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Integration of 3D Scanning and Augmented Reality (AR) Technology in East Kalimantan Furniture Products in E-Commerce

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ABSTRACT

The creative furniture industry in East Kalimantan faces the challenge of less effective online marketing in e-commerce. In 2018, there were more than 370 furniture entrepreneurs in the region, but only 37% of their total production managed to reach the market. According to projections from Markets and Markets, the market value of Augmented Reality (AR) in e-commerce is expected to grow by 34% between 2020 and 2025. To overcome this problem, the use of 3D object configuration visual technology and AR presents a better solution. promising solution. This technology can improve product presentation, create a more interactive and realistic shopping experience, and reduce the environmental impact of e-commerce due to the re-shipment of non-conforming products. The main objective of the research is to assess the effectiveness of product communication, the ease of the purchasing process, and the level of consumer trust in the product. This visual method of 3D object configuration combines 3D scanning to produce detailed and realistic 3D images. This research uses a sprint design method based on design thinking, which involves co-creation to refine ideas. Next, a prototype design was developed with a focus on aspects of the user interface and user experience, fostering intelligent interaction between users and their environment, thus contributing to the progress of the Smart City concept in IKN Nusantara.

Keywords: augmented reality, e-commerce, furniture, smart city, 3D visual

INTRODUCTION

The use of e-commerce platforms plays an important role in increasing sales, a major challenge faced by the creative furniture industry in East Kalimantan to compete both at the national and global levels. 2018 statistics show that East Kalimantan has more than 370 furniture sector businesses, but only 37% of its total production has succeeded in penetrating the market (Ramadani, 2022).

Meanwhile, the National Capital City (IKN) of the Nusantara in East Kalimantan was designed to be a catalyst to stimulate massive economic growth, create jobs, and reduce poverty rates in Indonesia as a whole. By making the Nusantara a symbol of national identity and a new center of economic growth, it is hoped that it will have a chain effect by becoming a center for equitable growth, especially outside the Java region (Nugroho, 2022).

IKN will be built by implementing the "smart city" concept based on eight principles, namely; (1) design according to natural conditions, (2) Bhinneka Tunggal Ika, (3) fostering connectivity, activity and accessibility, (4) minimizing emissions carbon, (5) promote circularity and resilience, (6) prioritize safety and affordability, (7) increase comfort and efficiency through technology, and (8) create economic prospects for all. A crucial aspect of the Smart City concept involves the establishment of an information system that aims to facilitate and increase public access to information (Limas et al., 2021).

One of the breakthroughs in the world of technology that can be applied to gain easy access to the creative industry marketing sector is Augmented Reality (AR) technology (Nugraha & Purwati, 2023). AR technology is now increasingly popular among e-commerce business people. According to information provided by Markets and Markets, the projected growth in market worth for Augmented Reality within the e-commerce sector indicates a substantial increase. Specifically, it is anticipated to surge from $1.15 billion in 2020 to $4.88 billion by 2025, demonstrating a robust annual growth rate of 34% (CAGR) spanning the period from 2020 to 2025 (Iatsyshyn et al., 2020). Hence, the primary objective of this study is to integrate these two elements: the enhancement of furniture product marketing via e-commerce, alongside the utilization of visual technology for 3D

object customization and augmented reality. This integration serves as a crucial step in bolstering the advancement of the Smart City concept within IKN.

Figure 4. 3 D visualization design
source: author documentation

The application of 3D object visual configuration technology and Augmented Reality (AR) in furniture marketing can facilitate users to project furniture from e-commerce into their real world. Users can interact and design the position of indoor furniture products more interactively and realistically through the e-commerce platform. In addition, this technology has the potential to improve user experience and support increased sales of furniture products in the e-commerce realm (Hilken et al., 2017). Thus, it is hoped that this research can make a positive contribution to the development of Smart City in the National Capital City (IKN), while increasing the effectiveness of furniture product promotion through e-commerce.

The primary goal of this study is to assess the product communication's efficiency, the affordability of the buying process, and the degree of consumer confidence in the product within the IKN city. The innovative approach applied in this research involves the use of visual methods of 3D object configuration using 3D scanning. Compared to 3D modeling, 3D scanning methods are much more effective and efficient for producing highly detailed and realistic depictions of furniture objects. This makes it easier for furniture manufacturers and entrepreneurs to transform their products into Augmented Reality. This stage is an important step that can make it easier for them to access a wider online market by increasing product offerings through technology that can provide consumers with an extraordinary experience that has a positive impact on purchasing decisions and consumer

satisfaction levels. In this way, a smarter interaction between the user and the environment is created (Chakti, 2019).

This research uses the Design Sprint method which consists of stages: empathy, definition, ideation, prototype, and validation (Wangsa et al., 2022). The data collected includes information regarding the development conditions of the furniture industry in East Kalimantan as well as the challenges faced by this industry. These data will be analyzed using the multiple linear regression method to identify the relationship between various relevant variables and look for appropriate alternative solutions to overcome existing problems. These solutions will then be developed collaboratively (co-creation) (Sari & Tedjasaputra, 2017), followed by collecting data regarding prototyping needs, including schemes for using 3D and AR visual objects in the context of the furniture product to be configured. 3D.

In this research, several variables were found regarding the obstacles faced by the East Kalimantan furniture industry in selling on e-commerce, such as the lack of detailed product information that potential buyers can obtain, the color of the product in the photo does not match. product dimensions and detailed, and the buyer cannot estimate the suitability of the product to their space. Based on these variables, researchers formulated a solution using augmented reality technology that can change the online shopping experience to be more real. By using this technology, potential buyers can see product details more freely, and can project furniture products displayed on e-commerce into the potential buyer's real room, with just one touch on the smartphone screen.

Figure 4.2. Appearance of product tests on tablets and cellphones
source: author documentation

The results of this research are useful for providing suggestions to furniture companies in East Kalimantan to improve product marketing in e-commerce using 3D object configuration visual technology and Augmented Reality (AR) (Haleem et al., 2022). This research can also make a positive contribution to the development of the IKN Smart City by optimizing the use of information and communication technology.

Related to this research, several previous studies are relevant and can be used as references, namely:

1. Research by Saputra and friends in 2019 shows that the application of 3D visual technology and Augmented Reality can be implemented in the wooden furniture industry. However, this research identified limitations in the 3D modeling and rendering process which still requires a high level of expertise and quite a long time for each product (Saputra & Budiyanto, 2019).
2. In a study conducted by Rejeb and colleagues in 2022, it was found that Augmented Reality technology has the potential to improve consumer experience and have a positive impact on purchasing decisions (Rejeb et al., 2023).
3. Aparicio and his team's research in 2022 regarding Augmented Reality technology which can help consumers choose furniture products and increase their satisfaction Aparicio and his team's research in 2022

regarding Augmented Reality technology which can help consumers choose furniture products and increase their satisfaction (Aparicio et al., 2022).

4. In research conducted by Suchita and colleagues in 2018, it was discussed how Augmented Reality technology could increase interaction between users and the Smart City environment (Suchita & Sujata, 2019).
5. Research by Kang and colleagues in 2015 regarding 3D virtual reality stores can shape consumer purchasing decisions, finding that 3D product visualization can have a positive influence on consumer perceptions and purchase intentions in the context of online shopping (Kang et al, 2020).
6. An article written by Gattullo and his colleagues in 2018 proposed the development of an Augmented Reality application that would allow users to see the products they want to buy in real-time. Applications also allow consumers to adjust product characteristics according to their preferences before making a purchase (Gattullo et al., 2019).

The main innovation in this research lies in increasing the use of Augmented Reality (AR) technology using 3D scanning methods as visualization of 3D object configurations, to produce very detailed and realistic image representations of furniture objects in a relatively short time. This approach is aimed at optimizing efficiency in the process of converting furniture products in the real world into objects in Augmented Reality. The main goal is to enable furniture businesses to expand their market reach by adopting online marketing strategies that utilize this technology. Thus, it is hoped that this technology can provide a more realistic experience for online consumers, have a positive impact on purchasing decisions, and overall increase customer satisfaction. This opens up opportunities to create better interaction between users and the environment in the Smart City concept.

RESEARCH METHOD

The research method used is the design sprint method, an approach to developing product concepts and prototypes in five stages over five days: understand, diverge, decide, prototype, and validate. This method is essentially used to overcome problems through design with efficiency.

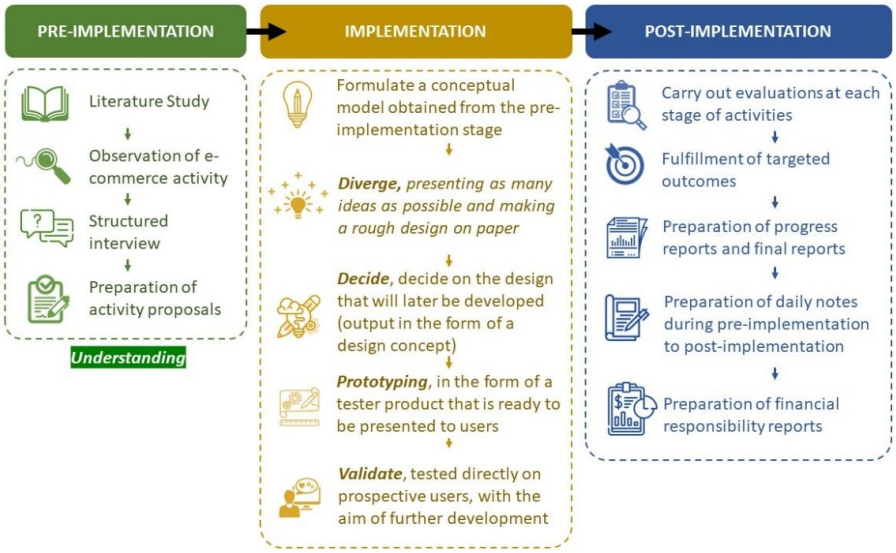

Figure 4.3. Research flow diagram
source: author documentation

First stage: Understanding

This stage aims to produce a consistent understanding of the solutions to be developed. This stage uses data collection techniques through a gradual mixed approach (sequential mixed methods) which combines qualitative methods and quantitative methods. The qualitative method used in this research is interviews with several respondents who meet the qualifications, such as urban residents who are used to shopping on e-commerce, furniture business people, and potential buyers of minimalist furniture products. This approach aims to strengthen the data obtained. This research uses literature studies from books, articles, scientific journals, theses, government reports, academic publications, and commercial sources. The theoretical review used is based on primary sources which contain findings from previous research, as well as secondary sources which function as support. After collecting data, the next step was participatory observation, the research team observed e-commerce activities for furniture products. All data that has been collected will be strengthened with structured interviews covering all aspects of the process carried out by the furniture company. This stage aims to generate as many alternative ideas for innovation and marketing strategies as possible that are appropriate to the situation in the study area.

Second stage: Diverge

After gaining a consistent understanding of the specifications of the product to be developed, the next step is exposing the idea and making initial design details in written format, so that the entire audience can have a clear understanding of the details and implementation of the idea. To facilitate this process, the research team used illustrated notes attached to the idea boards. The evaluation process for each idea takes into account the objectives, characteristics, type of application, intended audience, device specifications relevant to product creation, and user capabilities. In this context, the main focus is furniture business owners and their target audience.

Third stage: Decide

The next step is to decide on the design that will be developed. This stage uses a voting mechanism to select the most optimal design. The design that receives the most votes will go through the process of being adjusted to become a more detailed design for prototyping.

Fourth stage: Prototyping

Making a prototype is the most exciting and challenging stage, this stage involves various abilities to produce a prototype that is worthy of testing. In this prototyping process, we refer to the storyboard or service design that was agreed upon at the previous stage. The steps for implementing Augmented Reality (AR) are:

a. Executes a series of studio setup processes, especially lighting and background adjustments, to ensure optimal scanning results.
b. Carrying out 3D scanning of furniture products.
c. Uploading 3D scan results and markers into the 3D warehouse.
d. Using Google Lens to scan QR codes to display 3D visualization results of furniture products that are ready to be applied in the real world through Augmented Reality technology.

Figure 4. 4 D scanner setup
source: author documentation

Figure 4.5. Steps for implementing Augmented Reality (AR) technology.
source: author documentation

Fifth stage: Validate

The final stage that needs to be carried out is testing and validation. Product prototypes are tested empirically on potential buyers. The approach used is the method of filling out a questionnaire and confirming it through an interview method with potential users, to produce comprehensive product validation data. The results of this validation process will be determined for further development.

RESULT AND DISCUSSION

The primary objective of this research is to assess the influence of implementing Augmented Reality technology on the efficiency of information communication and the effectiveness of furniture product promotion in e-commerce. This research uses a case study of a 3D visual model of wooden furniture products from Kalimantan. The final stage of developing this prototype is the testing stage which involves several users in validation sessions. The users who participated in the testing phase had profiles that matched the product description in Table 4.1 below.

	Statements
1	The application of product visualization in three-dimensional (3D) format can display it with optimal quality.
2	Web page performance remains responsive when 3D models are displayed.
3	3D visualization can be interacted with using available navigation methods.
4	3D visualization depicts appropriate proportions and realism.
5	3D visualization provides a more detailed picture of the furniture products being offered.
6	The visual representation of the product in 3D format reflects the original furniture well.
7	The dimensions of the 3D visualization correspond to the actual size of the product.
8	The colors in the 3D visualization are adjusted to the actual colors of the product.
9	The 3D visualization texture reflects the texture that exists in the original product.
10	The use of 3D visualization in products increases its level of persuasiveness compared to the use of two-dimensional (2D) visualization.

Table 4.1. Statements for test usage by correspondents
source: processed by the author

Correspondents are asked to provide responses based on a Likert scale consisting of five options that can be selected: "strongly disagree", "disagree", "don't know", "agree", and "strongly agree". Each correspondent will be given a rating in the range scores 1 to 5 in sequence, where 1 indicates the lowest level of disagreement and 5 reflects the highest level of agreement from the correspondent.

Correspondents	Statements										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
1	4	4	4	5	5	5	4	4	4	5	44
2	5	4	4	5	5	5	4	4	5	5	46
3	4	3	3	4	5	5	4	5	5	5	43
4	4	4	3	5	5	5	4	5	5	5	45
5	4	4	4	4	5	5	4	3	5	5	43
6	5	4	4	5	5	5	4	5	5	5	47
7	5	4	4	5	5	5	4	5	5	5	47
8	5	4	3	5	5	5	5	5	5	5	47
9	4	5	5	5	5	5	4	4	4	5	46
10	4	4	5	5	5	5	4	5	4	5	46
11	4	4	4	4	5	5	4	5	5	5	45
12	5	4	4	4	5	5	5	5	5	5	47
13	5	4	3	5	5	5	5	5	4	5	46
14	5	5	3	5	5	5	5	4	5	5	47
15	4	5	4	5	5	5	5	5	5	5	48
16	5	4	4	4	5	5	5	5	5	5	47
17	4	5	4	5	5	5	4	4	4	5	45
18	5	4	3	5	5	5	4	5	5	4	45
19	4	5	5	4	5	5	4	5	4	5	46
20	4	4	3	5	4	4	3	5	5	4	42

21	4	4	4	4	5	5	4	5	5	5	45
22	4	4	4	5	4	5	4	5	5	5	45
23	5	4	4	5	5	5	5	5	5	5	48
24	5	5	5	5	5	5	5	5	4	5	49
25	5	4	4	5	5	5	5	5	5	5	48
26	5	4	4	4	5	5	5	5	5	5	47
27	5	4	4	3	5	5	5	5	5	5	46
28	5	5	4	3	5	5	5	4	4	5	45
29	5	5	4	5	5	5	5	4	5	5	48
30	5	5	4	5	5	5	4	4	5	5	47
31	5	5	4	5	5	4	5	4	5	5	47
32	5	5	5	5	5	5	5	5	5	5	50
33	4	4	5	5	5	5	5	5	5	5	48
34	4	5	5	5	5	5	5	4	5	5	48
35	5	5	5	4	5	5	5	5	5	5	49
36	4	5	4	5	5	5	5	5	5	5	48
37	5	4	4	4	5	5	5	5	5	5	47
38	4	5	4	5	5	5	4	4	4	5	45
39	5	5	5	4	5	5	5	5	5	5	49
40	4	4	5	5	5	5	5	5	5	5	48
Total											1859

Table 4.2. Results of statements tested to correspondents
source: processed by the author

In data analysis using a Likert scale, the test results can be explained by calculating the total score obtained, namely 1,859, from a group of 40 participants who answered ten statements. If it is assumed that the lowest score value in this scale is "a," the number of participants is "k," the number of statements is "p," then it can be identified "mn" as the minimum number of scores, "ml" as the maximum number of scores, "md" as the middle value (median), "k1" as the first quartile (Q1), and "k3" as the third quartile (Q3).

$$mn = k \times p \times b \quad (1)$$

$$= 40 \times 10 \times 1 = 400$$

$$ml = t + p + a \quad (2)$$

$$= 40 \times 10 \times 5 = 2.000$$

$$md = (ml + mn) / 2 \quad (3)$$

$$= (2.000 + 400) / 2 = 1.200$$

$$k1 = (mn + md) / 2 \quad (4)$$

$$= (400 + 1.200) / 2 = 800$$

$$k3 = (ml + md) / 2 \quad (5)$$

$$= (2.000 + 1.200) / 2 = 1.600$$

The results of the calculations on the scale are used to determine the location or position of the score value. The position of this score value can be seen in the illustration in Figure 4.6.

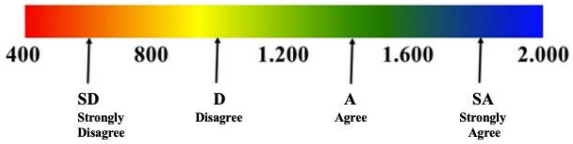

Figure 4.6. Calculation results on a Likert scale
source: processed by the author

A total score of 1,859 in the "strongly agree" position indicates that the use of 3D visualization can significantly improve customers' ability to understand and evaluate wooden furniture products better. This also results in increased customer confidence in making purchasing decisions regarding the product. The findings from testing this prototype have significant relevance in the context of online promotion of wooden furniture products. The purpose of using this feature is to improve user ease in exploring the product and to create product mockups in a room environment.

The test results also reflect the satisfaction expressed by visitors who act as testers regarding the 3D visualization features and their experiences. This feature received high appreciation because it is able to present product details from various angles and provides a more realistic picture of the condition of the product when placed indoors. Therefore, 3D visualization provides a more comprehensive representation than 2D visualization in the context of this test. More respondents are interested in utilizing 3D visualization to view product images. In this research, it was also found that a comparison of the level of understanding of product suitability can be found in Table 3 in the advanced research stage.

Test variable	**Visualization in 2D**	**Visualization in 3D**
Specifications for size	1.1	4,7
Specifics regarding color	2,3	4,5
Texture particulars	2,2	5
Illustrate the product	0,8	5
Total	6,4	19,2

Table 4.3. Visualization based on furniture design style
source: processed by the author

Correspondents were asked to evaluate the products displayed using visual representations in 2 dimensions (2D) and 3 dimensions (3D). The variables tested include aspects such as size details, color details, texture details, as well as the overall representation of the product. The assessment results show that the total score for 2D visualization is 6.4, while for 3D visualization it reaches 19.2. From these results, it can be concluded that respondents tend to have a higher level of trust in products displayed in the form of 3D visualization and through Augmented Reality technology than products that only use 2D visualization. This difference in confidence levels can be considered three orders of magnitude higher.

CONCLUSION

Based on research results, the use of 3D visualization technology and Augmented Reality for information media and promotion of East Kalimantan wooden furniture products in e-commerce has proven to be very effective. In prototype testing involving several respondents, it was found that respondents gave a significant "strongly agree" rating. Meanwhile, in the test of understanding and level of trust, the results showed that respondents were three times more confident and confident in buying products displayed using 3D visualization technology and Augmented Reality than products that were only displayed in 2D. Furthermore, Augmented Reality has been proven to be able to increase overall understanding of detailed aspects of products, such as shape, size, color, and details. Close integration between virtual elements and the physical environment is a key element in this research. In conclusion, 3D visualization technology equipped with Augmented Reality features can overcome the limitations that may exist in marketing furniture via online platforms. This research has the potential to expand potential consumers' understanding and positive responses to interactive visualization technology, as well as opening up opportunities for its application in related industries. The limitation of this research is that each different type of furniture may require different 3D scanning techniques, so special and structured training needs to be held for furniture business people with experts on the correct 3D scanning procedures so that they can produce optimal 3D visuals.

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