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DEVELOPMENT OF AN E-COMMERCE STORE WITH INTEGRATED AUGMENTED REALITY

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ABSTRACT

Augmented reality is a cutting-edge technology that is still in its infancy when it comes to being integrated into the e-commerce industry. However, by incorporating this technology, we can provide customers with a more immersive and personalized shopping experience. Currently, e-commerce lacks the capability to offer a virtual experience, but with augmented reality, this issue can be addressed and a new form of interaction between consumers and e-commerce platforms can be established. The future of e-commerce is expected to be heavily influenced by augmented reality technology as customers demand a more tailored shopping experience.

In this study, we developed an e-commerce store by creating a web application that utilizes AR to overlay 3D models of products onto the real-world environment, thereby transforming the user experience.

Keywords: 3D Modeling, Augmented Reality, E-Commerce, Firebase, Flutter, Unity.

I. INTRODUCTION

Augmented Reality (AR) is a technology that enhances reality by adding digital components to it. The concept of AR dates back to 1957 with the invention of the Sensorama, a machine that provided users with a combination of visuals, sounds, vibrations, and smells. However, it wasn't until the release of the mobile game "Pokemon GO" in 2016 that AR gained widespread popularity. In this game, players could interact with superimposed 3D models of Pokemon in real-time. Since then, companies such as Apple and Google have released their own AR development tools. AR is typically classified into five categories: Location-based, Projection-based, Superimposition, Outlining, Marker-based, and Markerless.

When discussing the specific use of AR in the context of e-commerce, it's clear to see the increasing impact it is having. Here are a few statistics that demonstrate this growth:

1) A majority of individuals, or 71%, express a desire to experience a product in their immediate surroundings prior to making a purchase.

2) Approximately six out of ten people believe that utilizing augmented reality offers the optimal shopping experience.

3) Recent research indicates that incorporating AR into e-commerce, it leads to a 40% increase in conversion rates.

II. LITERATURE SURVEY

Introduction:

Augmented reality (AR) is an emerging technology that is transforming the way people shop online. With the use of AR, customers can experience a more interactive and personalized shopping experience by virtually trying on clothes or viewing products in a real-world setting. Ecommerce stores are taking advantage of this technology to enhance the customer experience and increase sales. In this literature survey, we explore the research and development efforts that have been conducted in the field of ecommerce with augmented reality.

Augmented Reality in Ecommerce:

Augmented reality technology overlays virtual objects onto the real world, creating a mixed reality experience. In ecommerce, this technology can provide customers with a more engaging shopping experience, by allowing them to virtually try on clothes or view products in a real-world setting. According to a study conducted by Ernst and Young, 40% of consumers would pay more for a product if they could experience it through augmented reality technology. The study also showed that 65% of consumers believed that augmented reality would help them make better purchasing decisions.

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AR can also help ecommerce stores reduce their return rates by allowing customers to virtually try on clothes and see how they look before making a purchase. This technology can also help stores reduce their costs by eliminating the need to maintain physical inventory for all sizes and colors of a product. Instead, they can offer virtual inventory, giving customers access to a wider range of products.

Technologies Used in Building an Ecommerce Store with Augmented Reality:

To build an ecommerce store with augmented reality, developers can use a variety of technologies, including AR software development kits (SDKs), 3D modeling software, and cloud computing services. The following are some of the most popular technologies used in building an ecommerce store with augmented reality.

AR SDKs:

AR SDKs provide developers with a set of tools and APIs that enable them to create AR experiences. These SDKs include features such as image recognition, tracking, and rendering. Some popular AR SDKs include ARCore by Google, ARKit by Apple, and Vuforia by PTC.

3D Modeling Software:

To create 3D models of products, developers can use 3D modeling software such as Blender or Maya. These software packages enable developers to create highly detailed 3D models that can be used in AR applications.

Cloud Computing Services:

Cloud computing services such as Amazon Web Services (AWS) or Microsoft Azure can be used to store and process the vast amounts of data required for AR applications. These services provide developers with access to powerful computing resources and storage capabilities.

Case Studies:

Several ecommerce stores have successfully implemented AR technology to enhance the customer experience and increase sales. Here are some examples:

IKEA Place:

IKEA Place is an AR app that allows customers to virtually place furniture in their homes before making a purchase. This app uses Apple's ARKit and allows customers to browse through thousands of products, place them in their home using their smartphone camera, and even walk around and view the product from different angles. This app has been successful in increasing sales for IKEA by providing a more immersive and interactive shopping experience.

Warby Parker:

Warby Parker is an eyewear company that has implemented AR technology to allow customers to virtually try on glasses. Their Virtual Try-On feature uses face mapping technology to create a 3D model of the customer's face and allows them to try on different frames virtually. This feature has helped reduce the company's return rate by providing customers with a better idea of how the glasses will look on their face.

Sephora:

Sephora, a makeup retailer, has implemented AR technology to allow customers to virtually try on makeup. Their Virtual Artist feature uses facial recognition technology to create a 3D model of the customer's face and allows them to try on different makeup products virtually. This feature has helped increase sales for Sephora by providing customers with a more personalized and engaging shopping experience.

Wayfair:

Wayfair, an online home goods retailer, has implemented AR technology in its mobile app to allow customers to preview furniture in their homes before purchasing. The Wayfair app uses Google's ARCore platform to superimpose 3D models of furniture onto the user's camera view. This feature has helped customers visualize how the furniture will look in their homes and has increased customer confidence in their purchases.

L'Oreal:

L'Oreal, a cosmetics company, has implemented AR technology in its mobile app to allow customers to virtually try on makeup. The Makeup Genius app uses facial recognition technology to create a 3D model of the customer's face and allows them to try on different makeup products virtually. This feature has helped L'Oreal increase sales by providing customers with a more engaging shopping experience.

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Challenges and Future Directions:

Although AR technology has the potential to revolutionize ecommerce, there are still some challenges that need to be addressed. One of the biggest challenges is the lack of standardization in AR development, which can lead to compatibility issues between different devices and platforms. Another challenge is the cost and complexity of developing AR applications, which can make it difficult for small businesses to implement this technology.

In the future, we can expect to see more advanced AR applications in ecommerce, such as virtual shopping assistants that can guide customers through the shopping experience and provide personalized recommendations. We may also see more integration of AR with other technologies, such as artificial intelligence and virtual reality, to create even more immersive and interactive shopping experiences.

Conclusion:

In conclusion, augmented reality is transforming the way customers shop online, and ecommerce stores are taking advantage of this technology to enhance the customer experience and increase sales. Developers can use a variety of technologies to build an ecommerce store with augmented reality, including AR SDKs, 3D modeling software, and cloud computing services. Several ecommerce stores have successfully implemented AR technology, and we can expect to see even more advanced applications in the future. However, there are still some challenges that need to be addressed, such as the lack of standardization in AR development and the cost and complexity of developing AR applications.

III. SYSTEM DESIGN ARCHITECTURE

The e-commerce store mobile app with augmented reality facilities is designed to allow users to browse and purchase products using their mobile devices. The app will also have an augmented reality feature that allows users to visualize how products will look in their home or other environments.. Detailed information about the development of this project is covered in this chapter.

The system flow chart is shown in Figure 1. Each block is described in this section.

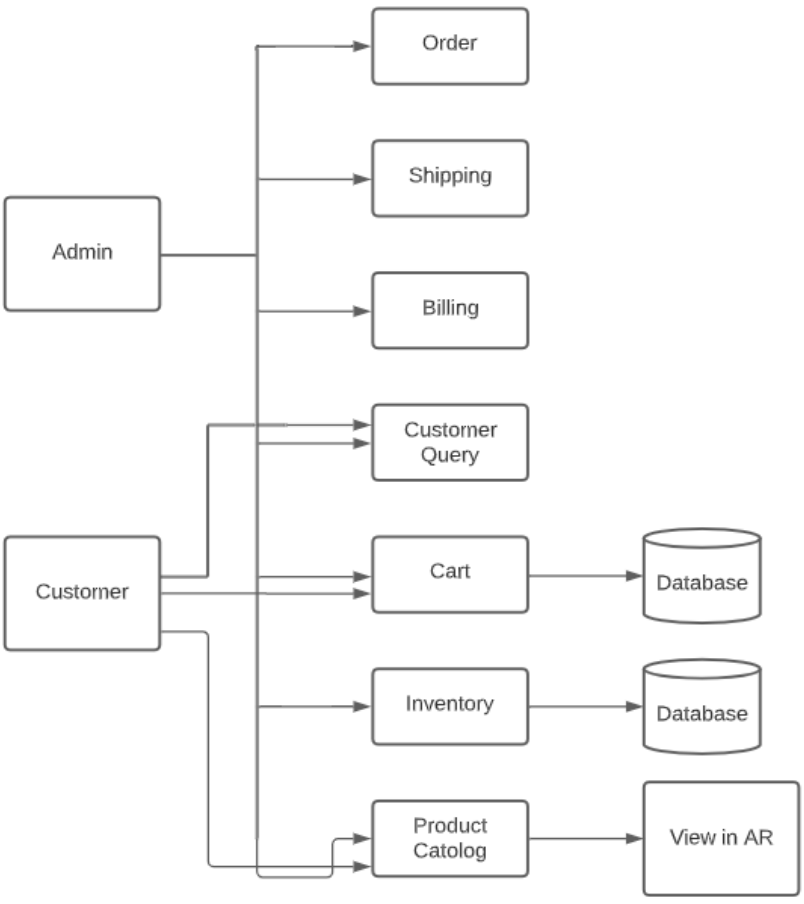

Fig. 1 Proposed system flow chart

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High-level system design architecture :

Frontend: The frontend of the application will be developed using the Flutter framework, which allows for cross-platform development. The frontend will consist of screens for product listings, product details, shopping cart, checkout, and augmented reality preview.

Backend: The backend of the application will be powered by Firebase, which provides cloud-based services for user authentication, real-time database, and cloud storage. The backend will store user data, product data, and order data.

Authentication: Firebase authentication will be used to authenticate users and secure the application.

Real-time Database: Firebase real-time database will be used to store product data, order data, and user data.

Cloud Storage: Firebase cloud storage will be used to store product images, augmented reality models, and other files.

API: An API layer will be developed to allow the frontend to communicate with the backend. The API will handle user authentication, product data retrieval, order processing, and payment processing.

Payment Gateway: A payment gateway such as Stripe or PayPal will be integrated with the application to allow users to make payments for their orders.

Augmented Reality: Augmented reality will be implemented using Unity. The AR models will be hosted on Firebase cloud storage and downloaded to the user's device when needed. Unity will use ARKit or ARCore to detect surfaces and allow users to preview products in their environment.

Analytics: Analytics will be implemented using Firebase analytics to track user behavior, such as the number of products viewed, the number of products added to the cart, and the number of orders placed.

Deployment: The application will be deployed on app stores such as Google Play and App Store.

Scaling: The application will be designed to handle a large number of users and orders. Firebase provides automatic scaling and can handle high traffic volumes.

IV. REQUIREMENT ANALYSIS

The requirements for the e-commerce store mobile app with augmented reality facilities can be divided into three categories: user requirements, functional requirements, and non-functional requirements.

A. User Requirements

User Personas: User personas will be created to represent the different types of users that will use the app, such as busy professionals, tech-savvy millennials, and senior citizens.

User Stories: User stories will be used to describe the tasks that users will perform with the app, such as browsing products, adding items to their cart, and making payments.

Use Cases: Use cases will be used to describe the different ways that users will interact with the app, such as searching for products, applying filters, and viewing product details.

B. Functional Requirements

Features and Functionality: The e-commerce store mobile app with augmented reality facilities will have the following features and functionality:

1.User registration and login

2.Product browsing and search

3.Shopping cart and checkout

4.Payment processing

5.Augmented reality visualization

Business Logic:

The app will implement the following business logic: Displaying product recommendations based on user browsing history and preferences. Generating personalized discounts and promotions for users

Workflow Diagrams: Workflow diagrams will be used to describe the flow of activities within the app, such as the checkout processand the augmented reality visualization process.

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C. Non-Functional Requirements

Performance: The app should be fast and responsive, with minimal loading times for pages and images.

Scalability: The app should be able to handle a large number of users and transactions, and be able to scale up or down as needed.

Security: The app should be secure and protect user data and payment information.

Compatibility: The app should be compatible with a variety of mobile devices and operating systems.

V. IMPLEMENTATION PLAN

The implementation plan for the e-commerce store mobile app with augmented reality facilities will involve the following steps:

Design and UI/UX: The app's design and user interface will be developed using Flutter, with a focus on creating an intuitive and user-friendly interface.

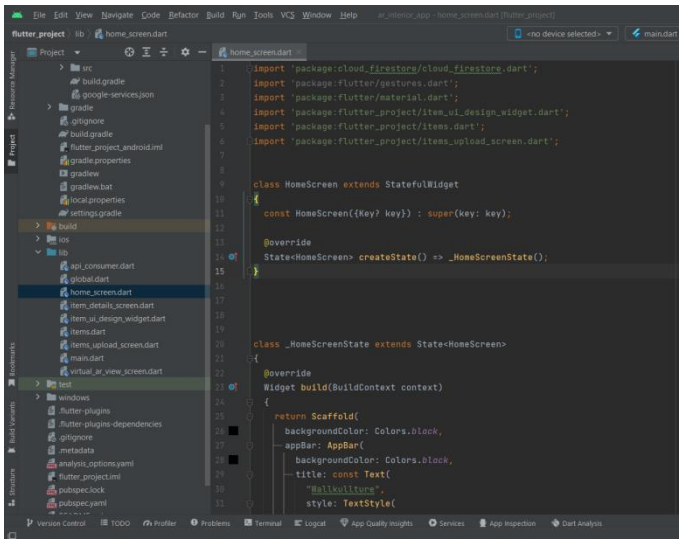

Fig. 2 Home page implementation

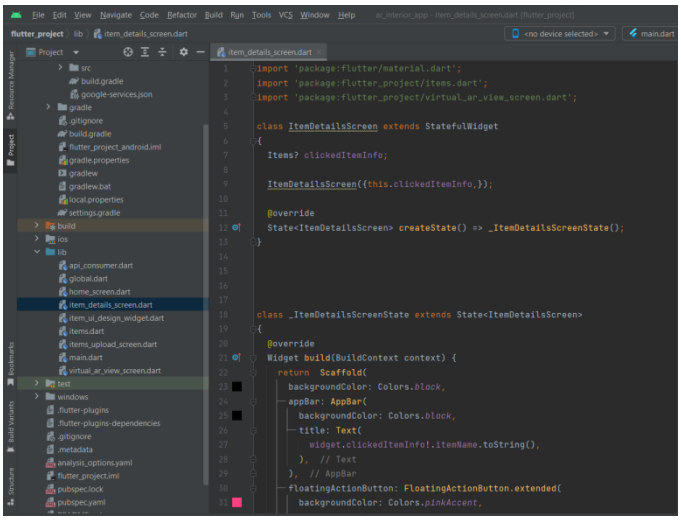

Fig. 3 Items details uploading page implementation

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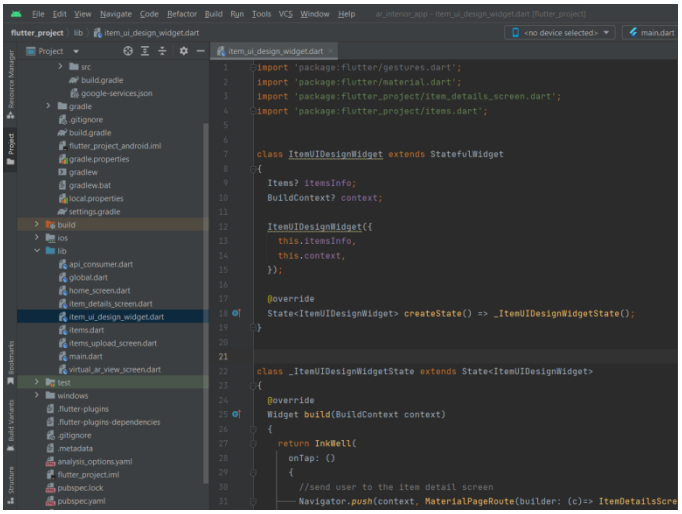

Fig. 4a Item description page implementation

Backend Development: The app's backend will be developed using Firebase, which will handle user authentication, product data storage, and payment processing.

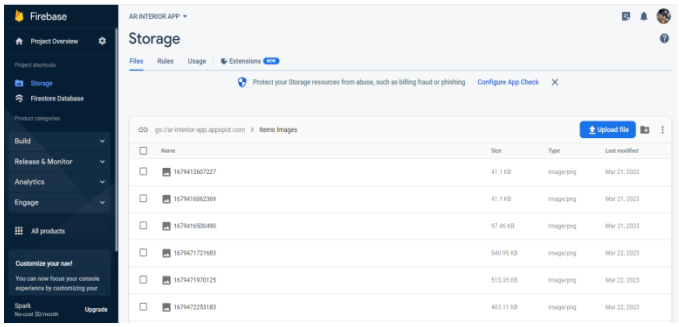

Fig. 4b Firebase storage implementation

Augmented Reality Feature: The augmented reality feature will be developed using Unity, which will allow users to visualize how products will look in their home or other environments.

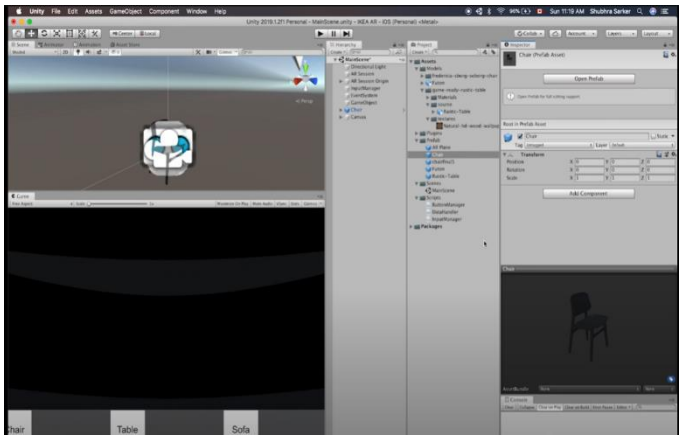

Fig. 5 Unity Implementation

Testing and Quality Assurance: The app will undergo rigorous testing to ensure that it meets all functional and non-functional requirements and is free of bugs and errors.

Deployment and Maintenance: Once the app is fully tested and approved, it will be deployed to the app stores and maintained with regular updates and bug fixes.

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VI. ADVANTAGES OF AUGMENTED REALITY IN E-COMMERCE WEBSITES

1. Boost customer engagement

The use of AR on e-commerce websites promotes user engagement, potentially leading to increased sales. Even if users don't make a purchase during their visit, their extended stay on the website builds a relationship with the products and brands, increasing the chances of future purchases. AR also creates an emotional connection between buyers and products, enhancing the consumer experience, generating excitement, and leaving a lasting impression. AR product presentations on e-commerce sites can improve consumer-product relationships, enhance the shopping experience, spark user interest, and captivate their attention.

2. Reach new customers

To stand out in today's noisy world, it's crucial to create excitement and buzz. One effective way to achieve this is through a captivating AR campaign. The use of advanced reality solutions in e-commerce can help attract and engage younger customers, particularly those in Generation Y and Z, who are often difficult to impress. Augmented reality has the potential to create a lasting impression and generate the desired "WOW" effect that appeals to this demographic. Since these generations influence trends and preferences, impressing them is a key strategy for promoting company products and encouraging purchases.

3. Reduce returns

The use of AR technology allows customers to obtain more detailed information about a product compared to still images or videos. AR enables the depiction of not only 2D views but also the features and benefits that a product can offer to potential buyers. Consequently, this helps to manage their expectations and ensure that the product meets their needs and desires upon receipt.

4. Creating AR in a Web browser

The use of AR technology allows customers to obtain more detailed information about a product compared to still images or videos. AR enables the depiction of not only 2D views but also the features and benefits that a product can offer to potential buyers. Consequently, this helps to manage their expectations and ensure that the product meets their needs and desires upon receipt.

5. Visualizations before Buying

Customers are given the chance to preview products prior to making a purchase, as they desire to test and thoroughly evaluate the product's value. Augmented reality provides customers with the means to easily carry out all necessary product evaluations at any time and place, simply by downloading an app and selecting the desired item.

6. Increase Brand Awareness

Augmented reality (AR) solutions enhance brand recognition and facilitate stronger marketing. Implementing AR technologies can elevate a brand, making it stand out as innovative, superior, pioneering, and noteworthy. Customers are more likely to return to businesses that have taken good care of them and provided them with exceptional experiences. This improves customer loyalty and their inclination to purchase products.

7. Optimize the Supply Chain

Augmented reality (AR) systems integrated into e-commerce websites or stores offer an endless array of products, irrespective of physical size or availability. By creating an e-commerce website and populating it with a diverse range of products, one can avoid costs such as rent, space maintenance, salaries for consultants and salespeople, as well as logistics. The only essential tasks are creating the website and ensuring a satisfactory customer experience.

The implementation of Augmented Reality (AR) technology creates engaging, enjoyable, and immersive experiences for consumers. Ensuring that AR can be easily deployed across devices and platforms, without requiring any special setup or configurations, remains crucial for effectively managing AR applications on a large scale.

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VII. REVIEWS FROM CUSTOMERS WHO HAVE SHOPPED AT E-COMMERCE STORES WITH AND WITHOUT AUGMENTED REALITY TECHNOLOGY

E-commerce Store Without Augmented Reality:

- "I was a bit disappointed with my shopping experience on this e-commerce store. Even though they had a wide variety of products, it was difficult to get a sense of what the products would look like in real life. I ended up purchasing a product that didn't meet my expectations."
- "I found this e-commerce store to be a bit lackluster in terms of the shopping experience. Without augmented reality, it was hard to get a sense of what the product would look like in my space. As a result, I ended up returning the product."

E-commerce Store With Augmented Reality:

- "I was blown away by the augmented reality feature on this e-commerce store. I was able to see what the product would look like in my space before making a purchase. It really helped me make an informed decision, and I ended up loving the product when it arrived."
- "The augmented reality feature on this e-commerce store was a game-changer for me. I was able to see the product in real-life before making a purchase, and it exceeded my expectations. I highly recommend this store for their innovative shopping experience."
- "I was a bit skeptical about shopping for furniture online, but the augmented reality feature on this e-commerce store made the process so much easier. I was able to see what the product would look like in my home, and it really helped me visualize how it would fit in with my decor. I ended up making a purchase and couldn't be happier."

VIII. RESULTS

Augmented Reality (AR) integrated into e-commerce store enables customers to interact with products in a dynamic and engaging way, similar to how they would in real life. Live 2D collaborative models are provided to help customers make informed purchasing decisions. As an illustration, various products may display different images based on the consumer's selection, as demonstrated in the images below.

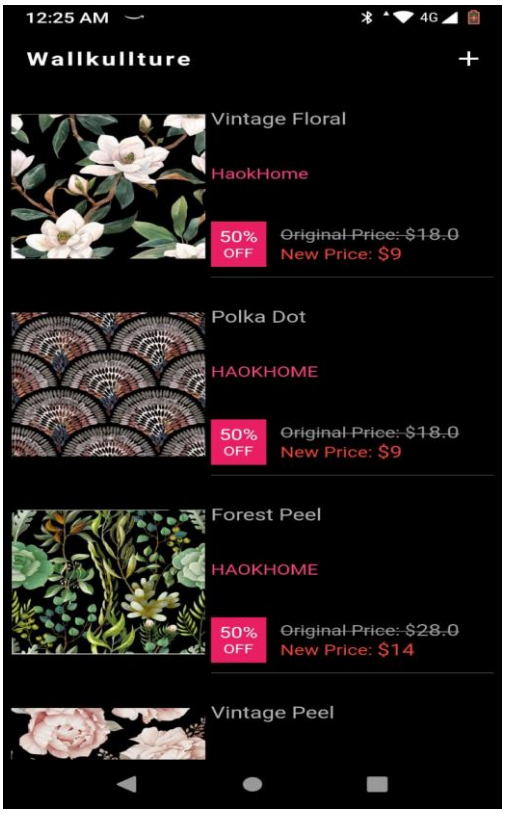

Fig. 6 Home Page

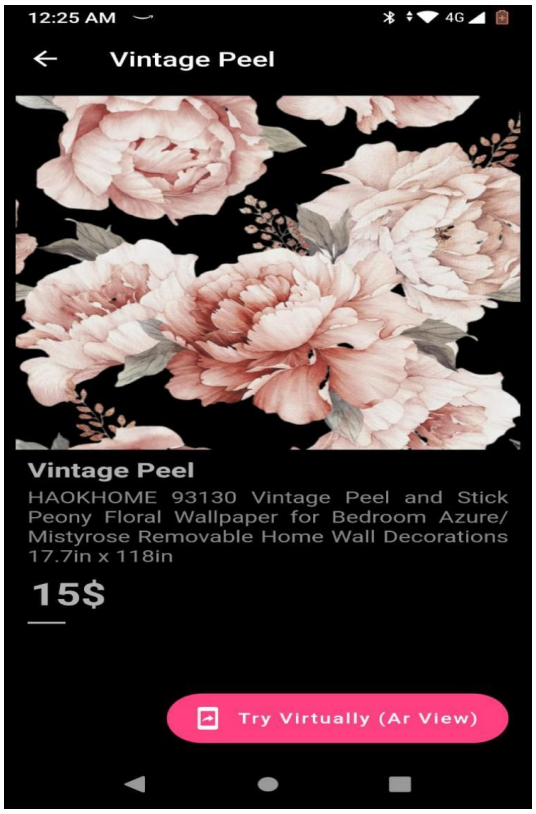

Fig.7 Description Page

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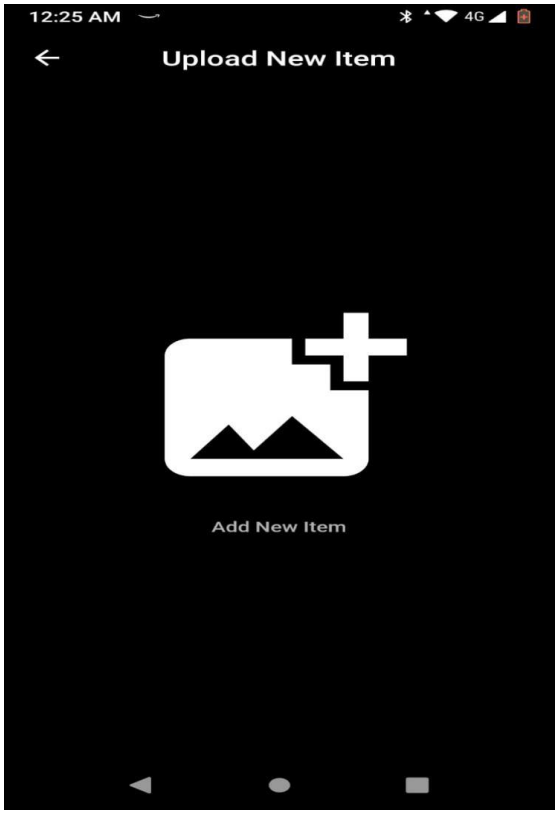

Fig. 8 Uploading Items Page

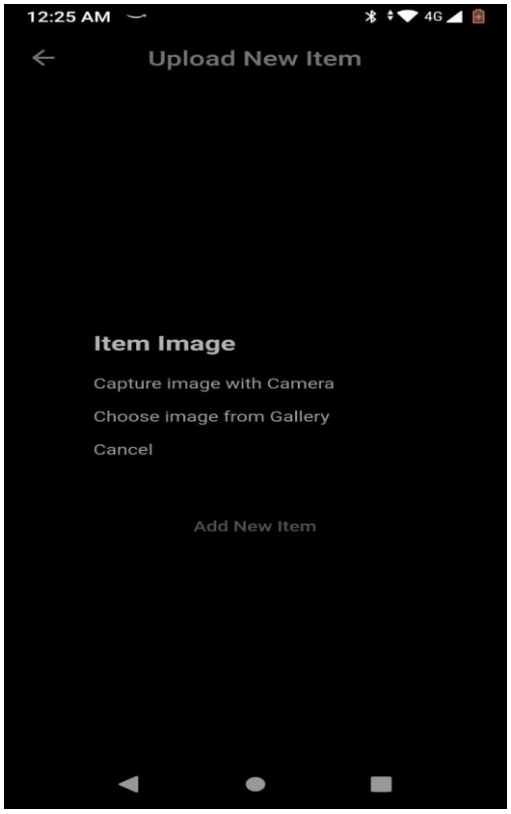

Fig. 9 Item uploading page

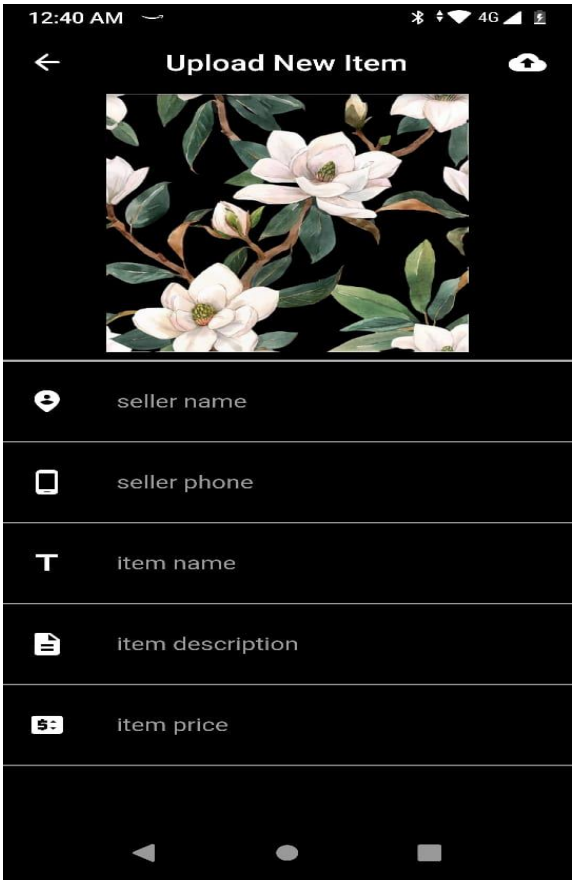

Fig. 10 Uploading Item Description page

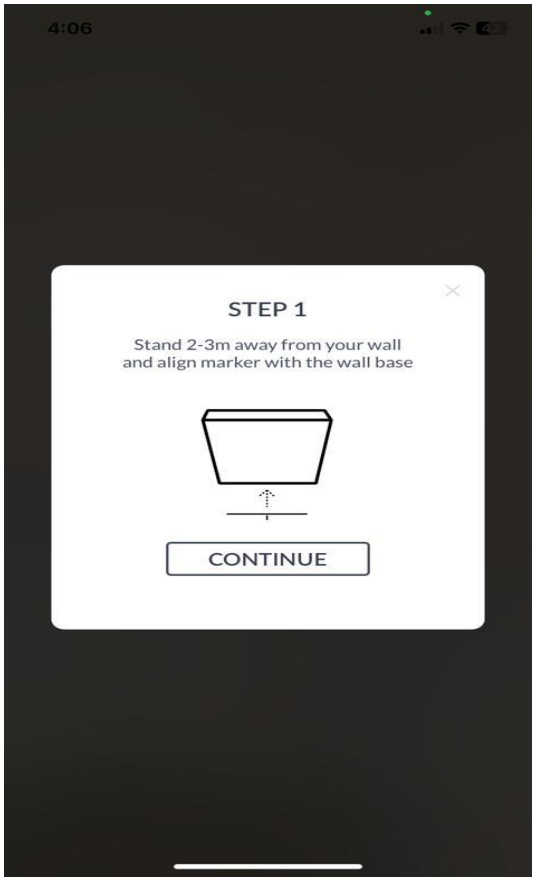

Fig.11 Ar View Step-1

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Fig.12 Ar View Scanning the Floor

Fig. 13 Ar View Aligning the wallpaper

Fig. 14 Ar view Step 2 Instruction 1

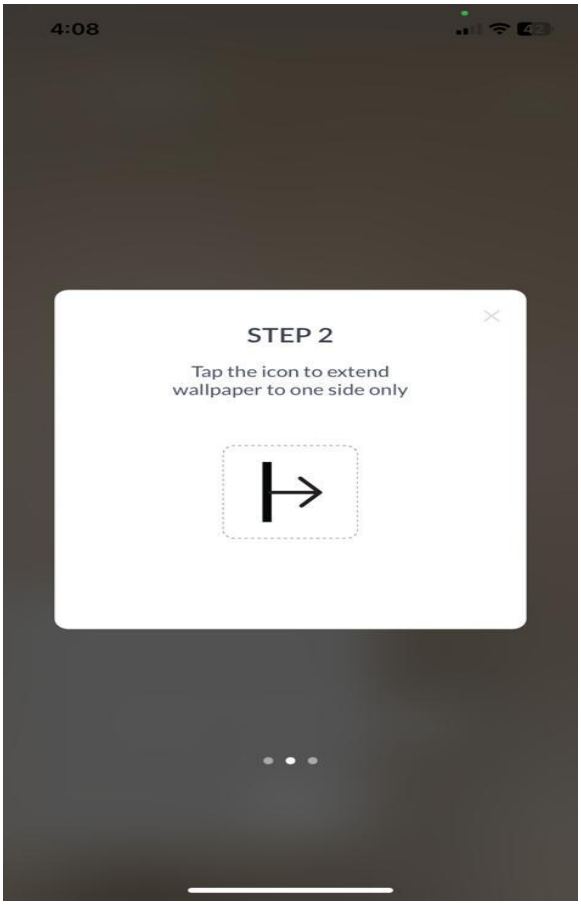

Fig. 15 Ar view step 2 Instruction 2

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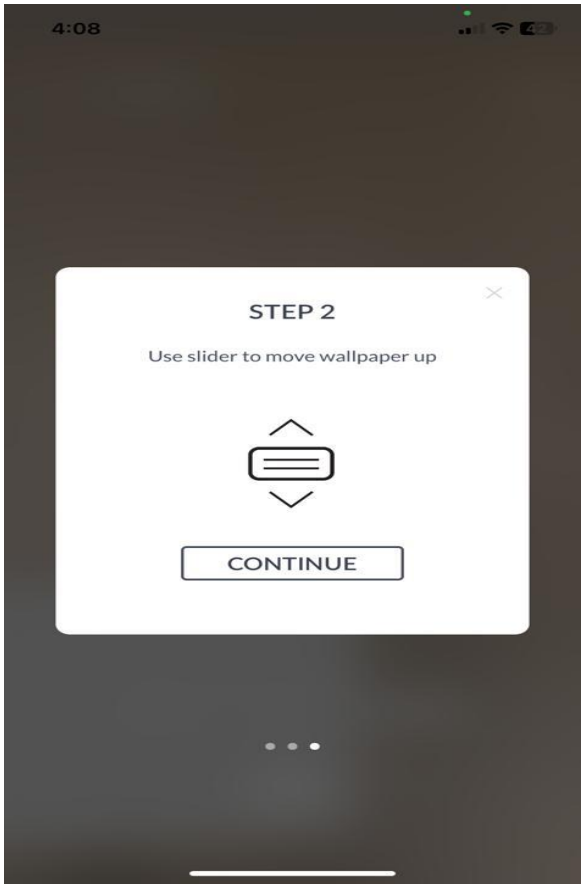

Fig. 16 Ar view Step 2 Instruction 3

Fig. 17 Ar View Final wallpaper

IX. CONCLUSION

The popularity of online shopping in India has increased significantly, with two major retail brands, Amazon and FlipKart, receiving an estimated monthly traffic of 500 million and 157.5 million, respectively. However, despite this trend, only a small percentage of visitors (between 2 and 4 percent) actually make purchases. In order to improve conversion rates and revenue, it is important for online retailers to take advantage of augmented reality technology. This technology allows for a more interactive shopping experience, as customers can virtually try on products before making a purchase. Augmented reality technology can lead to increased customer satisfaction, sales, and repeat business, ultimately resulting in better conversion rates and revenue. In the world of eCommerce, it is essential to find innovative ways to engage with customers, and augmented reality provides a unique opportunity to do so. With augmented reality, digital information and animations can interact with physical space, providing users with a new and exciting experience.

Since the main goal of this work was to develop a web application for the e-commerce sector that is able to extend the 3D models for the users in a real-time environment, we can definitely say that the developed application is fully capable of doing the mentioned work. However, there is still a lot to be done in the field of augmented reality and many challenges that need to be addressed, for example, scalability is an issue that needs to be worked on as rendering the 3D objects in real-time is quite a CPU heavy task and we also need to develop a way to compress the size of the 3D models, otherwise rendering in areas with low internet speed will be a time-consuming task. If we manage to overcome the aforementioned challenges, then augmented reality, along with e-commerce, will be the future of the way customers make their purchases.

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