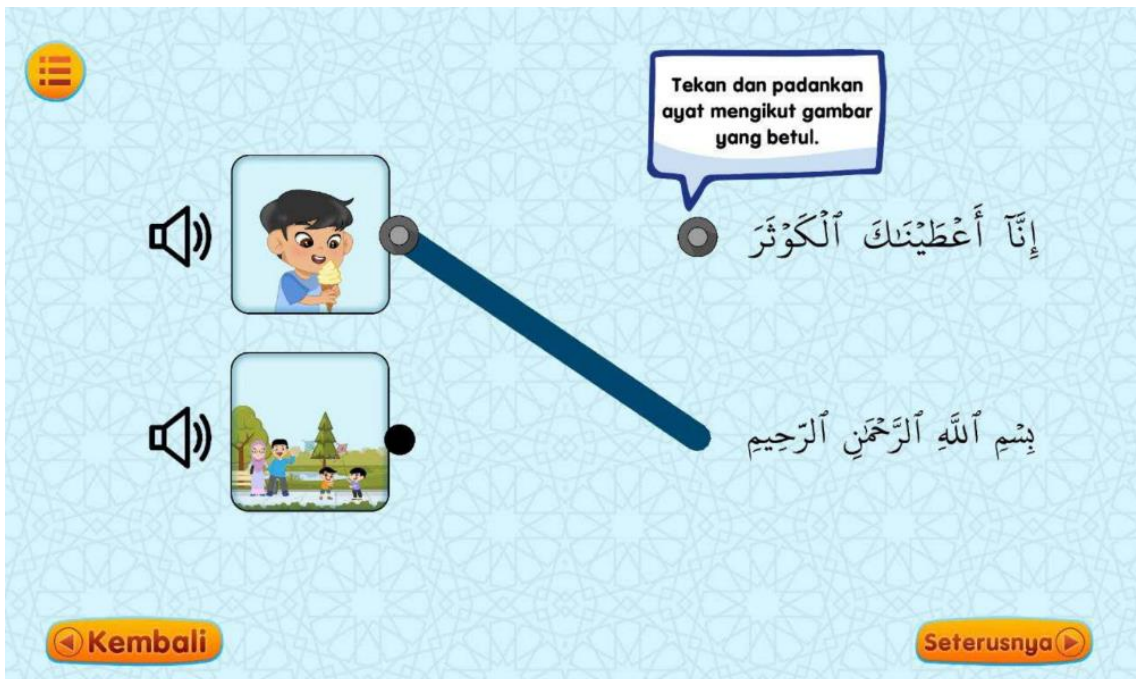


Figure 35 Game Screen 5

### **3.5.6 Proof of Initial Concept**

One possible concept for Quran memorization app for autism students could involve creating a prototype of the app and testing it with a small group of children with autism. This could involve gathering feedback from the children, their parents, and educators about the usability and effectiveness of the app in helping the ASD children memorize the Quran. In addition, it may be helpful to gather data on the children's progress in memorization over time to demonstrate the app's effectiveness. Other considerations for the proof of concept may include ensuring that the app is accessible and user friendly for children with autism, and that it aligns with the needs and preferences of this population. This Quran memorization digital application can be used by teachers in preschools for all preschoolers, parents at home, occupational therapists at the therapy centers. The effects of using this tool are abundant. This tool acts as a reinforcement exercise after the face-to-face Quran memorization with teachers and parents. It also helps the autistic preschoolers to be independent learners as the app is self-corrective. Autistic preschoolers can improve their focus and memory as the repetitive auditory and visual inputs help to improve their cognitive functions. Conceptually the ASD students will get:

- A reinforcement exercise of the Quran memorization (after learning of the verse was done through direct exposure with the teacher).
- A simple exercise on the memory (fill in the blanks, arrange the verse, matching the image with the verse)
- A simple puzzle of the visual meaning and application of the memorized verse (also already discussed during the direct exposure learning with the teacher)
- A simple relaxed and interesting game that is interactive for the child to play. For example, drag and place parts of the picture of an animal.

### **3.5.7 Validation and Testing Plan**

A testing or validation plan is an essential component of the development process for any software product, including an application for autistic children to memorize the Quran. This plan describes the activities to be done to ensure that the application is effective and

user-friendly for its intended audience. The testing strategy for a Quran memorizing application for autistic children should take into account the population's particular demands and obstacles. For instance, the testing strategy may need to incorporate specific tactics for addressing attention span, sensory processing, and communication problems.

The testing procedure should include both automated and manual testing techniques, as well as user acceptance testing conducted by a varied population of autistic children and their caregivers. This will ensure that the program fulfils the needs and preferences of its intended users and is able to support their Quran memorization efforts efficiently.

Test Case	Test Data	Expected Result	Actual Result	Pass/Fail	Comments
Create a new name	“izzat”	New name successfully created			
Create more than one new name	“izzat”, “izzati”, “muhammad”	Three new names successfully created			
Change player name	From “izzat” to “izzati”	Successfully change player name			
Enter level 1	Level 1 button	Navigate to next page that related to level 1			
Scan the Quran verse using AR camera	Verse 1-7 of Sura Al-Fatihah	Successfully scan the verses with pop-out verse as AR object			
Click next button	Button “Seterusnya”	Navigate to the next page			
Click back button	Button “Kembali”	Navigate to the previous page			



Click the verse	Quran verse (by level)	-Verse audio played  -The cursor moved simultaneously with the audio			
Click the audio icon	Audio icon	The audio of the verse is playing			
Click and drag the verse into the right place	The verse of the level	Successfully drag the verse into the right place			
Click and drag the verse into the wrong place	The verse of the level	- Unsuccessfully drag the verse into the wrong place  -the verse moves back to its original place			
Click the right piece of chunky verse	The first piece of chunky verse	The piece of chunky verse pop-out at the bottom			

Click the wrong piece of chunky verse	The second piece of chunky verse	The piece of chunky verse does not appear at the bottom			
Click and match the verse to the right picture	The first verse and the second picture	The line of the match appears to match both elements			
Click and match the verse to the wrong picture	The first verse and the first picture	The line of the match does not appear to match both elements			
Complete a mini game	Mini game by level	Successfully complete the mini game			
Unlock the new level	Complete the mini games	Successfully unlock new level			

### **3.5.8 Potential Used of Proposed Solution**

For this system, it could potentially be used in a number of different ways to help children with autism learn and understand the Quran. Some potential uses for this type of app could include:

1. To help the ASD children to focus on Quran Memorization
2. Providing them to be independent learners
3. Providing personalized learning plans
4. Motivate them to repeat the learnings.
5. Sequential learning of Quran memorization.

### **3.5.9 Gantt Chart**

Please refer to Appendix A. The Gantt chart is the distribution of tasks with a timeline of how long each task should last.

## **CHAPTER 4**

### **RESULTS AND DISCUSSION**

#### **4.1 Introduction**

The fourth chapter will examine the design, implementation, and testing of an interactive Quran memorization application for autistic children. This game targets autistic youngsters aged 5 to 12 years old. Unity3D, Adobe Illustrator, and Visual Studio Code are utilised throughout the development of this interactive application. The purpose of testing the interactive application is to identify any potential flaws and correct them promptly.

## 4.2 Development Tools

Table below shows the software that are used to develop the Quran Memorizing Interactive Application.

No	Tool	Purpose
1	Unity3D	to create the game space, game content, game design and gameplay
2	Visual Studio Code	For scripting the game logic
3	Adobe Illustrator	To create and edit the image marker
4	Adobe Photoshop	To create puzzle image and image placeholder
5	Adobe Premiere Pro	To edit and render the Al Fatihah voice recording.
6	Figma	To design the game mock-up.

### 4.3 Implementation

This section will describe the implementation of the Quran Memorizing Interactive Application. The implementation will involve the graphic designing of the game and the image marker and the multimedia contents.

Images play a crucial role in conveying the design of a scene interface. They serve as key components for various elements in the scene such as backgrounds, hints, AR markers, buttons, icons, and game objects. Typically, these images are sourced from the internet and then meticulously edited using sophisticated software such as Adobe Photoshop, Adobe Illustrator, and Figma. Once the editing is complete, these images are imported as 2D sprites into the Unity software to integrate seamlessly into the game content.

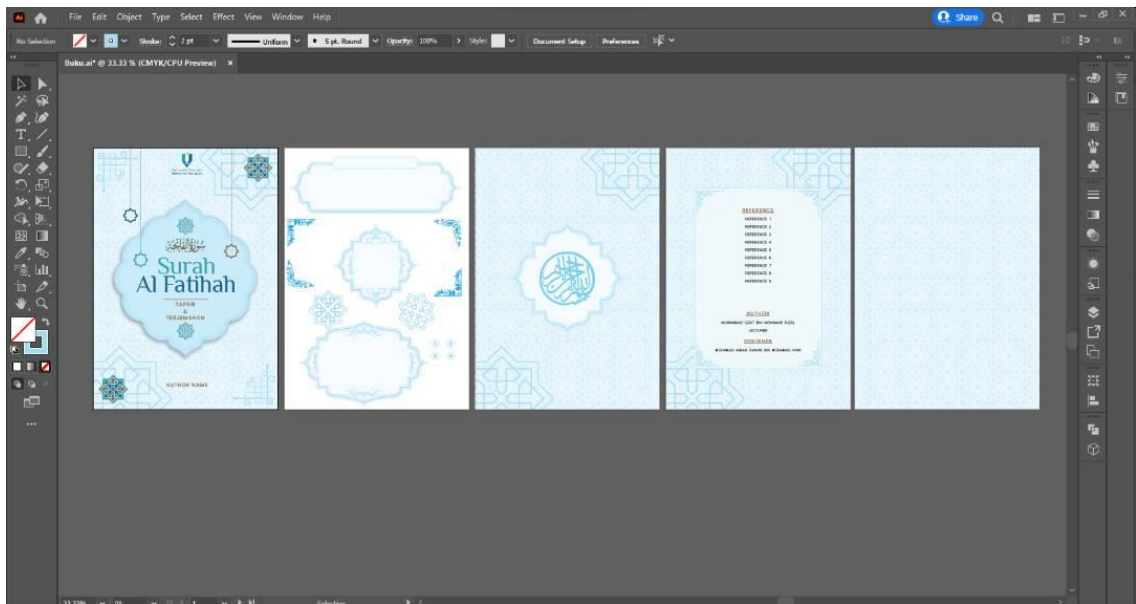


Figure 36 Example of editing marker for AR feature in Adobe Illustrator

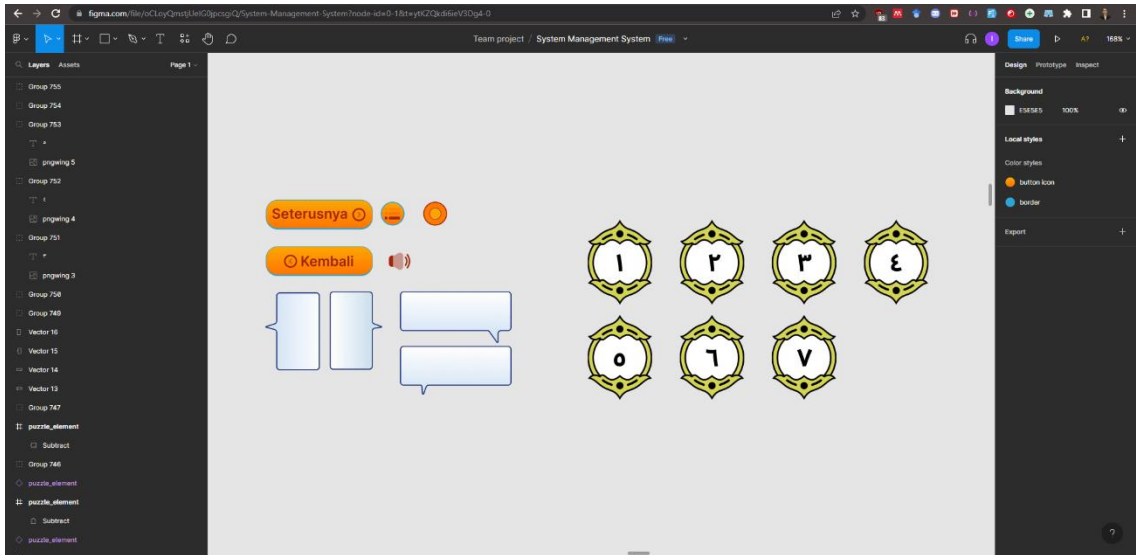


Figure 37 Example of editing game components in Figma

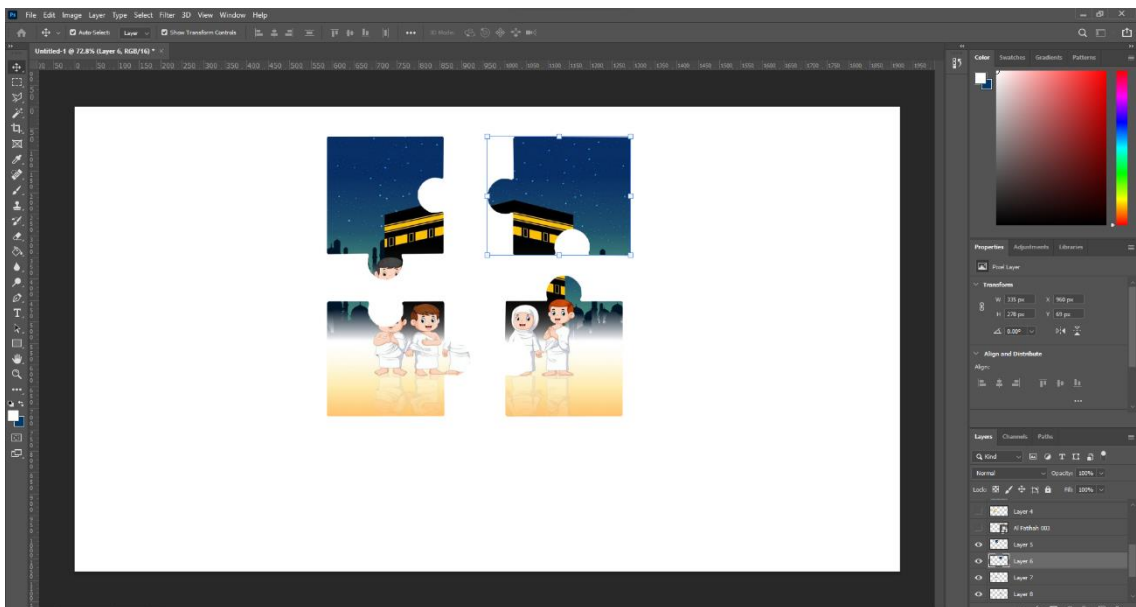


Figure 38 Example of editing game object in Adobe Photoshop

In addition to its primary function of conveying information and facilitating communication, text plays a crucial role in providing instructions to users. In the context of the game application at hand, text serves as a means of guiding players and informing them about the rules, objectives, and mechanics of the game. As such, the quality and clarity of the textual content are paramount to ensuring a positive user experience.

Furthermore, the audio component of the game, specifically the recitation of Al-Fatihah, holds significant cultural and religious importance, and as such, great care was taken in selecting a reputable reciter such as Sheikh Al-Mishary. Other audio elements, including background music and sound effects, are also carefully curated to enhance the gameplay experience.

The editing of the audio content was performed using industry-standard software such as Adobe Premiere Pro, ensuring a high level of quality and professionalism in the final product. It is worth noting that the game utilizes a single background, which is strategically designed to complement the overall aesthetic and gameplay experience.

In summary, the thoughtful and deliberate selection and curation of both textual and audio components of the game serve to elevate the overall quality of the product and contribute to a more engaging and enjoyable user experience.

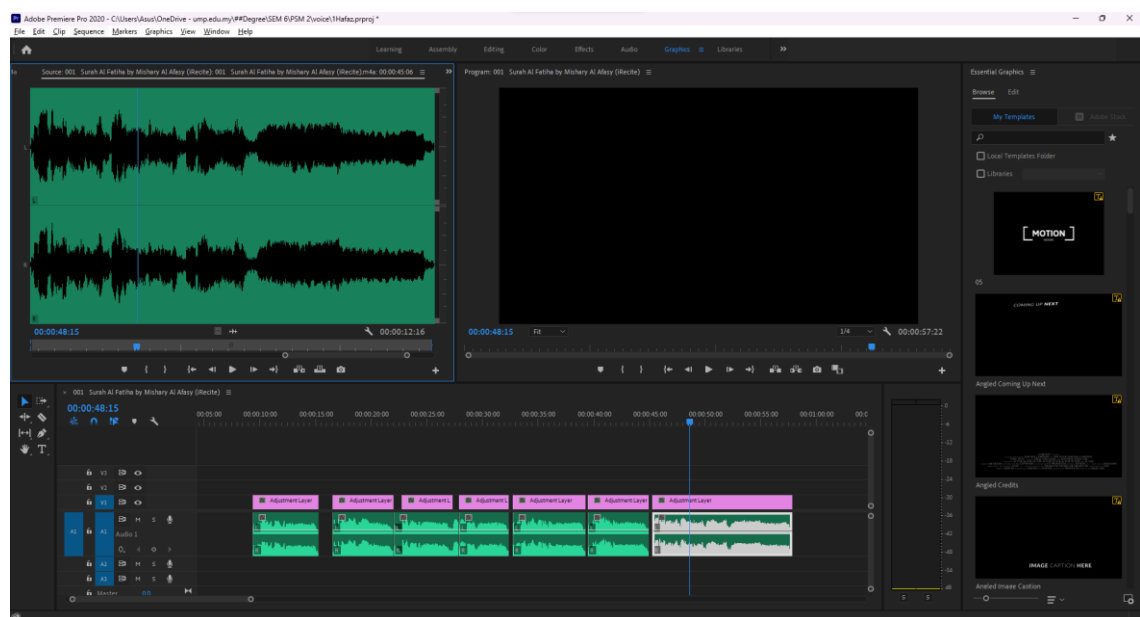


Figure 39 Example of editing the in-game voice in Adobe Premiere Pro



### **4.3.1 Development of the Game Application**

Following the completion of the design phase, the development stage of the game application will commence, utilizing the powerful Unity software. This sophisticated software environment provides a comprehensive suite of tools and resources that enable the game developer to bring the envisioned game concept to life, in a seamless and efficient manner. Through the meticulous and iterative process of programming, debugging, and testing, the developer will work tirelessly to create a polished, bug-free, and immersive gaming experience, that will captivate and engage the target audience.

### 4.3.1.1 Home Screen

Figure below shows the home screen of the application. This home screen consists of five buttons which are info-icon button, exit-icon button, user-icon button, menu button and “MULA” button. All these buttons are put in separate except the “MULA” button that in the bottom middle of the screen. The other buttons are put at the corner of the screen. A text “1Hafaz” at the middle of the screen and in the blue container represent the game name and a text “Q-MAPS” under the text “1Hafaz” is shown represent the term which is this game is for the autistic children. When the user clicks the exit-icon button, the game will be closed. The info-icon button will show the information about this game. The user-icon button will navigate the user to a new screen that give option to the user whether they want to change player name or not. The menu button will navigate the user to the level screen that require the user to choose the level that they want to play. For the “MULA” button, the user will be navigated to the current level they play.

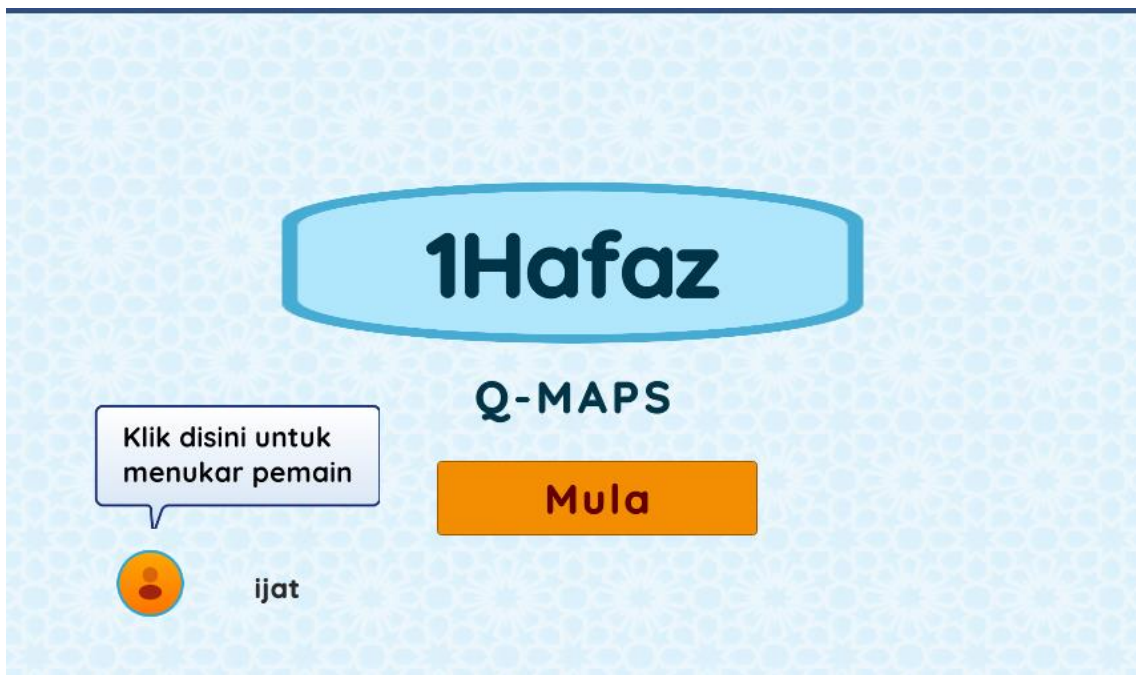


Figure 40 Home Screen

#### 4.3.1.2 Change Player Name Screen

Figure below shows the Change Player Name screen interface, a simple and user-friendly interface designed to allow users to update their player's name within the application. The interface is divided into three main sections: a text input field, a change button, and a back button.

At the center of the screen, there is a text input field where the user can type in their new player's name. The input field is clearly labeled and visually distinct, making it easy for users to locate and use. Below the input field, there is a change button labeled "Tukar" that can be clicked to initiate the name change process.

When the user clicks the "Tukar" button, a dialogue box will pop out confirming the name change and prompting the user to confirm their new name. The dialogue box is designed to be clear and concise, making it easy for users to understand and complete the name change process.

On the top right corner of the screen, there is a back button labeled "KEMBALI" that can be clicked to navigate back to the previous page. The back button is prominently displayed and visually distinct, making it easy for users to locate and use.



Figure 41 Change Player Name Screen

### 4.3.1.3 Level Screen

Figure below shows the Level screen interface, designed to provide users with a simple and intuitive way to select a specific level in the application. The interface consists of two main elements: a back button, and seven level buttons.

Located in the top right corner of the screen, there is a back button labelled "KEMBALI." This button can be clicked to navigate back to the previous page, providing users with an easy way to backtrack and retrace their steps.

At the centre of the screen, there is a container that contains seven level buttons, each representing one of the seven verse from Al Fatihah. The level buttons are clearly labelled and arranged in a logical order, starting from "Aras 1" (representing the first verse from Al Fatihah) and ending with "Aras 7" (representing the last verse).

To proceed to a specific level, users can simply click on the corresponding level button but the user must complete the previous level before enter new level. Clicking a level button will take the user directly to that level, allowing them to start playing or interacting with the content associated with that level.

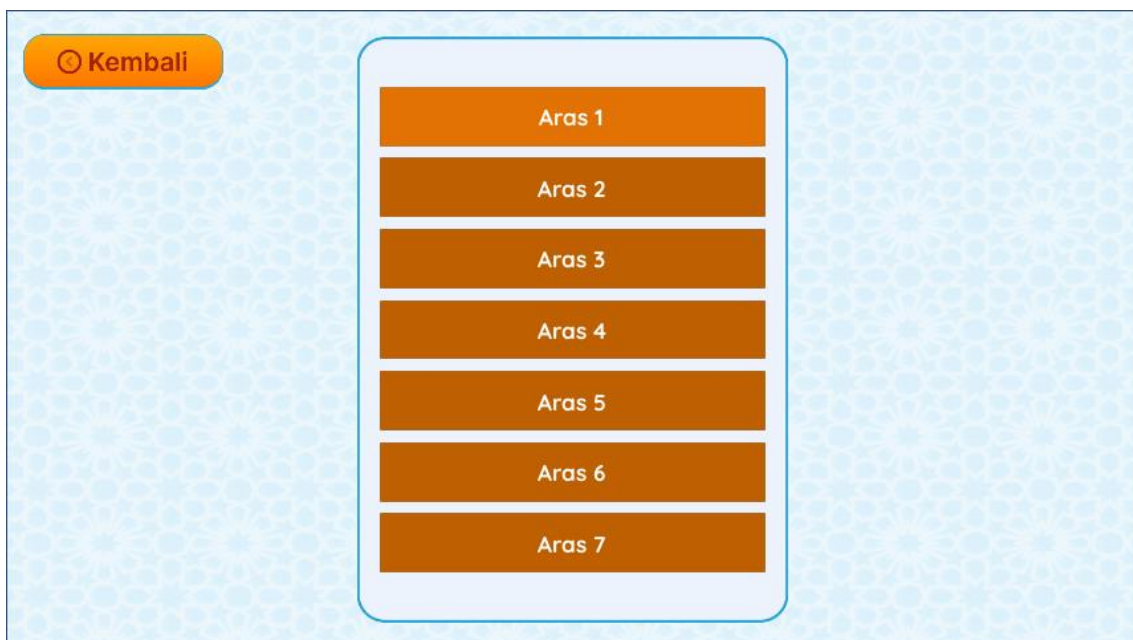


Figure 42 Level Screen

#### **4.3.1.4 AR Screen**

The image below showcases the AR features screen, which offers users an immersive and interactive experience. Within this screen, users are presented with a dedicated camera view in a box, allowing them to effortlessly scan the provided marker. Scanning the marker is essential to unlock the augmented reality (AR) multimedia content. Once the marker is successfully scanned, users will witness captivating AR elements, such as dynamic text and voice components, seamlessly appearing on their screen. The voice component corresponds to the specific level, providing users with an engaging audio rendition of the verse associated with that level. Furthermore, the verse itself will be prominently displayed on the screen, enhancing the visual and textual connection to the AR content. By incorporating AR technology, this feature enriches the user's learning experience, making it more interactive, captivating, and memorable. Users are incentivized to engage with the activity and explore subsequent levels by scanning the appropriate marker, ensuring a rewarding and comprehensive learning journey

#### 4.3.1.5 Step 1 Screen

Displayed in the figure below is the interface for Step 1, which enables users to undertake a comprehensive journey throughout the level. In this particular phase, users are presented with the opportunity to both read and listen to the recitation of the verses contained within Surah Al-Fatihah. Upon selecting a specific verse, the voice of the esteemed sheikh will commence reciting the corresponding verse in line with the user's level of proficiency. Notably, users are able to repeatedly listen to the recitation until they feel confident enough to recite the verse independently. The image at the center right of the interface shows the related image of the verse. The animated display located beneath the Al-Fatihah verse serves to further enrich the user's experience by portraying the meaning of the verse in an engaging manner. Located at the lower right corner of the screen, a "Seterusnya" button has been provided to facilitate users' progress to the next step, whilst the "Kembali" button situated at the lower left corner of the screen serves as a navigation tool allowing users to return to the previous page.



Figure 43 Step 1 Screen



#### 4.3.1.6 Step 2 Screen

The interface showcased below depicts Step 2 of the level, which entails the user dragging verses to their designated spaces. This step allows users to enhance their understanding and mastery of the verses contained within the Surah Al-Fatihah. To facilitate this, users are provided with a red volume icon button which, when clicked, provides an auditory hint by reciting the corresponding verse for each designated space. For instance, in this particular step, the first volume icon corresponds to the recitation of the first verse of the Al-Fatihah, whilst the second icon corresponds to the seventh verse of the same surah. It is worth noting that the second voice will be randomly generated from the remaining verses, while the first voice will be tailored to the user's level of proficiency. Following the successful placement of the verses in their designated spaces, users may proceed to the next step by clicking the "Seterusnya" button.



Figure 44 Step 2 Screen



Figure 45 Step 2 Screen - After Drag



#### 4.3.1.7 Step 3 Screen

The interface displayed below showcases the Step 3 screen of the level. This engaging screen presents users with an interactive task where they are required to carefully select one of the verses presented on the right side of the screen and match it with the corresponding picture displayed on the left side. To assist users in correctly identifying the matching picture, a helpful feature is incorporated: a volume icon located next to each picture. By simply tapping on the volume icon, users can listen to a voice recording of the verse associated with the picture. This audio cue provides a valuable aid, allowing users to effortlessly locate the appropriate match for the verse among the pictures. This user-friendly approach enhances the overall user experience, ensuring a more enjoyable and successful gameplay session.



Figure 46 Step 3 Screen

#### 4.3.1.8 Step 4 Screen

The figure depicted below illustrates the Step 4 screen of the level. This screen presents users with an engaging activity where they are required to click on the verse boxes provided at the top of the screen in the correct order. Users have the flexibility to attempt the task multiple times until they successfully click on the verse boxes in the correct sequence. As users click on a verse box, the corresponding verse will be displayed in the designated space at the bottom of the screen. Prompt feedback is provided to enhance the user experience: If the user answers correctly, a dialogue box will promptly appear, affirming their response with the word "Correct." In the event of an incorrect answer, the dialogue box will indicate "Incorrect," and the answer will be reset, allowing users to make additional attempts until they arrive at the correct answer. This feature encourages perseverance and enables users to progressively improve their skills and accuracy in a supportive learning and memorizing environment.



Figure 47 Step 4 Screen

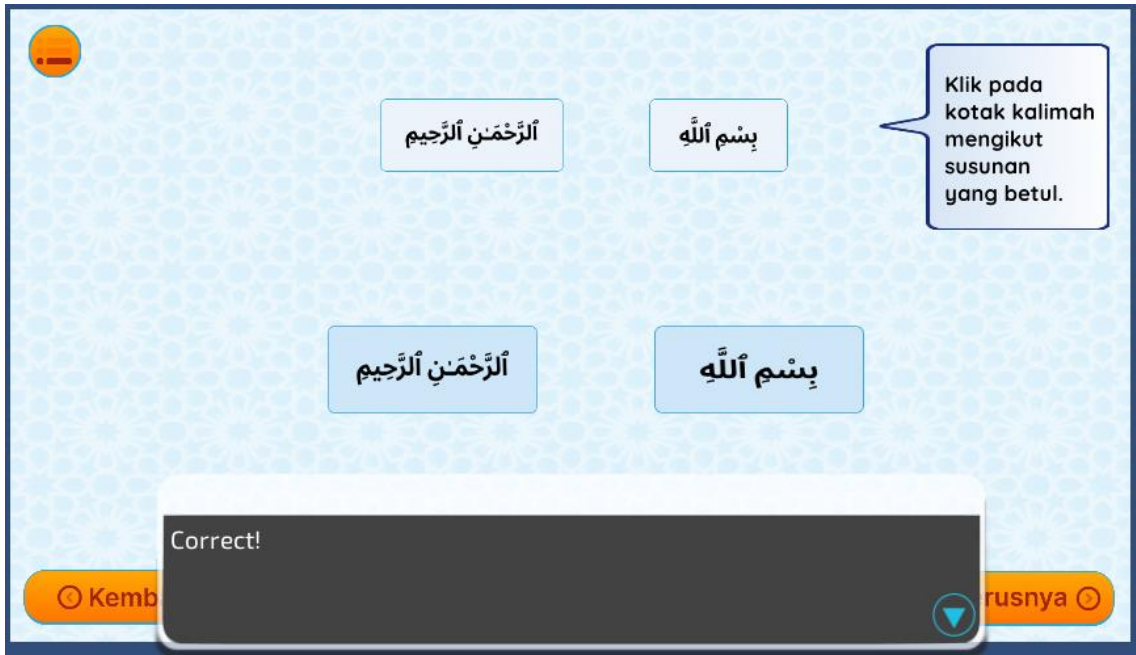


Figure 48 Step 4 Screen correct answer

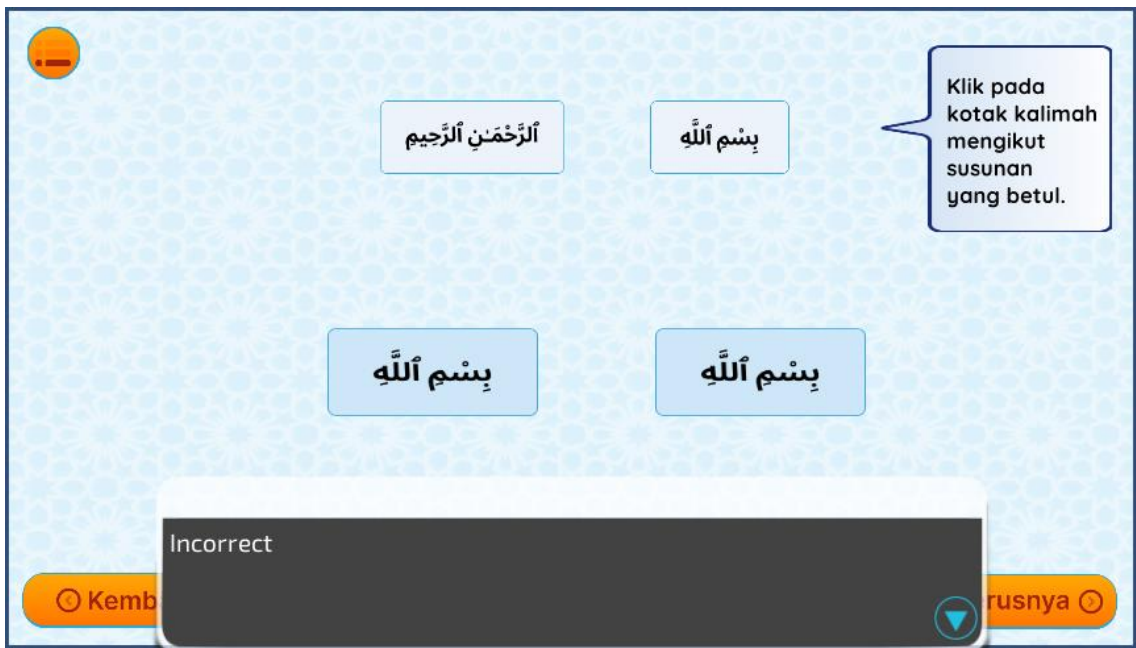


Figure 49 Step 4 Screen incorrect answer

#### 4.3.1.9 Mini Game Screen

The screen illustrated below represents the final step of each level, wherein the user is required to engage in a mini-game to complete the level. In this specific game, users are tasked with arranging a puzzle to form a complete image. This entails dragging puzzle components into their designated placeholders, utilizing the image located above the placeholder as a reference or hint. If the user places a puzzle component in the incorrect space, the component will revert to its original position until correctly placed. Upon completing the puzzle, users may proceed to unlock the next level (Aras) by clicking the "Seterusnya" button. The implementation of this game in the final step of each level serves the purpose of providing relaxation to autistic students after completing the preceding stages.

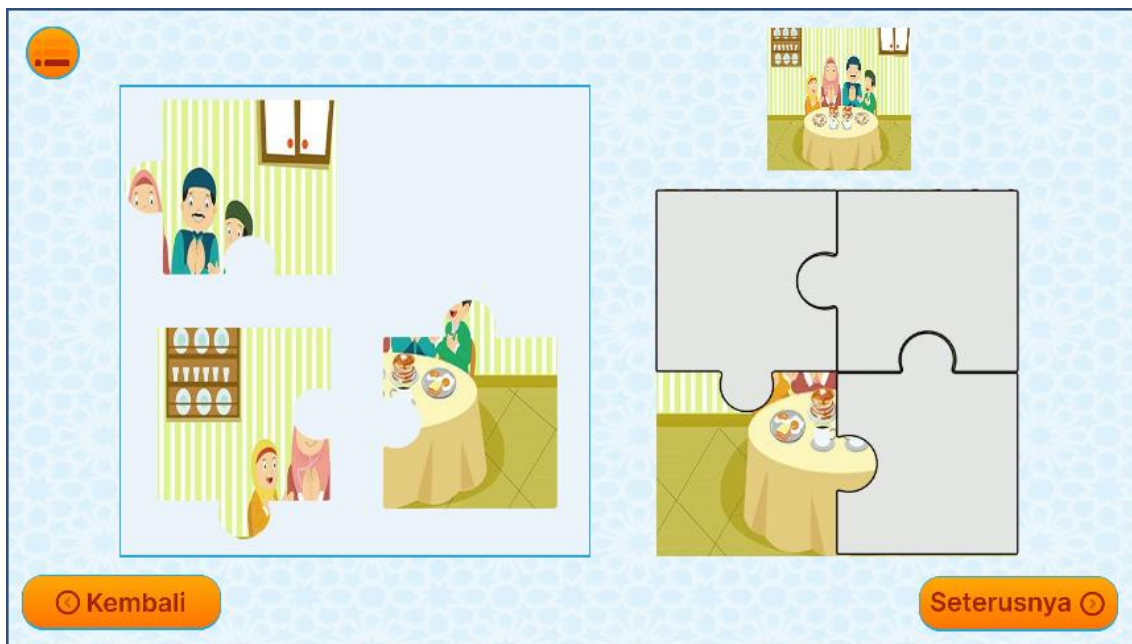


Figure 50 Mini Game Screen

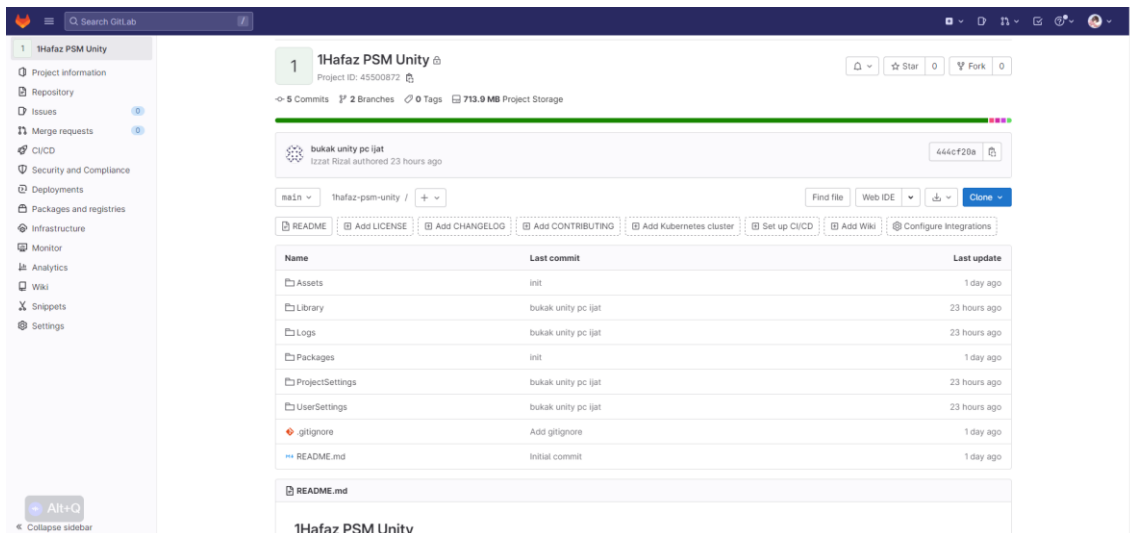
### 4.3.2 Version Control

Having cloud backup for projects with frequent changes is of utmost importance. In the case of project 1Hafaz, the developer has opted to use GitLab as his version control system. GitLab is a cloud-based platform that enables efficient collaboration and version control of code changes made by multiple contributors in real-time. This platform allows for a centralized repository where all changes to the codebase can be tracked, managed and viewed.

To manage the GitLab repository, the developer has decided to use Sourcetree. This tool provides a user-friendly interface that facilitates the management and viewing of changes in the codebase. It simplifies the process of cloning, branching, and merging code. With Sourcetree, the team can easily monitor and manage the development process of their project.

By using GitLab and Sourcetree, the team can efficiently collaborate on the project and ensure that all changes are tracked and versioned. The GitLab repository provides a centralized location where all changes are recorded, and team members can quickly access the codebase and review changes made by their colleagues. With Sourcetree, the team can easily revert to previous versions of the codebase in case any issues arise.

Overall, the use of GitLab and Sourcetree enables the team to manage their project efficiently and collaborate effectively. These tools provide the necessary features to ensure that the project is delivered successfully. Figure below shows the screenshot of the project 1Hafaz in the Gitlab.



**Figure 51 Project 1Hafaz – Gitlab**

The figure below depicts a screenshot of the Sourcetree interface that has been utilized to clone and control the version of the project. In the image, the user interface of Sourcetree is visible, which shows a graphical representation of the project 1Hafaz's repository tree structure, including all the project files and directories. The interface provides an intuitive way for the team to manage their project's Git repository and visualize the changes made to the project files.

On the left-hand side of the interface, there is a sidebar that displays a list of all the branches in the repository, along with their commit history. This sidebar also shows any remote repositories that have been added to the project. In the center of the interface, there is a file viewer that displays the contents of the selected file. The file viewer highlights any changes made to the file and shows the differences between the current version and previous versions.

At the top of the interface, there is a toolbar that includes buttons for common Git commands such as Pull, Push, Fetch, and Commit. These buttons allow users to execute Git commands directly from Sourcetree without having to use the command line, streamlining the development process.

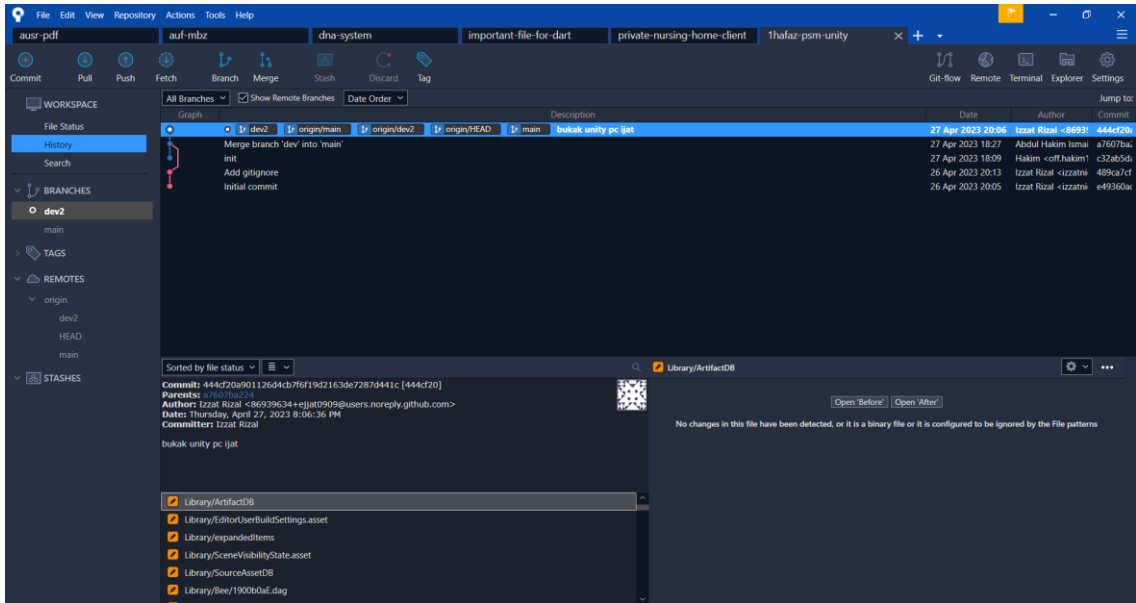


Figure 52 SourceTree 1Hafaz



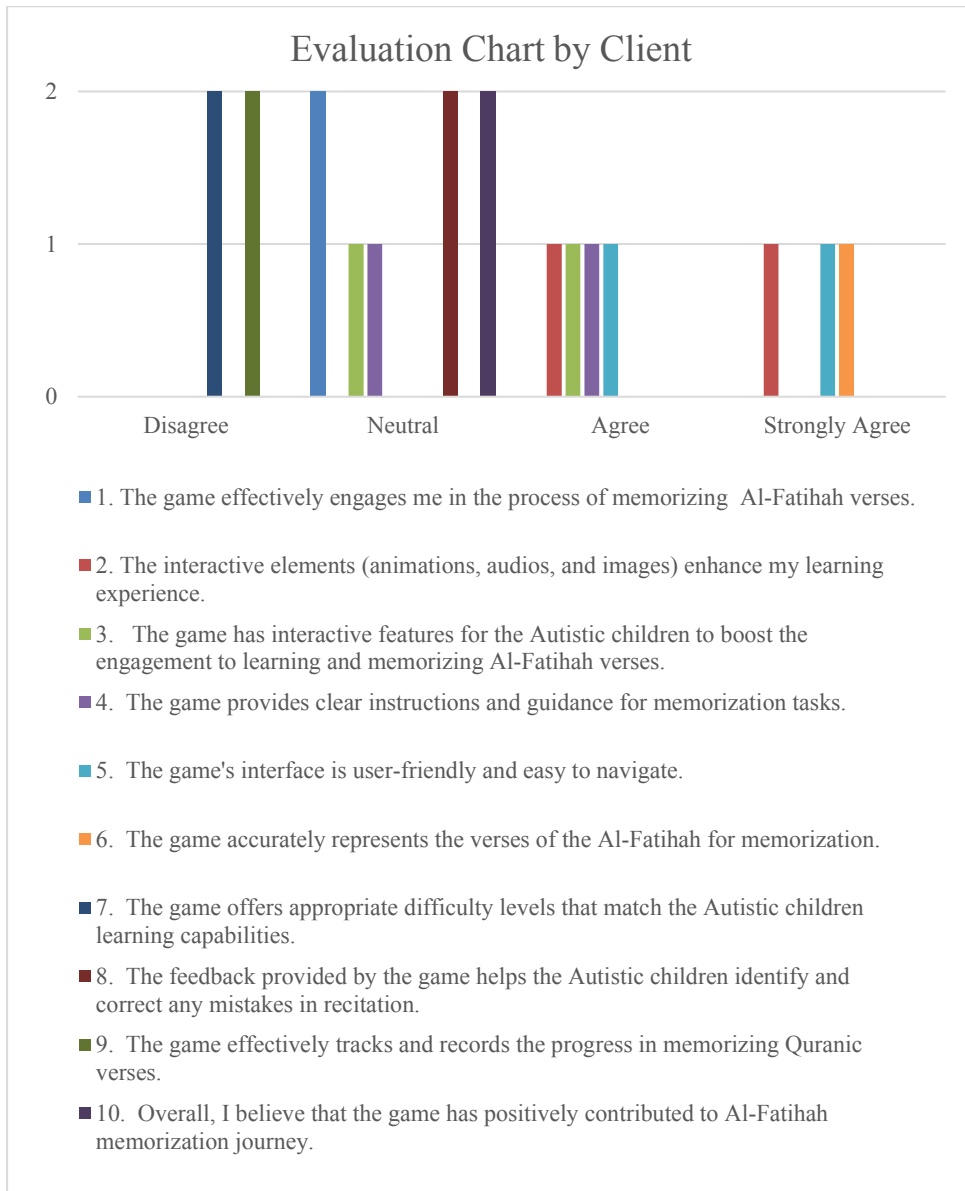
#### 4.4 Results and Discussions

Upon the successful completion of the development phase, a meticulous testing process was diligently undertaken to thoroughly assess the functionality, usability, and overall effectiveness of the Quran Memorizing Interactive Application game. To ensure accurate evaluation, a personal Samsung Tablet was utilized by the dedicated user for comprehensive testing. The testing and evaluation phase encompassed a diverse pool of 20 respondents, thoughtfully selected from the esteemed MZR Company staff. The User Acceptance Test (UAT) was conscientiously employed, encompassing a thorough examination of all available features within the game application to validate their flawless performance. For further insights and detailed analysis, please kindly refer to the meticulously prepared UAT form thoughtfully included in **APPENDIX B**. The astoundingly positive outcomes of the UAT unequivocally indicate the seamless functionality and exceptional performance of all the meticulously developed features within the game application, showcasing its resounding success and unwavering reliability.

To comprehensively assess the usability and effectiveness of the game application, a meticulous survey or evaluation was administered to users upon completion of their gameplay experience. The evaluation was conducted through a user-friendly Google Form, thoughtfully designed to gather valuable insights. For detailed reference, kindly consult APPENDIX C, where the comprehensive evaluation form can be found. This carefully crafted evaluation form comprises ten thought-provoking questions, necessitating users to provide ratings on a scale ranging from "strongly disagree" to "strongly agree." By utilizing this scale, users are empowered to express their nuanced opinions, contributing to a robust and insightful evaluation of the game application's usability and overall effectiveness.



#### 4.4.1 Evaluation from Client



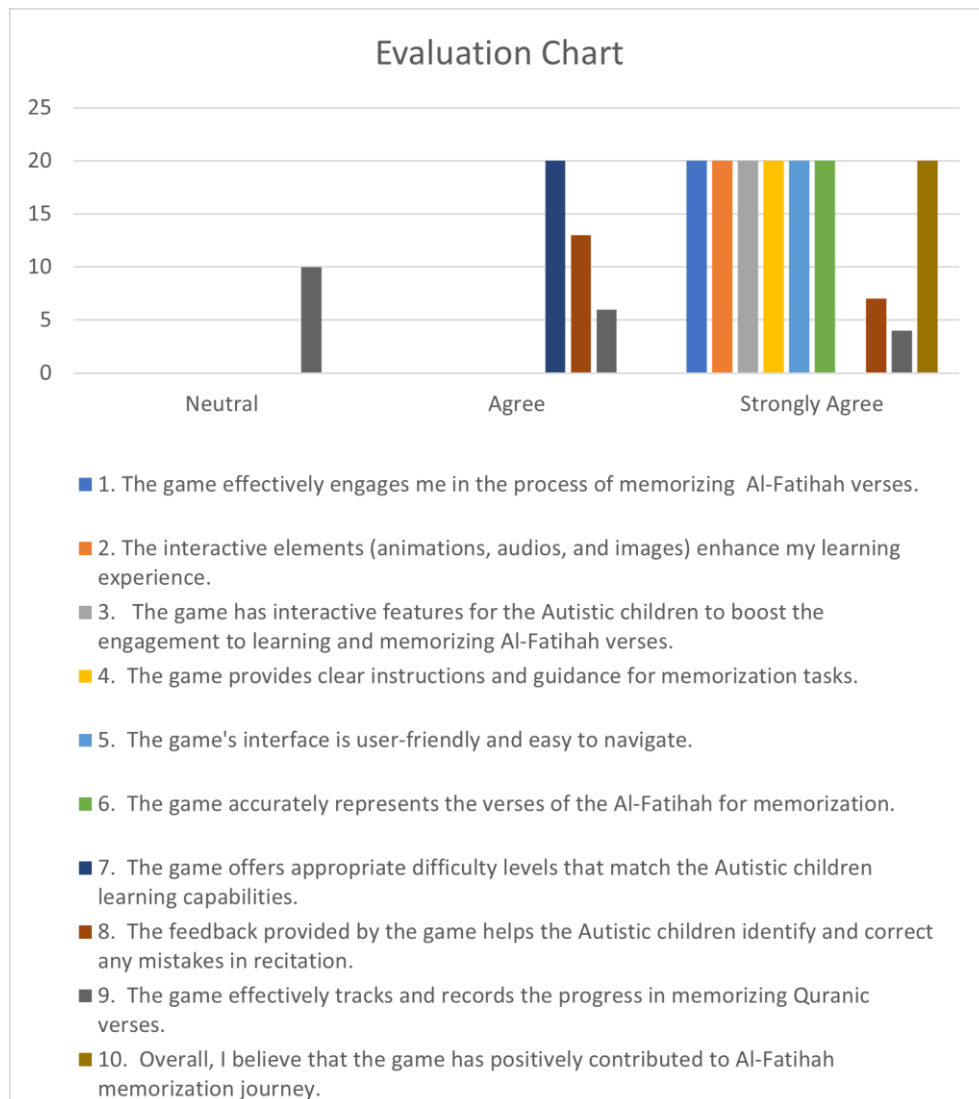
**Figure 53 Evaluation Chart by Client**

According to the graph, the evaluation results indicate the participation of two respondents from the client, representing their valuable perspectives. Notably, 20% of the respondents expressed their views through a combination of disagreement and agreement, while 40% maintained a neutral stance regarding the evaluation questions. Encouragingly, 15% of the respondents strongly agreed with the evaluation questions, showcasing a favourable reception.

Regarding the engagement in the process of memorizing Al-Fatihah verses, both respondents remained neutral. However, one respondent strongly agreed that the interactive elements

(animations, audios, and images) enhanced their learning experience, while the other respondent held an agreeable viewpoint. Furthermore, one respondent agreed that the game's interactive features effectively boosted engagement in learning and memorizing Al-Fatihah verses, and acknowledged the provision of clear instructions and guidance. The other respondent remained neutral on this aspect. Regarding the game's interface, one respondent strongly agreed that it was user-friendly and easy to navigate, while the other respondent expressed agreement. Both respondents strongly agreed that the game accurately represented the verses of Al-Fatihah for memorization. Regrettably, both respondents disagreed on the game's ability to offer appropriate difficulty levels that match the learning capabilities of autistic children, as well as effectively track and record progress in memorizing Quranic verses. Fortunately, both respondents maintained a neutral stance on the feedback provided by the game to identify and correct any mistakes in recitation, while firmly believing that the game had positively contributed to the journey of Al-Fatihah memorization.

#### 4.4.2 Evaluation from User



**Figure 54 Results of user feedbacks from question 1 until question 10**

Based on the provided graph, an impressive majority of 75.5% of respondents expressed a resounding "strongly agree" rating, indicating their profound affinity for the game. Furthermore, 19.5% of respondents endorsed the game with an "agree" rating, while a small percentage of 5% maintained a "neutral" stance. When asked about the effectiveness of engaging in the process of memorizing Al-Fatihah verses, an overwhelming unanimous response emerged, with all respondents expressing a steadfast "strongly agree" sentiment. This cohesive agreement extended to the perception that the game's elements significantly enhanced the overall learning experience. Notably, respondents exhibited a strong consensus regarding the game's interactive features designed specifically to stimulate engagement among autistic children, provide clear instructions and guidance, and offer a user-friendly interface that facilitated seamless navigation.

Furthermore, respondents overwhelmingly agreed that the game accurately represented the verses of Al-Fatihah, instilling confidence and precision in the memorization process. However, when considering the appropriateness of difficulty levels matching the learning capabilities of autistic children, respondents conveyed a predominantly affirmative "agree" stance, with only a fraction of respondents expressing a "neutral" viewpoint. Additionally, a notable majority agreed that the game's feedback mechanism was instrumental in identifying and rectifying recitation errors, while a smaller percentage expressed a resolute "strongly agree" sentiment. Regrettably, a significant portion (50%) of respondents adopted a "neutral" position concerning the game's ability to effectively track and record progress in memorizing Quranic verses, while 30% expressed an "agree" sentiment and the remaining 20% firmly endorsed a "strongly agree" perspective. Nevertheless, overarching consensus prevailed as all respondents unequivocally affirmed that the game significantly and positively contributed to their Al-Fatihah memorization journey.

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Introduction**

Chapter 5 presents a comprehensive summary of the development of the Quran Memorizing Interactive Application for Autistic Children, highlighting the achievement of objectives and the resolution of previously identified challenges. Traditional methods of learning and memorizing Al-Fatihah often rely on static materials, such as Al-Quran and Muqaddam, accompanied by teacher-led instruction. However, autistic children may struggle to maintain focus and can become disinterested in these conventional approaches. Recognizing the potential for boredom to hinder learning, this game application was specifically designed to captivate and motivate children through the integration of multimedia elements, including animations, audio, and images. By engaging with the game application, children can enjoy a fun and entertaining learning experience. The development of this application involved the utilization of software tools such as Unity, Microsoft Visual Studio 2019, and Figma, following the agile Scrum methodology, which facilitated regular progress updates throughout each phase. The implementation and evaluation of the game application involved High Functioning Autism (HFA) children aged 6 to 10 years, as well as teachers and parents, who actively tested and provided feedback on the application's effectiveness and functionality. The evaluation process yielded overwhelmingly positive feedback from children, teachers, and parents, affirming the success of the game application in achieving its intended goals. This innovative approach to Quran memorization has the potential to revolutionize the

learning experience for autistic children, fostering their interest and facilitating their progress in a supportive and enjoyable manner.

## **5.2 Discussion on User Acceptance Test**

Upon completion of the development process, the implementation and evaluation phases are undertaken to assess the functionality, usability, and effectiveness of the game application. To ensure the application's functionality, a User Acceptance Test (UAT) is conducted, wherein users are tasked with testing the correct functioning of all the features within the game application. This testing is performed across various pages of the application. The detailed of the UAT form can be found in **APPENDIX B**. The comprehensive findings indicate that all the available features within the game application demonstrate proper functionality. The UAT results, documented in **APPENDIX D**, showcase the involvement of two esteemed clients from the MZR Company. Encouragingly, during the testing phase, the game application demonstrated smooth functionality and met the clients' expectations, instilling confidence in its performance and reliability.

During the testing phase, the game application was demonstrated to the clients, and upon completion of their gameplay experience, a survey was administered using Google Forms. The survey comprised scale-based questions, as the target users were individuals with High Functioning Autism. After conducting an analysis of the survey responses, it was observed that a majority of the respondents consistently rated their agreement with the statements as "strongly agree" or "agree." These overwhelmingly positive ratings indicate that the game has received favourable feedback from the respondents.

The figure below portrays a fruitful UAT session conducted online via Google Meet, involving esteemed representatives from the MZR company. During the interactive discussion, the client provided exceedingly positive feedback regarding the game application, expressing their satisfaction and appreciation for its exceptional features and functionality.



Figure 55 UAT session with client from MZR

### 5.3 Limitation and Constraint

Throughout the game development process, certain constraints were encountered, which are as follows:

1. **Technical Limitations:** Various technical challenges and limitations were faced during the game development project.
2. **Time Constraints:** The project had to adhere to strict timelines, requiring efficient time management and prioritization.
3. **Resource Limitations:** Availability of resources, such as technology, and budget, posed constraints during the game development.
4. **Compatibility Challenges:** Ensuring compatibility across different devices, platforms, and operating systems proved to be a significant constraint.
5. **Design and Aesthetic Considerations:** Striving for an appealing and visually engaging game design while considering technical limitations and user preferences.
6. **Testing and Quality Assurance:** Conducting comprehensive testing and quality assurance within the given constraints to ensure a seamless and error-free gaming experience.
7. **Accessibility and Inclusivity:** Ensuring the game application is accessible and inclusive for users with varying abilities, including autistic children.
8. **User Feedback Incorporation:** Integrating user feedback and making necessary adjustments within the development constraints to enhance user experience.



The game application has the following limitations:

1. **Platform Restriction:** The current version of the game application is available only for Android devices, limiting access for users who prefer other operating systems.
2. **Lack of Player Accounts:** The game application does not provide individual player accounts or profiles. As a result, users are unable to save their progress or track their achievements across multiple sessions.
3. **Language Limitation:** The game application is currently available only in Bahasa Melayu (Malay language), which may pose a limitation for users who prefer other languages or require multilingual support.

Despite working independently, I persevered and successfully created a remarkable game application that specifically caters to the unique needs of autistic children in their Quran memorization journey. By overcoming various challenges, I have developed an innovative solution that engages and supports autistic children, ensuring a fulfilling and effective learning experience.

## 5.4 Future Work

1. **Multi-platform Compatibility:** Expand the game application to be compatible with other platforms such as iOS and web browsers, ensuring wider accessibility for users across different devices.

2. **Player Accounts and Progress Tracking:** Implement a robust player account system that allows users to create individual profiles, save their progress, and track their achievements. This feature will enhance the user experience and provide motivation for continuous engagement.

3. **Language Localization:** Introduce language localization options to cater to a broader audience. By providing translations and language options, the game application can reach a more diverse user base, accommodating different language preferences and improving inclusivity.

4. **Enhanced Learning Modules:** Incorporate additional interactive learning modules and activities to expand the scope of Quran memorization. Introduce gamified quizzes, challenges, and rewards to make the learning experience more engaging and interactive for autistic children.

5. **Parent/Teacher Involvement Features:** Integrate features that allow parents or teachers to monitor the progress of autistic children using the game application. This can include progress reports, communication channels, and personalized recommendations to facilitate collaboration and support.

6. **Customization Options:** Provide customization options within the game application, allowing users to personalize their learning experience. This can include choosing preferred reciters, adjusting difficulty levels, and customizing visual elements to cater to individual preferences.

7. Collaborative Features: Introduce collaborative features, such as multiplayer modes or cooperative challenges, to promote social interaction and teamwork among autistic children. This can foster a sense of community and encourage peer learning.

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# APPENDIX A

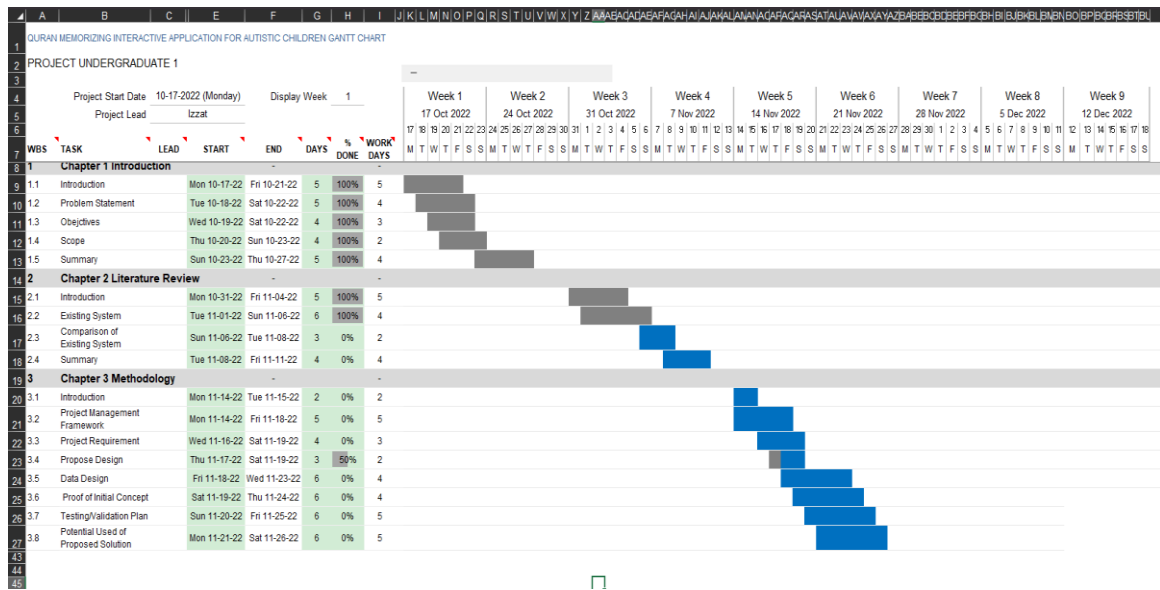


Figure 56 Project Gantt Chart



## APPENDIX B

Tester Name	
Date	

Event	Pass (√) / Fail (X)
<b>Home Screen</b>	
Able to click “Mula” button	
Able to click “Tukar Pemain” button	
<b>Change Player Name Screen</b>	
Able to click “Kembali” button	
Able to write name in the text field	
Able to click “Tukar” button after enter new player name	
Player name have been changed in the Home Screen after click the “Tukar” button	
<b>Level Screen</b>	
Able to click “Kembali” button	
Able to click “Aras 1” button if all the buttons are locked except “Aras 1” button	

Able to click any “Aras” button if the buttons are unlocked	
<b>AR Screen</b>	
Able to scan the marker	
Voice recording is played when successfully scan the marker	
<b>Step 1 Screen</b>	
Able to click menu button	
Able to click “Kembali” button	
Able to click “Seterusnya” button	
Able to click the verse	
Voice recording of the verse is played after clicking the verse	
The cursor follows the voice simultaneously with the voice recording	
<b>Step 2 Screen</b>	
Able to click menu button	
Able to click “Kembali” button	
Able to click “Seterusnya” button	
Able to click the verse	


Voice recording of the verse is played after clicking the verse	
Able to click the volume icon 1	
Able to click the volume icon 2	
Voice recording of the verse is played after clicking the volume icon 1	
Voice recording of the verse is played after clicking the volume icon 2	
Able to drag the verse to the wrong answer space	
The verse goes back to the original position after drag to the wrong answer space	
Able to drag the verse to the correct answer space	
The verse stays in the correct answer space after drag to the correct answer space	
<b>Step 3 screen</b>	
Able to click menu button	
Able to click “Kembali” button	
Able to click “Seterusnya” button	
Able to click the first verse at the right side of the screen	
Able to click the second verse at the right side of the screen	

Able to click the first volume icon	
Able to click the second volume icon	
Able to match the first verse to the first image	
Able to match the first verse to the second image	
Able to match the second verse to the first image	
Able to match the second verse to the second image	
<b>Step 4 screen</b>	
Able to click menu button	
Able to click “Kembali” button	
Able to click “Seterusnya” button	
Able to click the first verse box for first answer	
Able to click the first verse box for the second answer	
Able to click the second verse box for first answer	
Able to click the second verse box for the second answer	
Able to click arrow button in the correct dialogue box	
Able to click arrow button in the incorrect dialogue box	
<b>Game Screen</b>	

Able to click menu button	
Able to click “Kembali” button	
Able to click “Seterusnya” button	
Able to drag first puzzle piece to the correct placeholder	
Able to drag first puzzle piece to the wrong placeholder	
Able to drag second puzzle piece to the correct placeholder	
Able to drag second puzzle piece to the wrong placeholder	
Able to drag third puzzle piece to the correct placeholder	
Able to drag third puzzle piece to the wrong placeholder	
Able to drag fourth puzzle piece to the correct placeholder	
Able to drag fourth puzzle piece to the wrong placeholder	


## APPENDIX C


### EVALUATION FORM FOR USER



## Evaluation Form

Hello and good day! I am Muhammad Izzat Bin Mohamad Rizal, an undergraduate student from the Faculty of Computing at Universiti Malaysia Pahang. I am currently working on a game called the Quran Memorizing Interactive Application for Autistic Children. I would greatly appreciate your feedback on this game, as it will assist in its development and improvement. Your insights are valuable in enhancing the game's effectiveness and user experience. Thank you for taking the time to provide your feedback.

izzatnick123@gmail.com [Switch accounts](#) 

 Not shared

\* Indicates required question

1. The game effectively engages me in the process of memorizing Al-Fatihah verses. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

2. The interactive elements (animations, audios, and images) enhance my learning experience. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

3. The game has interactive features for the Autistic children to boost the engagement to learning and memorizing Al-Fatihah verses. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

4. The game provides clear instructions and guidance for memorization tasks. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

5. The game's interface is user-friendly and easy to navigate. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

6. The game accurately represents the verses of the Al-Fatihah for memorization. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

7. The game offers appropriate difficulty levels that match the Autistic children learning capabilities. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

8. The feedback provided by the game helps the Autistic children identify and correct any mistakes in recitation. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

9. The game effectively tracks and records the progress in memorizing Quranic verses. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

10. Overall, I believe that the game has positively contributed to Al-Fatihah memorization journey. \*

1      2      3      4      5

Strongly Disagree                  Strongly Agree

Submit

Clear form



## APPENDIX D

### USER ACCEPTANCE TEST I HAFAZ

Tester Name	A'lia Huda binti Abu Bakar
Date	9/06/2023

Event	Pass (√) / Fail (X)
<b>Home Screen</b>	
Able to click "Mula" button	√
Able to click "Tukar Pemain" button	√
<b>Change Player Name Screen</b>	
Able to click "Kembali" button	√
Able to write name in the text field	√
Able to click "Tukar" button after enter new player name	√
Player name have been changed in the Home Screen after click the "Tukar" button	√
<b>Level Screen</b>	
Able to click "Kembali" button	√
Able to click "Aras 1" button if all the buttons are locked except "Aras 1" button	√
Able to click any "Aras" button if the buttons are unlocked	√
<b>Step 1 Screen</b>	
Able to click menu button	√
Able to click "Kembali" button	√
Able to click "Seterusnya" button	√
Able to click the verse	√
Voice recording of the verse is played after clicking the verse	√

The cursor follows the voice simultaneously with the voice recording	√
<b>Step 2 Screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to click the verse	√
Voice recording of the verse is played after clicking the verse	√
Able to click the volume icon 1	√
Able to click the volume icon 2	√
Voice recording of the verse is played after clicking the volume icon 1	√
Voice recording of the verse is played after clicking the volume icon 2	√
Able to drag the verse to the wrong answer space	√
The verse goes back to the original position after drag to the wrong answer space	
Able to drag the verse to the correct answer space	√
The verse stays in the correct answer space after drag to the correct answer space	√
<b>Game Screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to drag first puzzle piece to the correct placeholder	√
Able to drag first puzzle piece to the wrong placeholder	
Able to drag second puzzle piece to the correct placeholder	√

Able to drag second puzzle piece to the wrong placeholder	
Able to drag third puzzle piece to the correct placeholder	√
Able to drag third puzzle piece to the wrong placeholder	
Able to drag fourth puzzle piece to the correct placeholder	√
Able to drag fourth puzzle piece to the wrong placeholder	
<b>Step 3 screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to click the first verse at the right side of the screen	√
Able to click the second verse at the right side of the screen	√
Able to click the first volume icon	√
Able to click the second volume icon	√
Able to match the first verse to the first image	√
Able to match the first verse to the second image	√
Able to match the second verse to the first image	√
Able to match the second verse to the second image	√
<b>Step 4 screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to click the first verse box for first answer	√
Able to click the first verse box for the second answer	√
Able to click the second verse box for first answer	√
Able to click the second verse box for the second answer	√

Able to click arrow button in the correct dialogue box	√
Able to click arrow button in the incorrect dialogue box	√

Comment:

Kindly evaluate the game in this form: <https://forms.gle/y92SxnJ9c4FWPLv39>



A handwritten signature in black ink is positioned above a blue circular stamp. The stamp contains the text "MZR GLOBAL SDN BHD" around the perimeter, the registration number "1056636-U" in the center, and a small star at the bottom.

USER ACCEPTANCE TEST 1 HAFAZ

Tester Name	Amira binti Mohd Ishak
Date	9/06/2023

Event	Pass (√) / Fail (X)
<b>Home Screen</b>	
Able to click "Mula" button	√
Able to click "Tukar Pemain" button	√
<b>Change Player Name Screen</b>	
Able to click "Kembali" button	√
Able to write name in the text field	√
Able to click "Tukar" button after enter new player name	√
Player name have been changed in the Home Screen after click the "Tukar" button	√
<b>Level Screen</b>	
Able to click "Kembali" button	√
Able to click "Aras 1" button if all the buttons are locked except "Aras 1" button	√
Able to click any "Aras" button if the buttons are unlocked	√
<b>Step 1 Screen</b>	
Able to click menu button	√
Able to click "Kembali" button	√
Able to click "Seterusnya" button	√
Able to click the verse	√
Voice recording of the verse is played after clicking the verse	√

The cursor follows the voice simultaneously with the voice recording	√
<b>Step 2 Screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to click the verse	√
Voice recording of the verse is played after clicking the verse	√
Able to click the volume icon 1	√
Able to click the volume icon 2	√
Voice recording of the verse is played after clicking the volume icon 1	√
Voice recording of the verse is played after clicking the volume icon 2	√
Able to drag the verse to the wrong answer space	√
The verse goes back to the original position after drag to the wrong answer space	
Able to drag the verse to the correct answer space	√
The verse stays in the correct answer space after drag to the correct answer space	√
<b>Game Screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to drag first puzzle piece to the correct placeholder	√
Able to drag first puzzle piece to the wrong placeholder	
Able to drag second puzzle piece to the correct placeholder	√

Able to drag second puzzle piece to the wrong placeholder	
Able to drag third puzzle piece to the correct placeholder	√
Able to drag third puzzle piece to the wrong placeholder	
Able to drag fourth puzzle piece to the correct placeholder	√
Able to drag fourth puzzle piece to the wrong placeholder	
<b>Step 3 screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to click the first verse at the right side of the screen	√
Able to click the second verse at the right side of the screen	√
Able to click the first volume icon	√
Able to click the second volume icon	√
Able to match the first verse to the first image	√
Able to match the first verse to the second image	√
Able to match the second verse to the first image	√
Able to match the second verse to the second image	√
<b>Step 4 screen</b>	
Able to click menu button	√
Able to click “Kembali” button	√
Able to click “Seterusnya” button	√
Able to click the first verse box for first answer	√
Able to click the first verse box for the second answer	√
Able to click the second verse box for first answer	√
Able to click the second verse box for the second answer	√

Able to click arrow button in the correct dialogue box	√
Able to click arrow button in the incorrect dialogue box	√

Comment:

Kindly evaluate the game in this form: <https://forms.gle/y92SxnJ9c4FWPLv39>

