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AUGMENTED REALITY ON ISLAMIC TERMINOLOGY SIGN LANGUAGE

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Abstract

One of the significant challenges in learning Islamic terms in sign language is the lack of accessible resources. This often results in limited opportunities for individuals interested in this field acquire knowledge effectively. To address this issue, this project aims to develop an Augmented Reality (AR) application specifically designed for learning Islamic terminology in sign language. The development of this application follows the Waterfall methodology, chosen for its structured approach and guidelines, which are well suited for this type of project. To evaluate the usability of AR applications, the System Usability Scale (SUS) questionnaire was employed. The questionnaire was distributed through a Google Form survey to gather feedback from users. The results from the SUS questionnaire indicate that the AR application is user-friendly and effectively meets the needs of its target audience.

Keywords: Islamic Sign Language; Augmented Reality; Mobile Application

INTRODUCTION

Over 17.5 million deaf people worldwide use sign language as their primary form of communication (Bragg et al., 2020). Sign language, originally developed for deaf and hearing-impaired individuals, has grown in diversity, with an estimated 138 to 300 different types used globally today due to increasing interactions among various groups (Altememe & Abbadi, 2021). Examples include Arabic, Indonesian, American, Indian, and Thai Sign Languages. While sign language does not follow the same sentence structure as spoken languages, it maintains similar complexity. In the context of Islam, Arabic Sign Language (ArSL) is the

main sign language used in Islamic education, particularly in teaching the Arabic alphabet to those with hearing impairments (Pemungkas, Wahab & Suwarjo, 2023).

Optimal learning facilitation is crucial for deaf and hearing-impaired individuals to effectively learn about Islam. This challenge also affects those without hearing impairments who wish to support the deaf community in Islamic education. Due to the lack of appropriate educational resources, there have been missed opportunities to provide a foundation of Islamic knowledge to the deaf, impacting their understanding of worship and religious practices (Mardiyanti & Haryanthi, 2018; Muhamad & Khamaruddin, 2019). Addressing these educational and communication barriers is essential for fostering inclusive environments that enable full engagement in both academic and religious pursuits, benefiting both the deaf community and those who support them.

This project aims to assist individuals interested in learning Islamic sign language by utilizing augmented reality (AR) technology. The goal is to provide a platform that offers a more immersive and engaging way to learn and understand Islamic worship practices. AR's unique ability to create immersive hybrid learning environments, combining physical and digital objects, supports the development of skills such as problem-solving, critical thinking, and verbal communication (Akçayır M & Akçayır G, 2017).

Problem Statement

The lack of resources to learn Islamic terminology sign language

Rashid, Yasin, and Ashaari (2018) noted that instructing basic fardu ain to the deaf and hearing-impaired poses challenges due to the lack of appropriate sign language terminology. This issue also affects those without hearing impairments, who struggle to find resources for learning Islamic sign language. The limited availability of Islamic terminology in sign language hinders both deaf individuals and those without hearing impairments from effectively pursuing Islamic knowledge and practices (AbdElghfar et al., 2023). Omar, Alsharif, and Yakar (2021) highlighted that religious teaching materials for the hearing-impaired are scarce, impacting even those without hearing impairments who seek to learn or teach Islamic sign language.

Lack of accessibility to learn Islamic terminology sign language

People with hearing impairments face difficulties finding simple ways to learn Islamic terminology in sign language. This challenge is also shared by those without hearing impairments who wish to learn Islamic sign language to better communicate with the deaf community. The lack of accessible resources for learning Islamic terminology can affect the spiritual understanding of deaf individuals and may lead to misconceptions (Bakar, Hamdani & Alias, 2019). Similarly, individuals without hearing impairments struggle to find comprehensive resources to teach and support the deaf community effectively. Insufficient accessibility in learning sign language further complicates the learning process for deaf Muslims. Mardiyanti et al. (2018) noted that a major obstacle for deaf Muslims is the lack of readily accessible information, a barrier that also affects those without hearing impairments who seek to assist and teach them.

Project Objectives

The main objective of this project was to:

i. To design a storyboard of augmented reality application that can help individuals who was interested in learning about Islamic terminology sign language.
ii. To develop an augmented reality application that teaches individuals who was interested about Islamic terminology sign language.
iii. To evaluate the usability of augmented reality in teaching Islamic terminology sign language to individuals interested in learning.

Project Scope

The project aimed to design and developed an augmented reality (AR) application for learning Islamic Sign Language, accessible to anyone interested. It provided an overview of Islamic Sign Language, focusing on hijaiyah letters, several Islamic phrases, and *al-Fatihah*. The AR application utilized marker-based technology to integrate animations, graphics, images, text, and audio, allowing users to scan a marker to display a 3D model of the sign language. This model could be viewed from multiple angles to ensure a comprehensive

understanding, helping users accurately learn Islamic Sign Language. Malay was used as the medium of instruction within the application.

Project Significant

The significance of this project lies in providing an Islamic Sign Language application for individuals of all ages and hearing abilities interested in learning Islamic terminology. By integrating augmented reality technology, the project addresses the shortage of resources for acquiring Islamic Sign Language proficiency, enhancing accessibility for those with varying degrees of hearing impairment. The use of AR enriches the educational experience, offering a comprehensive solution beyond conventional textbooks. Ultimately, the project supports the development of Islamic Sign Language skills across a diverse audience.

Deaf and hearing-impaired individuals benefit greatly when others learn Islamic terminology sign language. Inclusive learning fosters cultural understanding, reduces communication barriers, and enhances interactions between diverse groups. As more people engage with Islamic Sign Language, opportunities for collaboration, education, and employment for the deaf community increase, promoting social inclusion and empowerment.

LITERATURE REVIEW

Overview Of Sign Language

Sign Language is the primary form of communication for many individuals who are deaf or hard of hearing, though it is not their sole means of communication (Rastgoo, Kiani, Escalera & Sabokrou, 2021). Through hand movements, body positioning, and facial expressions, a person can effectively convey emotions, opinions, and concepts (Ng, Zuo & Ahn, 2021). The language consists of manual gestures complemented by non-manual signals like body stance and facial cues. Sign languages such as American Sign Language (ASL), French Sign Language (LSF), German Sign Language (DGS), and Greek Sign Language (GSL) are fully developed natural languages, distinct from both surrounding spoken languages and each other

(Wolfe et al., 2023). These languages are passed down through generations within the deaf and hearing-impaired community.

Sign Language That Used by Muslim

Muslims around the world use different sign languages depending on their country. In Malaysia, the native sign language for the deaf is Malaysian Sign Language (MSL) (Mokhtar & Anuar, 2014). In the Middle East, Arabic Sign Language is used, with variations across different countries (AbdElghfar et al., 2023). This diversity highlights the rich cultural and linguistic variety within the global Muslim community. Each country's sign language develops independently, influenced by local languages, culture, and social norms, meaning the sign language used by Muslims varies by geographical location. Figure 1 displays MSL used by Malaysian Muslims, while Figure 2 showcases Arabic Sign Language used by Arab Muslims.

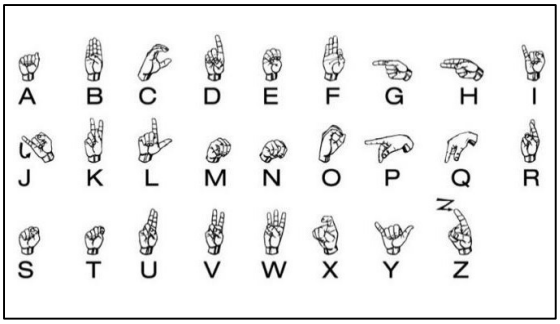

Figure 1: MSL Sign Language

(*Source*: https://themalaysianreserve.com/2023/09/27/inclusive-healthcare-sign-language-interpretation-for-deaf-malaysians/)

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Figure 2: Arabic Sign Language

(*Source*: Lotfi, E., Amine, B., & Mohammed, B., 2015)

Augmented Reality

Augmented reality (AR) involves the integration of information such as text, graphics, audio, and virtual enhancements with real-world objects. AR adds virtual data to real-world environments (Kim, Kang, Choi & Hong, 2017) and is widely used in fields like engineering, advertising, and healthcare. The term "augmented reality" was first coined in 1992 by Boeing researcher Thomas Preston Caudell while developing an industrial AR application for viewing assembly diagrams (Arena, Collota, Pau & Termine, 2022).

Augmented Reality Marker Based

According to Boonbrahm, Boonbrahm, and Kaewrat (2020), marker-based augmented reality uses visual markers, often printed with images or patterns, to trigger augmented content in the real world. The AR system relies on cameras or sensors to identify these markers as reference points. The system must determine both the user's position and the desired position for focus. Adding a detectable pre-defined sign or “marker” to the environment and using computer vision algorithms to identify it is known as “tracking.” Markers can be 3D objects, QR codes, or 2D images, and their purpose is to indicate where virtual items should be displayed.

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METHODOLOGY

The methodology used in this project was the Waterfall model. Among software development models, the Waterfall approach is considered the simplest to understand (Gharejeh, 2019). It assumes that all project requirements are known before the design and implementation stages begin (Almeida & Simões, 2019). The Waterfall model is favored for its sequential and linear approach, where each phase must be completed before moving to the next (Pargaonkar, 2023). The Waterfall methodology consists of five phases: requirement, design, implementation, testing, and maintenance. Figure 4 illustrates these phases.

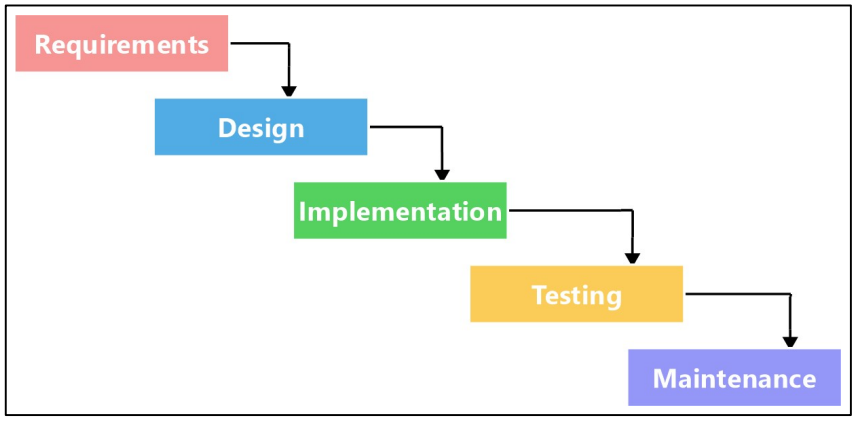

Figure 4: Waterfall Methodology

(Source: https://blog.mindmanager.com/waterfall-methodology/)

Requirement phase

A thorough literature review was conducted during this phase to gather crucial information for the project. Existing data from various sources were collected to enhance understanding and guide the project effectively. This phase involved five key activities: studying sign language, exploring Islamic terminology in sign language, studying marker-based augmented reality, and reviewing the methodology for the project. The deliverables included the project background, problem statement, objectives, a literature review of augmented reality, and the chosen project methodology.

Design phase

In this phase, the focus was on creating a detailed plan for the project based on requirements gathered in the previous phase. The design phase includes elements like flowcharts and storyboards, which help visualize the structure and flow of the project.

Implementation phase

During the implementation phase, careful selection of software tools and applications was crucial to achieving the project's objectives. The chosen tools played a key role in transforming design specifications into a functional system. Applications were selected based on their compatibility with project requirements and their contribution to smooth development and deployment. Activities in this phase included installing software for augmented reality development, using Unity as the primary tool, and Blender for creating 3D models and animations.

Testing phase

In the testing phase, the software development life cycle (SDLC) was thoroughly tested to ensure it met specified requirements and functioned correctly. This phase began with an introduction outlining the objectives, scope, and goals. Key components such as the testing environment, required resources, and entry and exit criteria were clearly defined. Testing was planned to take place at University Technology MARA (UiTM) Jasin, Melaka, using the System Usability Scale (SUS) as the testing method.

i. Participants

Participants were individuals aged 18 and above interested in learning Islamic sign language. They evaluated the application through a usability test, with questionnaires distributed online via Google Forms.

ii. Instrument

An online questionnaire based on the System Usability Scale (SUS) was used to evaluate the application. The SUS consists of 10 questions rated on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Figure 5 shows the System Usability Scale questionnaire.

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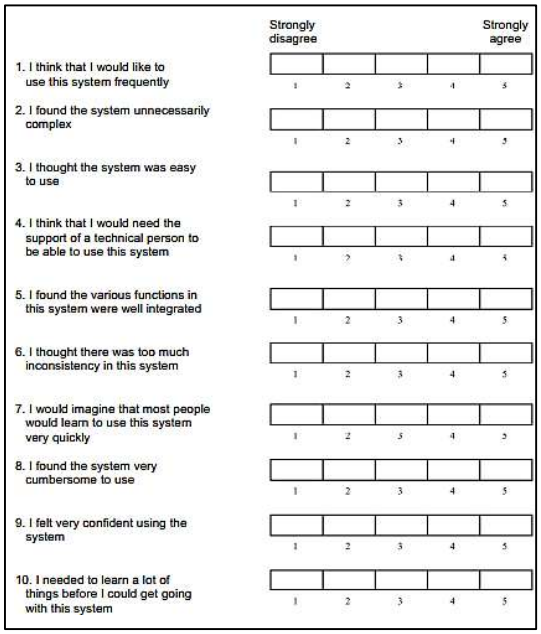

Figure 5: System Usability Scale Questionnaire

(*Source*: Panagopoulos, C., Kalatha, E., Tsanakas, P., & Maglogiannis, I., 2015)

iii. Calculation

In the SUS, odd-numbered questions were scored from 0 to 4, while even-numbered questions were scored from 4 to 0 (Klug, 2017). The total score was calculated by summing the scores of all 10 questions, resulting in a score between 0 and 40, which was then multiplied by 2.5 to obtain a SUS score between 0 and 100. SUS scores can be converted into letter grades, with an average score of 68 corresponding to a "C" grade. Figure 6 shows SUS score interpretation using letter grades.

Letter grade	Numerical score range
A+	84.1–100
A	80.8–84.0
A-	78.9–80.7
B+	77.2–78.8
B	74.1–77.1
B-	72.6–74.0
C+	71.1-72.5
C	65.0–71.0
C-	62.7–64.9
D	51.7–62.6
F	0–51.6

Figure 6: SUS score interpretation using letter grades

(*Source*: Panagopoulos, C., Kalatha, E., Tsanakas, P., & Maglogiannis, I., 2015)

Maintenance phase

The maintenance phase, the final stage of the software development life cycle (SDLC), involves deploying the system to the production environment and making any necessary updates or modifications to ensure it meets user requirements. However, due to time constraints, the maintenance phase couldn't be fully implemented for this project.

RESULT AND DISCUSSION

In the evaluation of this application, 30 participants were surveyed. The group consisted of 20 women (66.7%) and 10 men (33.3%). Most participants (76.7%) were between 20 to 22 years old, with 20% aged 23 to 24 years, and only one participant (3.3%) aged 18 to 20 years. Regarding familiarity with Islamic sign language, 76.7% of participants had no prior knowledge, while 23.3% did. Additionally, only 10% of participants found it easy to access learning materials for Islamic sign language, with the remaining 90% indicating difficulty. Table 1 provides detailed demographic information from the evaluation summary.

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Table 1: Participant's Demography

Question	Range	Frequency	Percentage
Gender	Male	10	33.3
	Female	20	66.7
Age	18 – 20	1	3.3
	21- 22	23	76.7
	23 – 24	6	20
	25 and above	0	0
Do you know Islamic sign language?	Yes	7	23.3
	No	23	76.7
Do you think it is easy to access learning materials for Islamic sign language?	Yes	3	90
	No	27	10

System Usability Scale Findings

The evaluation form in Table 2 is adapted from Figure 5. System Usability Scale (SUS) evaluation consists of 10 questions, each rated on a 5-point Likert scale. The scale ranges from 1, representing "Strongly Disagree," to 5, representing "Strongly Agree."

Table 2: System Usability Scale (SUS)

Question	1	2	3	4	5
1. I think that I would like to use this system frequently	.				
2. I found the system unnecessarily complex					
3. I thought the system was easy to use					
4. I think that I would need the support of a technical person to use this system					
5. I found the various functions in the system were well integrated					
6. I thought there was too much inconsistency in this system					
7. I would imagine that the most people would learn to use this system very quickly					
8. I found the system very cumbersome to use					
9. I felt very confident using the system					
10. I needed to learn a lot of things before I could get going with this system					

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Calculation of System Usability Scale

The System Usability Scale (SUS) evaluation used a specific calculation method to determine usability scores. Table 3 presents the scores based on the scale, while Table 4 shows the detailed calculations derived from the SUS. The formula used to calculate the SUS score is as follows:

SUS = ((Q1-1) + (5-Q2) + (Q3-1) + (5-Q4) + (Q5-1) + (5-Q6) + (Q7-1) + (5-Q8) + (Q7-1) + (5-Q8) + (Q9-1) + (5-Q10) * 2.5)

This formula combines the individual question responses, adjusts for positive and negative phrasing, and scales the score to a range of 0 to 100. Using this formula, the total score of all respondents in this usability test was 240. To determine the average SUS score, the following formula was applied:

Average = SUS / number of respondents

Table 3: System Usability Scale (SUS)

Scale	Score
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

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Table 4: Calculation based on SUS

Respondent Number	Item Question										Total	SUS Score (Total * 2.5)
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
1	4	1	4	1	4	1	4	1	4	1	35	87.5
2	4	1	5	3	4	1	5	1	5	2	35	87.5
3	5	1	5	1	5	1	5	2	5	3	37	92.5
4	5	1	5	1	5	1	5	1	5	2	39	97.5
5	4	2	4	3	4	2	4	2	4	4	27	67.5
6	5	2	4	2	5	2	4	1	5	2	34	85
7	5	2	4	2	5	1	4	1	4	2	34	85
8	4	1	5	1	4	2	5	1	5	2	36	90
9	5	1	5	2	4	2	5	2	4	2	34	85
10	5	1	4	2	5	1	5	2	4	2	35	87.5
11	5	2	4	1	5	2	5	1	4	2	35	87.5
12	4	2	4	2	4	2	4	2	4	2	30	75
13	4	2	4	2	4	2	4	2	4	2	30	75
14	4	2	4	2	4	2	4	2	4	2	30	75
15	4	2	4	2	4	2	4	2	5	2	31	77.5
16	4	2	4	2	4	2	4	2	4	2	30	75
17	4	2	4	4	4	2	4	2	4	4	26	65
18	4	2	4	2	4	2	4	2	4	3	29	72.5
19	4	2	4	2	4	2	4	2	5	2	31	77.5
20	4	2	4	1	5	1	5	1	5	1	37	92.5
21	5	1	5	1	5	1	5	1	5	1	40	100
22	4	2	5	1	4	1	5	2	4	1	35	87.5
23	5	2	4	1	5	2	5	1	4	1	36	90
24	5	1	4	1	5	1	4	1	5	1	38	95
25	3	2	4	2	3	2	4	2	3	2	27	67.5
26	5	2	4	1	5	1	5	2	5	1	37	92.5
27	4	4	4	3	5	5	4	5	4	4	20	50
28	4	2	4	1	4	1	4	1	5	3	33	82.5
29	4	1	4	2	4	1	4	1	4	1	34	85
30	4	1	5	1	5	2	5	2	5	1	37	92.5
			Total									240
			Average									82.67

With a total SUS score of 240 and the average calculated at 82.67, the system was rated within the 'A' range, as depicted in Figure 6. This indicates that the system was considered good, especially when the average SUS score benchmark is 68.

CONCLUSION

The project successfully achieved its objectives, resulting in the development of an effective augmented reality application for learning Islamic Sign Language. Despite minor imperfections, the application provides an immersive and interactive educational experience

that addresses the limited resources for learning Islamic terminology. User feedback, gathered through the System Usability Scale (SUS), confirmed the application's usability. While there were some limitations during development, recommendations for future improvements have been made. Overall, the application serves as a functional and valuable tool for students interested in learning Islamic Sign Language.

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