Augmented Reality based on Android for the Promotion of Furniture Products with Geometry Translation

Dedi[1], M. Ramaddan Julianti[2], Jarudin[3*], Syaipul Ramdhan[4], M. Fitriansyah AK[5]

Abstract

Technology has opened up space for companies to develop marketing methods, especially during a pandemic when people prefer to shop from home. In determining the marketing method for furniture products according to consumer interests, entrepreneurs must have the right marketing media reference to provide detailed information to avoid consumer dissatisfaction with marketed products. This research aims to create alternative media in promoting products and produce applications that can help sales and marketing through mobile applications installed by smartphones. The method used in this study implements the SLAM (Simultaneous Localization and Mapping) method. The test results of this study indicate that the Augmented Reality (A.R.) application can be accepted by the public as an alternative media in product introduction with a percentage value of 80% of respondents as many as 36 people, and has an attractive appearance and is easy to use according to consumer desires.

Key Words: Augmented Reality, Media Interactive, Translation Geometry, Promotion.

DOI Number: 10.14704/nq.2022.20.5.NQ22194 **NeuroQuantology 2022; 20(5):452-457**

Introduction

A furniture is an object commonly used to equip a home or office [1]. Consumers have several aspects of buying furniture products, such as compatibility or compatibility with the room and adjusting to the desired needs. Therefore, in determining the marketing method for furniture products, consumer interests, entrepreneurs must have the right marketing media reference to provide detailed information to avoid consumer dissatisfaction with the products being marketed [2].

The development of current technology, such as smartphones, allows users to carry out various activities [3]. One of the activities that would enable technology is that technology no longer depends on 2D design. Companies engaged in manufacturing can take advantage of technological developments with a breakthrough in introducing and marketing products; one of the new technologies supporting a promotional medium is augmented reality [4]. In developing an application that utilizes augmented reality technology, a method often used is to use a particular medium called a marker [5].

Corresponding author: Jarudin

Address: [1,2,3*,4,5]Institut Teknologi Dan Bisnis Bina Saran Global, Tangerang, Indonesia.

[3*]E-mail: jarudin@global.ac.id

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 19 March 2022 **Accepted:** 24 April 2022

Marker functions as a target point to determine an object's position defined by digital things in the real world [6]. The use of features creates new problems because it forces its users to be bound to a predetermined object. In this case, it makes mobile applications inefficient or is no different from print media such as brochures and other printed media [7]. Several companies such as IKEA, Fabelio, and Mauson du Mount are currently conducting research. They feel that markers are very doubtful because their implementation of sales or marketing must depend on features.

In this case, without relying on markers, a solution must appear in promotional media, or a product launch would generate stable media. One method to assist sales and marketing in identifying products is without markers [8] augmented reality with the Simultaneous Localization and Mapping (SLAM) method. SLAM is an approach to recognize real-world structures by mapping each image by comparing the position of line patterns, dot patterns, color patterns, and other readable patterns [9]. SLAM is not a special algorithm but a model approach. Each researcher may have a different algorithm, but these algorithms have the same goal: real-time mapping [10].

When the promotion affects products that customers are not satisfied with the promoted product, there is still a lack of digital marketing media and the lack of knowledge of augmented reality technology using the SLAM process, which has caused concerns about using A.R. Technically [11]. How do you make an augmented reality application that can become an alternative media for introducing products and providing information visually and based on product specifications and can be implemented to consumers to get a positive response in presenting the products offered by sales and market?

The augmented reality furniture application [12] displays products that run on the Android operating system. The purpose of making augmented reality furniture applications can assist and market product promotions, provide information visually and based on product specifications, and serve as an alternative media in product introductions to obtain responses from consumers who can influence their purchase of products. Promote products by providing augmented reality, make it easier for consumers to see the shape of products based on 3D vision, and become a more innovative and informative promotional medium to provide enterprises with products and provide entrepreneurs with relevant digital technology developed knowledge [13].

Methodology

1. Proposed

This augmented reality furniture application uses a research model method or a qualitative approach with a survey, observation, and interview techniques. Based on the analysis of the problems carried out on systems and methods of introducing products or promotions to Easy-DIY Furniture, preferably to create new media that can assist sales and marketing in the launch of goods or promote creative and insightful approaches [14]. In the proposed solution to this problem, the Android-based simultaneous positioning and mapping method creates an augmented reality furniture application as a promotional medium.

I hope to combine augmented reality technology with mobile technology and hope to become an alternative media by showing consumers the products they want to provide. This application aims to display information to visualize 3D objects from these objects in real terms. By utilizing a cellphone camera to track unmarked, the selected item will appear according to the specified target point [15].

2. Use Case Diagram Modeling

Use Case Diagram modeling describes the system limitations and the main functions of the application [16]. Describe the parts of a system from the user's perspective. Use Case Diagram consists of actor definition, use case definition, and use case scenario see Figure 1.

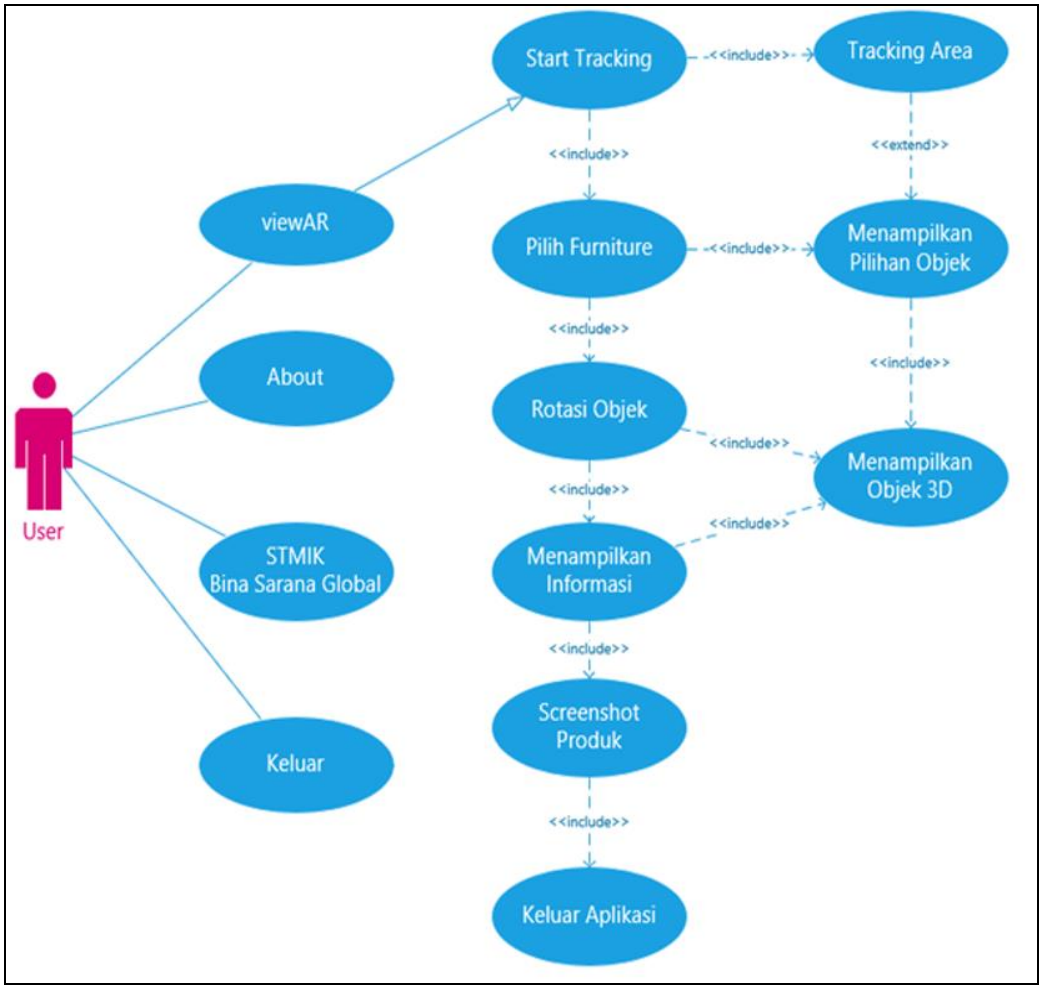

Fig. 1. Use Case Diagram Augmented Reality Furniture

Figure 1 is a use case diagram created to describe the new system. The new system's function describes user activities that will be processed by the system, such as playing A.R., rotating products, viewing information, product screenshots, about the Author and Institut Teknologi dan Bisnis Bina Sarana Global, and exiting the application. Researching for usability [17].

3. Simultaneous Localization and Mapping (SLAM)

Simultaneous Localization and Mapping (SLAM) is an alternative technology in the use of the A.R. method. Technology in the SLAM method allows tracking and mapping objects through the target point [18]. The A.R. app can recognize 3-dimensional objects and scenes and track and explain digital augmentations shortly and interactively [19].

Results and Discussion

1. Geometry Transformation

The theory of 3-dimensional geometric transformation plays an important role because it is the basic science used in application programs [20]. Translation, rotation, and scale have similarities; namely, they can move vertices (points) in a geometric arrangement. What distinguishes these three methods is how or how to move the vertexes. Use of different equations for each transformation. The theory of 3-dimensional geometric change plays a vital role because it is the fundamental science implemented in application programs. Before going any further [21], it is essential to know what geometric transformations mean. So any operation that can change the position, orientation, and size of an image of a geometric object can be called a geometric shift [22]. This final project will only discuss and use translational modification, rotation, scaling, and shearing. Translation, rotation, scaling, and shearing have in common: they can move the

vertices (points) composing a geometric object. What distinguishes the four is how or how to move the vertices. The use of different equations for each transformation. The homogeneous coordinate system uses four ordinates to represent the points. P = (XP, Y.P., Z.P., S), the fourth coordinate point represents the scale factor [23]. Convert to the cartesian coordinate system by dividing the other three coordinates and the fourth ordinate until the end (XP, Y.P., Z.P., S) has cartesian coordinates (XP / S, YP / S, ZP / S). Equation Q = P · M, Where Q = [X.Q., Y.Q., Z.Q., S] represents the 1x4 matrix containing the transformation point, P = [XP, Y.P., Z.P., S] represents the 1x4 matrix that contains the point to be changed will result in the transformation point. M = 4x4 transformation matrix as in the equation [24]. The 3-dimensional transformation consists of several transformation functions: translation, rotation, and scaling [25].

2. Translational Geometry-Transformation

Translation functions to shift objects from an initial position to a new place according to the user's wishes. The three-dimensional translation uses the X-axis, Y-axis, and Z-axis. Translational on three-dimensional objects use the following matrix:

T= [1 0 0 0 0 0 0 1 0 0 0 1 0 0 0 1]

P' = P * T (1)

Translation functions to shift objects from an initial position to a new place according to the user's wishes. Three-dimensional translation [4] uses the X-axis, Y-axis, and Z-axis. The translation on three-dimensional objects uses the matrix P '= P.T, which is then transformed into [x' y 'z' 1] and multiplied by the transformed matrix 4x4. The inverse operation can be performed by giving a negative sign (-) to Tx, Ty, and T.Z. so that the multiplication of the matrix becomes [x + Tx y + Ty z + T.Z. 1].

Rotation functions to rotate objects so that they can display perspectives from various angles [26]. The rotation of three-dimensional objects uses the following matrix:

R= [Cos(Θ) 0-Sin(Θ) 0 0 Sin(Θ) 0 1 0 0 0 Cos(Θ) 00001] (2)

3. Scale Geometry-Transformation

Scale functions to enlarge or reduce the object according to the desired size. The scale on three-dimensional objects using the following matrix:

S = [SX 0 0 0 0 0 0 Sy 0 0 0 Sz 0 0 0 1]

P' = P * S (3)

Perform conversion to get reverse operation of S.X., Sy, and Sz to 1 / S.X., 1 / Sy, and 1 / Sz so that the matrix product becomes [x / S.X. y / Sy z / Sz 1].

4. Implementation

The main page displays the View AR, which contains the A.R. Camera menu, rotation, information, and Screenshot. The AR Camera menu page has several menus such as, select a product that will display ten furniture products in the form of a 3D object, product rotation by choosing a top, bottom, right and left cycle. Product information will display product information from dimensions, the material used for maintenance, and product prices [27]. The Screenshot captures Figure 2. The smartphone screen displays consumer desires, thus facilitating consumers' offerings.

Fig. 2. A.R. Camera Page

5. Testing to User

The User Acceptance Test (UAT) stage at this stage of testing involves users or users [28]. Users include staff from Easy-DIY Furniture and the general public. In implementing the User Acceptance Test (UAT), the writer uses a questionnaire method that contains ten questions to be filled out by the user or user. The following is a recap of the results data from filling out the questionnaire; see Figure 3.

	Item-1	Item-2	Item-3	Item-4	Item-5	Item-6	Item-7	Item-8	Item-9	Item-10
Very Interesting	11	11	9	16	10	12	10	16	10	13
Interesting	10	13	13	13	10	9	20	11	14	11
Quite Interesting	15	12	14	7	16	15	6	9	12	12
Less Interesting	0	0	0	0	0	0	0	0	0	0
Not Interesting	0	0	0	0	0	0	0	0	0	0

Fig. 3. Test Results to User

Figure 3 shows that the answer value and overall average score is 84.5%. That the data shows that the augmented reality furniture application can be an alternative media in promotional media, has an attractive appearance, and is easy to use. The functions of the features used are by the desires of consumers in choosing and buying furniture products, with the results of questionnaire testing. To respondents as many as 36 people, including stakeholders, the percentage is 84.5%.

Conclusion

Based on the research and discussion results, Augmented Reality (A.R.) without MARKET SLAM (Simultaneous Localization and Mapping) in Easy DIY-AR application helps the marketing department get new alternatives in delivering their products in real-time. Every consumer can interact with Easy DIY-AR products, like coming directly to the location. The calculation of geometric translation methods supports the products displayed to create rotations and scales to suit customer needs. This technology is an excellent alternative to compete with other companies, especially the promotional strategies that are very supportive of Augmented Reality technology during this pandemic. Interested users using Augmented Reality (A.R.) technology SLAM has a satisfaction rate of 84.5%. Products are also displayed maximally by including all furniture products, but the application can run well. The advice to the SLAM Easy DIY-AR Augmented Reality (A.R.) application is to add more attractive features in terms of design, graphics, interfaces, and an order menu that consumers can immediately execute purchases directed to the store website. Improve the algorithm for better detection of target markers and objects. It is also necessary to develop this application similar or better to run on several different platforms such as IOS, Windows Mobile, and Virtual Reality (V.R.) technology.

References

W. Viyanon, T. Songsuittipong, P. Piyapaisarn, and S. Sudchid, "AR Furniture : Integrating Augmented Reality Technology to Enhance Interior Design using Marker and Markerless tracking," *In Proceedings of the 2nd International Conference on Intelligent Information Processing, 2017*, 1–7. doi: 10.1145/3144789.3144825

A.I. Choudhary, M. Asif, R.M. Choudhry, Z. Siddique, and S. Mughal, "Impact Of After Sale Service Characteristics on Customer Satisfaction," *Inf. Manag. Bus. Rev.*, vol. 3, no. 6, 360–365, 2011, doi: 10.22610/imbr.v3i6.952

U. Rizal and W. Susanty, *"The Analysis of History Collection System Based on Android Smartphone with Qr Code using QR Code Case Study: Museum Lampung,"* no. Icetd, 230–234, 2013.

F. Hendajani, A. Hakim, S.A. Sudiro, G.E. Saputra, and A.P. Ramadhana, "Tracking Visualization of 3 Dimensional Object Natural Science Learning Media in Elementary School with Markerless Augmented Reality Based on Android," *J. Phys.*, vol. 1192, 1–8, 2019. doi: 10.1088/1742-6596/1192/1/012055

Y.K. Dwivedi *et al.*, "Setting the future of digital and social media marketing research : Perspectives and research propositions," *Int. J. Inf. Manage.*, no. May, 102168, 2020, doi: 10.1016/j.ijinfomgt.2020.102168.

S. Ruest, A. Gjelsvik, M. Rubinstein, and S. Amanullah, "The Inverse Relationship between Digital Media Exposure and Childhood Flourishing," *J. Pediatr.*, vol. 197, 268-274.e2, 2018, doi: 10.1016/j.jpeds.2017.12.016

E. Hern, C.R. Jaimez-gonz, and B. Garc, "Interactive Mobile Applications to Support the Teaching of Reading and Writing of Spanish for Children in Primary Education," *Int. J. Interact. Mob. Technol.*, vol. 14, no. 14, 64–79, 2020. doi: 10.3991/ijim.v14i14.14925.

S. Kote and B. Borkar, "A Survey on Marker-less Augmented Reality," *Int. J. Eng. Trends Technol.*, 10(13), 639–641, 2014. http://www.ijettjournal.org

E. Klopfer, *Augmented Learning Research and Design of Mobile Educational Games*. 2008.

R.A. Bedar and M. Al-Shboul, "The Effect of Using STEAM Approach on Developing Computational Thinking Skills among High School Students in Jordan," *Int. J. Interact. Mob., Technol.*, vol. 14, no. 14, 80–94, 2020. doi: 10.3991/ijim.v14i14.14719

Y. Zhu and N. Li, "Virtual and augmented reality technologies for emergency management in the built environments : A state-of-the-art review," *J. Saf. Sci. Resil.*, vol. 2, no. 1, 1–10. 2021. doi: 10.1016/j.jnlssr.2020.11.004

S. Ramdhan, S. Ria, S. Siregar, and D. Itarini, "Prayer Guidance App Development Using Android-Based Augmented Reality," *J. SISFOTEK Glob.*, vol. 10, no. 1, 27–32, 2020.

A. Pramono and M.D. Setiawan, "Utilization of Augmented Reality as a Learning Medium for The Introduction of Fruits," *Intensif*, 3(1), 54–68, 2019. http://ojs.unpkediri.ac.id/index.php/intensif%0APemanfaatan

M.R. Salah, "The Impact of Training and Development on Employees Performance and Productivity "A case Study of Jordanian Private Sector transportation companies located in the Southern region o The Impact of Training and Development on Employees Performance and Produc," *Int. J. Manag. Sci. Bus. Res.*, vol. 5, no. 7, 2226–8235, 2016, http://www.ijmsbr.com/36.

J. Kaustubh, Y.H. Kasar, M. Mayuri, and N. Pooja, "Android Based E-Learning Application 'Class-E,'" *Int. Res. J. Eng. Technol.*, 1745–1748, 2017. www.irjet.net.

J. Bulliard *et al.*, "Preliminary testing of an augmented reality headset as a DICOM viewer during autopsy," *Forensic Imaging*, vol. 23, no. September, 1–4, 2020. doi: 10.1016/j.fri.2020.200417

S. Jamuna and P.R, "Utilization of Instructional Media in Teaching Science," *Int. J. Res. - Granthaalayah*, 53(SE), 51–56, 2017. doi: 10.29121/granthaalayah.v5.i3(se).2017.1940

P.A. Mahardika, I.M.A. Suyadnya, and K.O. Saputra, "Build a Room Decoration Simulation Application by Utilizing Markerless Augmented Reality Technology," *J-Cosine*, 3(1), 82–90, 2019, doi: 10.29303/jcosine.v3i1.238.

A. Blaga, C. Militaru, A. Mezei, and L. Tamas, "Augmented reality integration into MES for connected workers," *Robot. Comput. Integr. Manuf.*, vol. 68, no. September 2020, 1–11, 2021. doi: 10.1016/j.rcim.2020.102057

C. Li, B. Zheng, Q. Yu, B. Yang, C. Liang, and Y. Liu, "Augmented Reality and Three-Dimensional Printing Technologies for Guiding Complex Thoracoscopic Surgery," *Ann. Thorac. Surg.*, 20, 1–24, 2020. doi: 10.1016/j.athoracsur.2020.10.037

V. Krishnamurthy, K.K. Nagarajan, D.V.V. Prasad, and G. Kumar, "Augmented reality and virtual reality in our daily life," *Int. J. Informatics Commun. Technol.*, vol. 9, no. 3, 205–211, 2020. doi: 10.11591/ijict.v9i3.pp205-211

E.S. Goh, M.S. Sunar, and A.W. Ismail, "3D Object Manipulation Techniques in Handheld Mobile Augmented Reality Interface: A Review," *IEEE Access*, 10(3), 1–22, 2019. doi: 10.1109/ACCESS.2019.2906394

M. Xiao, Z. Feng, X. Yang, T. Xu, and Q. Guo, "Multimodal interaction design and application in augmented reality for chemical experiment," *Virtual Real. Intell. Hardw.*, 2(4), 291–304, 2020. doi: 10.1016/j.vrih.2020.07.005

M. Lynch, U. Kamovich, K.K. Longva, and M. Steinert, "Combining technology and entrepreneurial education through design thinking: Students' reflections on the learning process," *Technol. Forecast. Soc. Change*, no. June, 119689, 2019. doi: 10.1016/j.techfore.2019.06.015

J. Cannon-bowers, *Serious Game Design and Development: Technologies for Training and Learning*.

Y. Zhao *et al.*, "Compile-time code virtualization for android applications," *Comput. Secur.*, vol. 94, 1–16, 2020. doi: 10.1016/j.cose.2020.101821

H. Tohidi and M.M. Jabbari, "CRM as a Marketing Attitude Based on Customer's Information," *Procedia Technol.*, vol. 1, 565–569, 2012. doi: 10.1016/j.protcy.2012.02.123

P.V. Ghate and H.K. Pati, "Collaborative distributed communication in heterogeneous environments: A comprehensive survey," *J. Netw. Comput. Appl.*, 61, 1–20, 2016. doi: 10.1016/j.jnca.2015.10.006