Jurnal Teknologi Informasi dan Pendidikan
Volume 17, No. 1, March 2024
https://doi.org/10.24036/jtip.v17i1.816

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
tip.ppj.unp.ac.id

Implementation of Augmented Reality 3D Catalog And 2D Motion Based on *Multimarker*

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Article Information

Article history:

No. 816
Rec. November 30, 2023
Rev. January 13, 2023
Acc. January 15, 2024
Pub. January 17, 2024
Page. 107 – 121

Keywords:

- *Augmented Reality*
- *Multimedia Life Cycle Development (MDLC)*
- *Promotional Media*
- *Micro, Small and Medium Enterprise (SME)*
- *Multimarker Based Tracking*

ABSTRACT

In the current era of technological progress, various kind of technology can be applied in multiple fields. One technology that is currently popular is Augmented Reality (AR). This technology can be used in several ways, for example, Augmented Reality for the learning process, Augmented Reality for simulations and Augmented Reality for promoting a product. This research used Multimarker-based Augmented Reality technology to promote products at Essential Bakery. Essential Bakery is an Small and Medium Enterprise SME that operates in the food sector, one of which is bread. The research aims to help Micro, Small and Medium Enterprise (MSME) Essential Bakery promote its product to make the services provided more attractive and innovative. This research uses the MDLC (Multimedia Development Life Cycle) research method. This Augmented Reality Uses Multimarker-based tracking, which is a differentiator in previsious research. The result of this research is that the application can run 3D objects and 2D motion through the markers that have been created, and this application is very effective and innovative in promoting products from essential bakery.

How to Cite:

Santoso, R. A., & Cahyono, N. (2024). Implementation of Augmented Reality 3D Catalog And 2D Motion Based on Multimarker. Jurnal Teknologi Informasi Dan Pendidikan, 17(1), 107-121. https://doi.org/10.24036/jtip.v17i1.816

1. INTRODUCTION

Indonesia has many business people in the Micro, small, and Medium Enterprises (MSME) sector. The MSME sector it self can drive very clear economic growth. MSEME can also play an important role in reducing Indonesia's unemployment risk. Around 56.54 –

Volume 17, No. 1, March 2024
https://doi.org/10.24036/jtip.v17i1.816

62.92 million MSMEs, Indonesia is the country that has the most MSME industry players [1] . MSME players can quickly develop their businesses by spending a small amount of capital. In the MSME sector, there are still several problems, namely when you want to introduce a product to potential customers, and product that are not ready and damaged cannot be shown to potential customers. This makes potential customers less confident about purchasing the product in poor condition and out of sight.

To address the challenges mentioned above, there is a need for a medium to simplify product offers and introductions. With this medium, business operators need not fear promoting their products. The author propose a solution using Augmented Reality technology based on a Multimarker, combining 3D objects with 2D motion [2]. The advantage of Augmented Reality over Virtual Reality lies in its affordability and ease of system development, as opposed to Virtual Reality, which requires specialized and relatively expensive equipment [3].

Augmented Reality merges the virtual and real worlds. Aiming to integrate AR system into Reality by adding real-world information to the virtual realm [4]. Augmented reality has its uniqueness in that this technology is experiencing increasing popularity every year, and the price of smartphones is now increasingly easy to afford [5]. Actually, Augmented Reality is a derivative of Virtual Reality (VR) technology [6]. However, virtual reality is more complex and complete [7]. In developing this application, Unity software is employed. Unity 3D, a development platform for 2D and 3D applications, is used in this study to design the Augmented Reality application with 3D and 2D Motion [8].

The implementation in AR-based promotional media involves gathering information, such as the favorite product catalog at Essential Bakery MSMEs. Subsequently, 2D and 3D assets are created for the development of Augmented Reality-based promotional media. Next, markers are generated for scanning 2D motion and 3D objects to make them appear. Once the assets are collected, they are organized into a media format for promoting products in the form of a multi-marker Augmented Reality catalog at Essential Bakery SME . Finally, an evaluation is conducted on the created application as a promotional medium.

Multimarker is a technology that can combine several markers, which can display three 3D Objects at once from the application that has been created. And multimarker is a marker technology that is ideal for creating Augmented Reality With 2 or more object. For the position of the multimarker itself, there are several parts, namely (x1,……xn, y1,……yn, z1…..zn). (n) on each axis has a value meaning, where the value depends on the number that will be determined on the multimarker later [9].

In developing this application, multimarker technology is utilized by combining 2D motion with 3D objects, representing the latest innovative step to distinguish it from previous research. The advantage of this technology lies in the integration of 2D motion with 3D objects, making it more appealing to buyers and facilitating information capture. The presence of multimarkers also aids in promoting products in stores. The hope is that this research will enhance effective and innovative services by using Augmented Reality as

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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a promotional medium. Additionally, it is anticipated that individuals in Indonesia become more familiar with the latest technologies available.

According to the research by B.O. Tafakkur, Android-based application was designed using the Based Marker Tracker method as an alternative promotional medium to enhance the appeal of food and beverage products at Lesehan Kalisari. The development method employed in this study is the waterfall method. The result is a successfully designed application that displays 3D objects according to the marker, allowing the use of this application as an alternative promotional tool to market the food and beverage menu at the research location [10].

According to the research by Yuhanto et al, designing an Augmented Reality application to visualize a 3D modeling portfolio was conducted to address the existing issue. Before the adoption of Augmented Reality, people used printed materials on paper as a promotional medium. To tackle this problem, the research involved designing an Augmented Reality application to showcase portfolios by displaying pre-made 3D objects. The results of the study indicate that users can functionally view and generate images that meet their expectations [11].

According to the research by Prayugha et al ,titled "Implementation of Augmented Reality as a Promotion Media for Satya Negara University Indonesia based on Android using Marker-Based Tracking Method," the aim was to design an AR application for Satya Negara University Indonesia to create an Android-based promotional medium. The anticipated benefit of this research is to enhance promotional activities at USNI. The research utilizes the marker-based tracking method, where markers are used to identify objects captured by the camera. The outcome of this research is the successful implementation of Augmented Reality in the application, which can be used as a promotional medium for Satya Negara University Indonesia [12].

The research conducted Robianto et al , with the title "Utilization of Augmented Reality (AR) Technology in the Design of E-brochure as an Android-based Promotional Medium." The aim of this research is to facilitate users in viewing brochures from Taman Margastwa and Budaya Kinantan. By using a smartphone, the information obtained is clearer compared to using traditional paper brochures. The result of this research is the designed application that allows users to view 3D representations of tourist attractions, making it an attractive and unique promotional medium [13].

The research conducted by Bahiyah et al, utilized the Research and Development (R&D) methodology. The researcher addressed the issue by observing that the system at MK Meuble operates manually. Buyers visit the store to physically inspect desired items, but when the products are out of stock, customers cannot view sample products. The introduction of Augmented Reality technology aims to facilitate buyers who wish to interactively view sample products that are currently unavailable. This is achieved by presenting them in 3D through the designed Augmented Reality application [14].

According to the research from Mersia samar n.d, on the "Implementation of Augmented Reality in the Tourist Object Recognition Application in Ambon City," the identified problem is that information about tourist attractions in Ambon City is only available on the website. The author proposes a solution in the form of Augmented Reality technology, combining virtual 2D and 3D objects using a markerless method to make it more interactive and attract the attention of visitors. Based on testing using a questionnaire with 22 respondents, 89.77% expressed that the application had a significant impact on introducing tourist attractions in Ambon City [15].

2. RESEARCH METHOD

Specifically for applications related to multimedia, the MDLC (Multimedia Development Life Cycle) method is most commonly used for research involving multimedia or mobile app applications[16]. Another method commonly used is SDLC (System Development Life Cycle) in the current application development [17].

The research method used in this research is the Multimedia Development Life Cycle (MDLC). This stage consists of six stages, namely concept, design, Material Collecting (Collecting Materials), Assembly (Creation), Testing (Testing), and finally, Distribution (Distribution) [18],[19] .

2.1. Conccept

This stage is the primary phase of system design. It is used to determine the type of application and its purpose [20]. The fundamental rules for design are also established at this stage, such as size and targets. The output of this stage typically includes documentation to articulate the project's goals.

2.2. Design

Design is the stage of creating specifications that encompass the project's architecture, appearance, and material requirements for the program. The specifications are made as detailed as possible so that decision-making is not required in the subsequent stages.

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E.ISSN: 2620 – 6390
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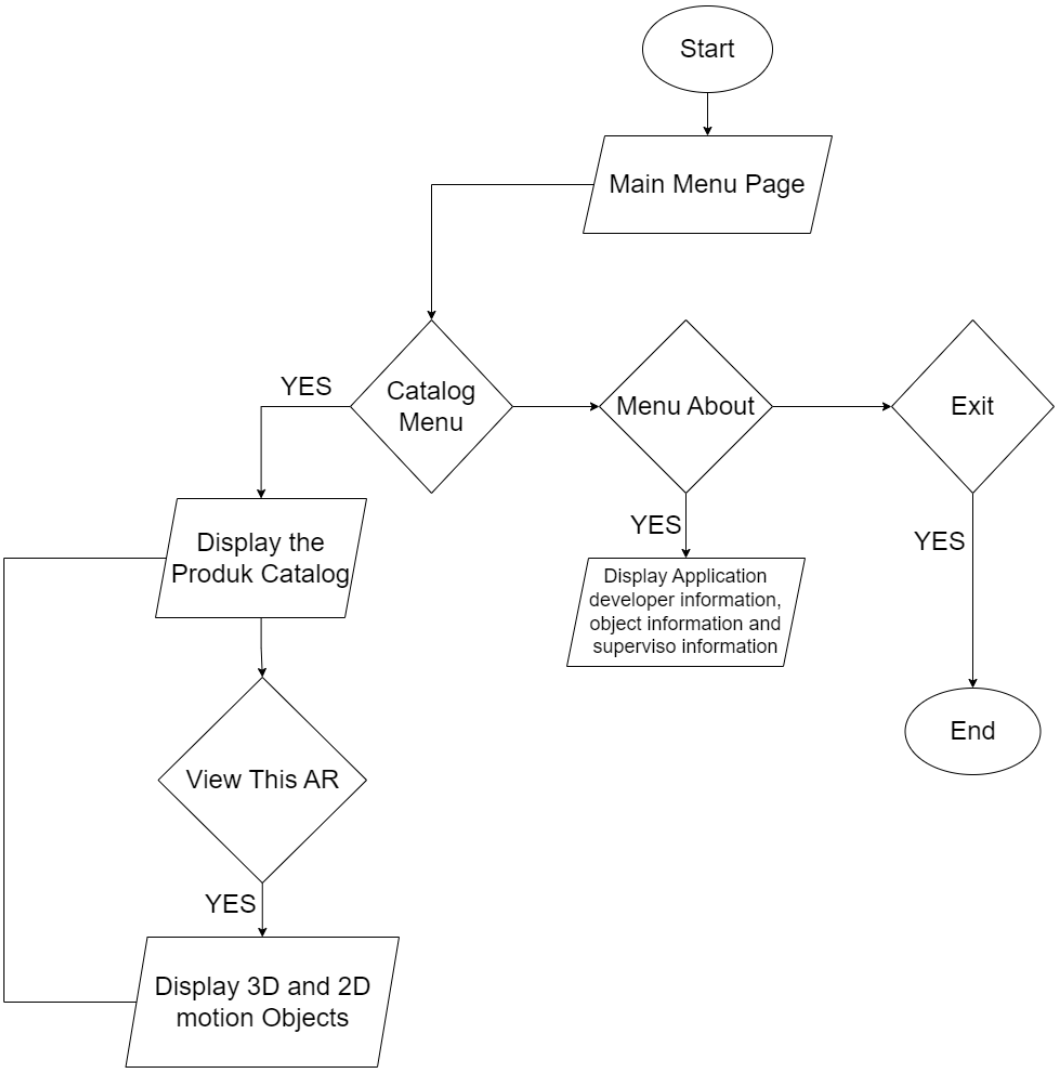

Figure 1. Flowchart Application

2.3. Material Collecting

Material Collecting is the stage of gathering materials that align with the predetermined needs. The materials may include elements such as sound, 2D motion, 3D objects, and audio.

2.4. Assembly

In this stage, all the objects or materials that were previously designed are created. The manufacturing process must align with the pre-established design to ensure that everything is organized and conceptualized perfectly. The following are the hardware and

software specifications used in designing the Augmented Reality system for the 3D & 2D Motion catalog application

2.4.1. Hardware requirements

In creating the Augmented Reality Catalog application, HP Pavillion X360 Hardware was used, with the spesifications in the table below.

Table 1. Laptop Specifications

No.	*Hardware*	*Information*
1	Merk dan model	HP Pavillion X360
2	Processor	Intel(R) Core(TM) i3-10110U CPU @ 2.10GHz 2.59 GHz
3	RAM	8,00 GB
4	Memori penyimpanan	SSD 512GB
5	Graphics Card	NVIDIA GeForce MX130
6	Operation System	Windows 11 Home Single Language

The software that researchers use to carry out trials for each application creation is a smartphone with the Samsung Galaxy A12 brand, with the following specifications:

Table 2. Smarthone Spesification

No.	*Hardware*	*Information*
1.	Merk dan model	Samsung Galaxy A12 (SM-A125F/DS)
2.	RAM	4GB
3.	System operasi	Android 12
4.	Kapasitas baterry	5000 mAh
5.	Memori Internal	128GB

2.4.2. Software requirements

There is quite a lot of software neede to develop this application, Because you have to use a database to store the markers that have been created. The following is some of the software used to develop this application.

Table 3. Software Requirements

No.	*Software*	*Information*
1.	Vuforia SDK	A software is needed to store a library in the form of a database created to store markers and function as a marker for a 3D object.
2.	Unity	Software commonly used for designing game applications and creating 3D & 2D Augmented Reality catalogs for promotional purposes
3.	Blender	An application for creating 3D objects.
4.	Photoshop	Software for creating 2D posters.
5.	Adobe After Effect	An application for creating 2D motion for Augmented Reality catalogs in both 2D and 3D motion.
6.	Figma	Software used to design the UI of the application in this

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E.ISSN: 2620 – 6390
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		research.
7.	Draw.io	A platform for creating a flowchart to design the workflow of Augmented Reality applications.
8.	QR Code Generator	A website for creating markers as indicators for 3D and 2D objects.

2.5. Testing

This testing is conducted after all the previous stages have been completed. The method involves running the application to check for any errors. In this research, the author and supervisor employ several testing phases, including device testing, black-box testing, marker tracking testing, and content validation testing.

2.6. Distribution

This stage is carried out by assigning the project to the research subject. After it is submitted, an evaluation is conducted to identify and improve any areas that need enhancement.

3. RESULTS AND DISCUSSION

3.1. System Design Analysis

3.1.1. Main Menu Display

In the initial display, there are three features as designed during the design phase. These include the Catalog, About, and Exit features, providing options for accessing the catalog, obtaining information about the application, and exiting the program, respectively.

Figure 2. Main Menu Display

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https://doi.org/10.24036/jtip.v17i1.816

3.1.2. Catalog menu display

Within the catalog menu, the researcher has included four products from Essential Bakery. These consist of four variations: softbun bread, chocolate banana bread, chocolate bread, and shredded beef bread.

Figure 3. Catalog Menu Display

3.1.3. Augmented Reality Camera Display.

In this display, the camera will detect markers, where a multimarker is used. Two objects are scanned directly, namely the 3D object and 2D Motion.

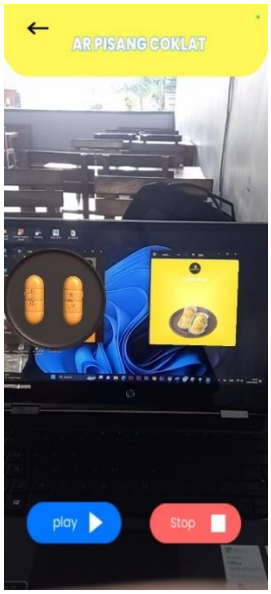

Figure 4.Augmented Reality Camera Display

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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3.1.4. About Display

In this display, the menu shows a brief description of the object, a short description of the application developer, and a description of the supervising professor.

Figure 5. About Display

3.2. System Testing

System testing is performed to verify and ensure the proper functionality of the application. The application is created in accordance with the design outlined in the preceding stages. This testing process involves several methods, such as testing on diverse devices, blackbox testing, marker testing, and content validation

3.2.1. Testing on Different Device

During the device testing stage, the objective is to evaluate how well the application functions on different devices and to ascertain its normal operation. The initial round of testing for this application is conducted on the following devices:

Table 4. Device Spesification

No.	*Hardware*	*Description*
1.	Merk	Xiaomi Redmi 10C
2.	RAM	4GB
3.	Operating System	Android 11

4.	Battery capasity	5000 mAh
5.	Internal Memori	128GB

Next, the second device employed is used to test the Augmented Reality application for promotional purposes.

Table 5. Device Spesification Vivo Y17

No.	*Hardware*	*Description*
1.	Merk	Vivo 1901
2.	RAM	4GB
3.	Operating System	Android 11
4.	Battery capasity	5000 mAh
5.	Internal Memori	64GB

Here is the third device utilized to test the Augmented Reality application for promotional purposes.

Table 6. Device Spesification Vivo Y30i

No.	*Hardware*	*Description*
1.	Merk	Vivo Y30i
2.	RAM	4GB
3.	Operating System	Android 10
4.	Battery capasity	5000 mAh
5.	Internal Memori	64GB

The following is the fourth device used to test the Augmented Reality application for promotional purposes.

Table 7. Device Spesification Vivo Y20

No.	*Hardware*	*Description*
1.	Merk	Vivo Y20
2.	RAM	3GB
3.	Operating System	Android 10
4.	Battery capasity	5000 mAh
5.	Internal Memori	64GB

Table 8. Different Device Test Results

No.	*Tested features*	*Xiaomi Redmi 10C*	*Vivo Y17*	*Vivo Y30i*	*Vivo Y20*
1.	Main menu	Success	Success	Success	Success
2.	Katalog	Success	Success	Success	Success
3.	View this marker	Success	Success	Success	Success
4.	Marker	Success	Success	Success	Success
5.	About	Success	Success	Success	Success

3.2.2. Black Box Testing

The black box test is conducted in accordance with the prepared testing scenarios.

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E.ISSN: 2620 – 6390
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Table 9. Black Box Testing Results

No.	*Test components*	*Test procedure*	*Expected outcomes.*	*Conclusion*
1.	Scene main menu	- Klik button katalog - Klik button about - Klik button exit	- Displaying a list of products from Essential Bakery. - Showing information about the application developer and supervising lecturers. - Exiting the main menu.	Success
2.	Scene katalog	- Klik button katalog - Klik button view this AR - Klik button back	- Displaying 3D objects and 2D motion of products from Essential Bakery.	Success
3.	Scene about	- Klik button informasi - Klik button exit	Displaying information from the application developer, MSME profile, and supervising lecturers.	Success
4.	Scene exit	Klik button exit	Exit the application	Success

3.2.3. Marker Testing

In the marker testing phase, it involves testing light intensity, tilt angle, and camera distance from the marker. The purpose of marker testing is to assess the effectiveness of multimarkers in identifying and displaying 3D objects and 2D motion. Additionally, it aims to determine the minimum and maximum requirements for incoming light intensity, recordable distance, and tilt angle to ensure the effectiveness of the multimarker method.

3.2.3.1. Tilt Angle Testing

The tilt angle testing aims to assess the extent to which the device can scan existing markers from various camera perspectives. The following rules are established for the tilt angle:

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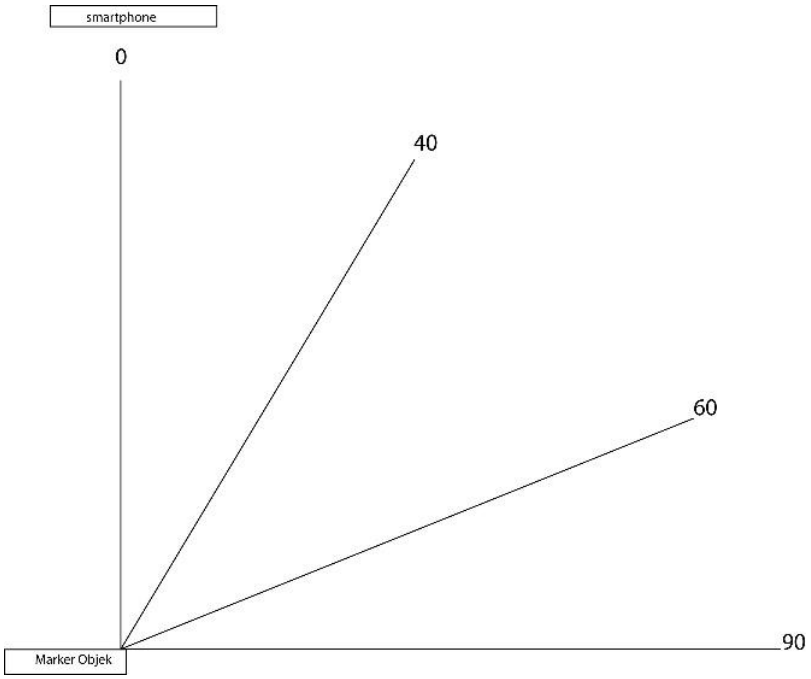

Figure 6. Standard tilt angle measurement

Table 10. Testing based on tilt angle

No.	*Corner*	*Conclusion*
1.	0^{o}	Success
2.	40^{o}	Success
3.	60^{o}	Success
4.	90^{0}	Unsuccessful

3.2.4. Light intensity testing

In this test, light intensity from indoor and outdoor settings is utilized. The goal is to assess the camera's effectiveness in capturing markers under specific lighting conditions.

Table 11. Light Intensity Testing

No.	*Light*	*Result*	*Conclusion*
1.	100%	The outdoor light is captured quite well, however, when it is too bright, the 3D objects and 2D motion tend to shift.	Success
2.	80%	The indoor light is captured very well.	Success
3.	50%	The light is captured less effectively, objects take a few seconds to appear.	Success
4.	0%	No light is entering.	Unsuccessful

3.2.5. Distance testing

This test is conducted to determine the extent to which the camera can capture the designed markers.

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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Table 12. Distance Testing

No.	*Distance*	*Result*	*Conclusion*
1.	10 cm	The camera detects well, allowing for easy detection of 2D motion objects and 3D objects.	Success
2.	20 cm	The camera is able to detect objects.	Success
3.	40 cm	The camera can easily detect both 3D and 2D objects.	Success
4.	60 cm	The camera can easily detect the marker.	Success

3.2.6. Content Validation Testing

In this stage, participants involved in the research object are engaged to test the created application. The evaluation is done on a scale of 1-4. The following is the content testing table for the Augmented Reality Catalog of Essential Bakery application:

Table 13. Content Validation Testing

No	*Question*	*Scoring scale*			
		1	2	3	4
	2D Motion Compatibility				
1	Has the motion effectively displayed promotions?				✓
2	Is the motion interesting?				✓
	3D Object Compatibility				
1	How is the assessment of the suitability of the 3D object for Soft Bun bread?				✓
2	How is the assessment of the suitability of the 3D object for Chocolate Banana Bread?				✓
3	How is the assessment of the suitability of the 3D object for Chocolate Bread?				✓
4	How is the assessment of the suitability of the 3D object for Shredded Beef Bread?				✓

4. CONCLUSION

Based on the conducted research, it can be concluded that the application made is very effective dan innovative to promote a product from essential bakery, and the development of the Augmented Reality application has been successfully achieved using several software tools, namely Unity, Blender, and After Effects, to display 2D motion and 3D objects representing products available at Essential Bakery based on created markers. After testing on various devices, the application runs smoothly, allowing for proper detection of 3D objects and 2D motion. However, compatibility issues were observed in some device versions. For future research, it is recommended to develop an application that is compatible with all Android versions and consider the possibility of creating a version for iOS devices as well.

ACKNOWLEDGEMENTS

I thank to Allah SWT. I also want to thank my parents who have always supported me through sincere prayers. I extend my thanks to my family, especially Rio Adi Saputra, Rian Mulyadi, Riana Agustina, and my parents. who have been very helpful through prayers and financial support during the journal writing. I also want to express my gratitude to my supervisor, Mr. Nuri Cahyono, who has always guided and assisted me. And also to my friends who have always helped in the completion of this journal. Thank you, everyone.

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