

Implementation of Augmented Reality Shopping in E-Commerce to Increase Customer's Purchase Intention

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Abstract - E-commerce has grown immensely in the past few years, especially during the Covid-19 pandemic. This condition brings severe conditions. Most traditional business owners must shift and implement e-commerce into their business models. Although e-commerce has many advantages, it also has limitations. The limitation of e-commerce is that it is difficult for customers to visualize the products they will buy in the real world. Most E-commerce applications only allow customers to see images and reviews of the products they want to buy through the screen of their devices. This situation can decrease customer satisfaction if the products they believe do not match the images. This research aims to help solve the limitations of e-commerce applications by implementing Augmented Reality to help customers visualize the products they buy. The researcher developed an Android-based mobile AR application using Unity and the Vuforia engine. After creating our AR application, we surveyed 46 participants to test our AR application. The researcher used Likert Scale with a scale of 4. The result is that almost all participants agreed that AR makes it easier to visualize the product purchased from e-commerce. An average score of 3.6 shows that most participants strongly agree that AR positively influences their decision-making to buy products.

Keywords: Augmented Reality; E-commerce; Online Shopping; Purchase Intention; Mobile Augmented Reality

I. INTRODUCTION

The growth of e-commerce in these past few years has increased significantly, especially during the Covid-19 pandemic (Alfonso et al, 2021). As of March 2021, Covid-19 cases have reached nearly 500 million patients, totaling more than 6 million deaths (World Health Organization, 2023). This pandemic era forced people to stay at home and limit their interactions with other people to ensure their safety from being exposed to the virus. Because of this, online shopping has garnered more attention than before. More people are using online shopping as the go-to method to buy groceries and their daily necessities. With the increasing number of people using online shops, sales in e-commerce have also increased. As a result, E-commerce numbers kept growing by a staggering 25% worldwide in 2020, accounting for USD 360 billion in net sales in the U.S. in 2019 (Beurer-Zuellig et al, 2022). This increase in sales influences traditional business owners to create and implement e-commerce in their businesses.

As mentioned before, a lot of business owners have used e-commerce. It has a lot of advantages since customers do not have to go directly to the shop and can order it online. On the other hand, there are also disadvantages to using e-commerce. When shopping online, customers cannot directly see the product; instead, they must see pictures of them. They cannot touch the products, try them on or see the actual size of the product. Therefore, it can cause customers to buy the wrong products that do not meet their expectations and decrease their interest in shopping using e-commerce. Therefore, by implementing Augmented Reality, e-commerce needs to bring its products into the real world so customers can comprehend how the product they

buy translates to the real world.

Augmented Reality is a recent technology growing and will grow even more significantly. Augmented Reality allows interaction between our real-life environment, grass, trees, roads, houses, and more with digital augmentation. Augmented Reality can bring digital content into the real world, allowing us to visualize and comprehend how digital content translates into the real world. In addition, Augmented Reality can provide more details and information about the products sold in e-commerce. Augmented Reality can also solve the problem of customers not being able to fully understand the actual size and details of the products sold on e-commerce (Leonnard et al, 2019). Prior research on this topic has been done before by Rosanensi. The purpose of this previous research was to increase the effectiveness of e-commerce by developing an Augmented Reality application to help homemakers and career women visualize the kitchen tools they want to buy through e-commerce (Rosanensi, 2020). Another prior research by Welivita focused on implementing Augmented Reality for e-commerce customers to try cosmetics and accessories using face detection through smartphone cameras (Welivita et al, 2017).

Shopping online provides many benefits, but sometimes people find it challenging to visualize and feel the product they will buy in the real world (Pantelimon et al, 2020), (Ljubisavljević et al, 2021), (Rhee & Lee, 2021). A study by Iisnawati showed that most people have difficulty visualizing the products they want to buy through online stores (Iisnawati et al, 2022). Therefore, many people are looking for a solution to the problem and have found Augmented Reality. From the early 2000s onwards, with the development of mobile devices such as tablets and mobile phones, AR has become the perfect medium to reach consumers (Welivita et al, 2017). Augmented Reality is a technology that combines visual objects or virtual worlds into real-world display in real-time; this is done by drawing computer graphic illustrations in a natural environment (Garg et al, 2021). As a result, customers can see, touch, and try the product in real-time. They can even interact with the seller or shopkeeper for information about the outcome (Kazmi et al, 2021).

Many studies have been conducted to implement AR in e-commerce. In designing an AR application, it is crucial to make the design and interaction with the user as simple as possible (Yoo, 2020). The implementation of AR technology must be carried out as clearly as possible so that users do not experience difficulties using AR features (Gunillasson, 2020). A study from Talib Tahirović has tried to create an AR mobile application for furniture stores. They use Unity and Vuforia to showcase products with AR. Their experiment results in an application that can show products to customers (Tahirović et al, 2018). Apart from mobile, there is also research that develops it on a website. They implemented AR for a makeup sales website where customers could try out real-world makeup using photos of their faces (Poushneh & Vasquez-Parraga, 2017). Another research that applies AR to e-commerce applications is the research conducted by Yim (Yim et al, 2017). The research

involves AR for e-commerce to present products like watches and glasses. Customers can use smartphone cameras to make it seem like they are directly trying out a watch or glasses product using AR. There is also research conducted by Yashvi Desai, who demonstrated the implementation of AR technology by using a smartphone camera to show a 3d model of a product. The application also allows users to interact with AR models, such as rotating, resizing, or changing the color of the model (Desai et al, 2021).

AR Applications for e-commerce can't be designed carelessly. Several crucial factors must be considered in implementing AR into e-commerce. Factors that must be considered to increase the effectiveness of AR in e-commerce are the presence of products (virtual presence), experience, benefits, interactivity, and enjoyment when customers use AR features to shop. (Qin et al, 2021), (Ramdani et al, 2022), (Khan, 2019). If these factors are met, it can increase customer satisfaction when using the AR feature. Aspects of pleasure and customer satisfaction will also increase due to using AR features that satisfy them (Söderström, 2021). The customer's purchase intention will increase customer satisfaction (Ramdani et al, 2022), (Riar, 2021). Not only customers using AR brings many benefits to e-commerce owners. A study concluded that the interactivity of AR perceived by customers would affect consumer attitudes and intentions (McLean & Wilson, 2019), (Jiang et al, 2021). As an example, IKEA has an AR app called IKEA Place. Customers who have used the application said that the use of the application. Using AR technology increases the attractiveness of users to buy products (Alves & Luís Reis, 2020). A study also states that the purchase intention of consumers who use IKEA Place can be further improved by the completeness of product information and presence through AR (Raska & Richter, 2017). The conclusion is that Augmented Reality presents an innovation for e-commerce to offer their products to customers. AR allows customers to see and interact directly with the products they are about to buy. However, to maximize its effectiveness in applying AR in e-commerce, it is necessary to consider factors that can increase customer satisfaction and purchase intentions.

This research aims to create and implement Augmented Reality for e-commerce applications in Indonesia, focusing on more products and testing its effectiveness in increasing customers' shopping interest. First, our mobile Augmented Reality application will be developed using Unity and Vuforia. Then, we will be conducting a survey on e-commerce customers in Indonesia to test whether it is true that implementing Augmented Reality in e-commerce can increase customer's interest in shopping.

II. METHODS

2.1. Creating Augmented Reality (AR)

Augmented Reality (AR) is a technology designed to increase Reality. It brings digital content like computer-generated images, texts, and sounds into the user's environment. AR creates a superimposed overlay of the

viewer in the electronically generated setting. AR identifies a physical object by recognizing its shape or a marker attached to it. Then, the AR software connects with a 3D digital facsimile of the entity called a digital twin. Data from the physical object is collected from the sensors and will be transferred to the digital twin. The software retrieves data from the twin, such as performance data about the thing, and the AR device shows it to the user. The user can interact with the object, sending a command to the cloud. The orders are then received by the cloud and sent to the thing.

To test how implementing Augmented Reality into e-commerce can increase customer's interest in the shop, we aim to create a mobile Augmented Reality application using *Unity* to develop our mobile Augmented Reality application. This situation allows us to show and let the customers experience how Augmented Reality can help them visualize how the actual products sold in e-commerce translate to the real world. Besides *Unity*, we also use software called *Vuforia* to implement the AR (Vuforia Developer Library, 2020). To create our AR application, we use several 3D models obtained from *free3d.com*. The models that we use for our AR application are a pair of glasses, a mug, and a book.

- **Set up *Unity* for AR Development**

The first step to creating AR in *Unity* is to set up *Unity* for AR Development. Next, we import the *Vuforia* package into *Unity* by selecting Assets > Import Package > Custom Package. Afterward, we navigate the *GameObject* dropdown menu and select “*Vuforia* > AR Camera.” Next, we use a *Ground Plane* provided by *Vuforia* to detect flat surfaces. *Ground Plane* is found in *GameObject*, and to add it, we go to *Vuforia Engine* > *Ground Plane* > *Ground Plane Stage*.

- **Making an Object**

After setting up *Unity*, we make or import an object. This object will appear in the AR. In this experiment, we use a 3D capsule as the object. Then, the object is added to the *Ground Plane Stage*.

- **Adding Plane Finder**

Plane Finder listens to users' input, attempts to find an appropriate plane to place objects in the real world, and places content in the real world. First, we select *Vuforia Engine* > *Ground Plane* > *Plane Finder* to add a plane finder. Then, we add *Ground Plane Stage GameObject* to the *Anchor Stage* parameter.

- **Build and Run *Unity***

After that, we will build and run *Unity* on Android by pressing the build settings. In the build settings, we set it up for Android and set the run device to our phone connected to our laptop or computer. After setting it up, we build and run. Finally, the *Unity* program will appear on our phones.

2.2. Survey

After creating the AR application, we tested our AR application by letting our participants try to use our application. And then, we surveyed by using *Google Forms* to see if implementing Augmented Reality in e-commerce increases their interest in shopping. Our survey consisted of 5 questions on a 4-point Likert scale (Regenbrecht & Schubert, 2021). Table 1 shows the question being used.

Table 1. Questionnaire Question

Questions	Likert Scale
Q1. Do the products displayed in our AR application look as realistic as in the real world?	(1: Strongly Disagree - 4: Strongly Agree)
Q2. Do you think using our AR application makes the product you want to buy as it exists in the real world?	
Q3. Do you feel a significant difference in product details displayed through the AR application compared to your screen?	
Q4. Does AR technology make visualizing the products you want to buy on e-commerce applications easier?	
Q5. Does AR technology affect your decision to buy products in e-commerce?	

To calculate the minimum number of respondents to our survey, we use Slovin's formula, as shown in (1). Slovin's formula is a formula used to calculate the sample size (n), given the population (N) and the margin error (e).

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Our target respondents are students at the School of Computer Science (SOCS) BINUS University, Alam Sutera campus. The minimum number of respondents to our survey is calculated using Slovin's formula to represent a population of 50 people with a margin of error of 5%, resulting in a minimum of 45 respondents. Our survey data is analyzed and processed using SPSS.

III. RESULT AND DISCUSSION

3.1. AR Application

We have created an Android-based mobile AR application that can portray objects in the real world using *Unity* and *Vuforia*, and we can implement Augmented Reality in our application. The 3D objects we chose are a pair of glasses, a book, and a mug. The application has a main menu that has a start and quit button. The start button will take the user to the AR view, and the quit button will close the application.

When the camera appears, the user will have to point the camera to a flat surface such as tables or floors. When the surface has been detected, a plane with the writing “*ground plane*” will appear. Then, the user can tap on the plane to make the objects appear. The arrows on the left and right are used to change the object shown by the AR. The objects mentioned can be seen in Figures 1.

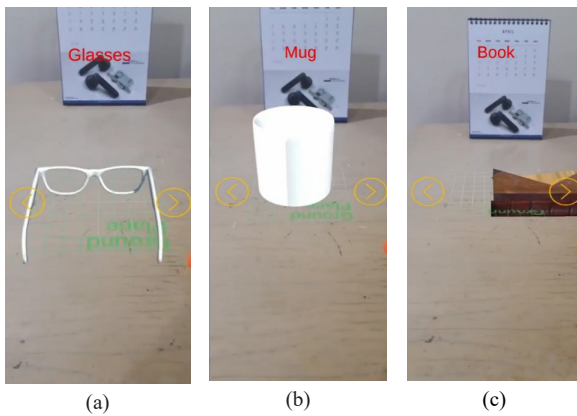


Figure 1. 3D AR Object View: (a) 3D Model for Glasses, (b) 3D Model for Mug, and (c) 3D Model for Book

3.2. Survey

The survey focuses on the functionality of our AR application and its engagement of it with the users. From the study of 46 participants, we got the results as follows:

Table 2. Survey Result

Questions	Most Answer Chosen	Frequency
Q1	3	33
Q2	4	23
Q3	3	20
Q4	4	28
Q5	4	22

Table 2 shows the result of the survey. The survey's first question asks the participants how realistic the objects displayed in the application are. The results showed that 33 out of 46 participants chose the value three, which means they agree that the application shows the objects as realistic as in the real world. The second question asks the participants if the things feel as if they exist in the real world. Most of the participants chose the value four, although some of them also chose the value 3. This situation could mean the AR does not perfectly portray the objects in the real world, but it is still acceptable. The third question is to determine if the participants feel any difference when using the AR application. The results showed that 20 out of 46 participants chose the value 3, and 19 chose the value 4. Almost all participants felt a positive difference in using AR to visualize the product they wanted to buy. The fourth question is to determine whether using AR makes it easier for participants to visualize the product to be purchased. The results showed that 28 out of 46 participants chose the value 4, and 15 chose the value 3. It means that more than half of the participants strongly agree, and almost all agree that AR makes it easier to visualize the product. The fifth question aims to determine whether using AR can influence participant decision-making in buying products through e-commerce, whether the presence of AR will affect them to buy, or whether it does not affect it at all. The results showed that 22 of 46 participants chose the value 4, and 17 chose the value 3. Overall, our participants agree that the presence of AR in e-commerce shopping influences their decision-making to shop even more.

IV. CONCLUSION

Lately, e-commerce has been developing since more people are online shopping because of the Covid-19 pandemic. E-commerce has brought a lot of advantages to customers, but they also have some disadvantages. When doing online shopping, customers cannot see the products, which means they cannot see the product's quality like in real life. That is why we want to implement Augmented Reality in e-commerce. Augmented Reality is a technology that projects digital objects into the user's environment. It allows customers to see products like in the real world. To test this theory, we made an AR application and surveyed 46 participants. The survey data proves no difference between seeing objects through AR applications and the real world. Most participants also agree that using AR positively influences their decision to buy the product and helps make it easier to visualize the product they purchased online.

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