IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

VISUALIZATION OF FURNITURE MODEL USING AUGMENTED/VIRTUAL REALITY

[1]Kaushiki Dutt Mishra, [2]Isha Parihar, [3]Ishika Jain, [4]Ajay Kumar, [5]Kakoli Banerjee
[1]U.G. Student, [2]U.G. Student, [3]U.G. Student, [4]Assistant Professor, [5]Professor
[1]Computer Science and Engineering,
[1]JSS Academy of Technical Education, Noida, India

Abstract: This project is centered on how to use Augmented Reality (AR) for demonstrating and visualizing furniture. The core idea is to develop an AR-based system with which users can interact with virtual furniture within a real- world environment. By adding 3D models of furniture to an AR platform, users can manipulate, view, and customize pieces of furniture in their own dwelling spaces, providing experience-rich practicality than can be obtained via the online catalogues or in-store display. Users are enabled to change position, size features and orientation of furniture models and visualize in real time how they will fit and look at home. The undertaking also offers color and material personalization, which completes an entire interior design planning tool. Implementation involves the creation of high- fidelity 3D models of various types of furniture, their optimization for AR applications, and developing a user-friendly interface that supports intuitive interaction. The productiveness of the system is quantified through user testing and focuses on user-friendliness, accuracy of placement, and overall user satisfaction. This AR/VR Furniture Visualization demonstration system certainly tries to provide a connection between online shopping and the analogue experience of using furniture: it can allow consumers to visualize and choose products more flexibly and excitingly, making decisions better.

I. INTRODUCTION

Furniture transformation in the recent world now goes with new technology, revealed by consumer behaviour in the last few years. The emergence of e- commerce through increasing access to the internet and smartphone entrance has resulted in consumers asking for more intriguing experiences and the personalization of shops. Traditional online methods usually do not satisfy the tactile and visual assurance required in furniture purchases, thus paving the way for Augmented Reality and Virtual Reality as game-changing technologies. Through AR and VR, immersive experiences can be developed, whereby home users could interact and visualize with furniture within their homes before making any purchasing decisions. AR brings together virtual elements to real life using their devices like smartphones or tablets, while VR creates entirely virtual environments for roaming and manipulating products. This is where the ability of customers to differentiate informed decisions and the possibilities of their returning goods and creating satisfaction comes. The main benefit in furniture retailing brought about by AR/VR is the "try-before-you-buy" performance enabling visualization of fit and aesthetics while delivering personalization by way of tailored recommendations according to user preferences. On the other hand, there are still challenges such as realistic rendering at different conditions and suitability for acceptance by users. Technical issues should, however, be solved, and user-friendly interfaces with support should adopt this kind of application into the globe. This review brings together literature and knowledge from the industry in analysing what really is at stake in terms of AR/VR in furniture retailing: the benefits, challenges, and future directions. This mention

emphasizes the real sense of transformation that such technologies can bring to consumer engagement, customer interaction and satisfaction in an increasingly digital marketplace.

II. RELATED WORK

The mentioned table includes the various research work in the field of visualization of furniture model using AR/VR

Table1. Related Work On Various Research Work On Visualization Of Furniture Model Using AR/VR

S.No	Paper Title	Publisher	Year	Objective
1	Virtual Reality for Furniture Design	Springer	2018	To explore the use of VR for visualizing furniture designs in real-time.
2	Augmented Reality for Furniture Shopping	Elsevier	2019	Investigating AR's role in enhancing the furniture shopping experience
3	A Study on Virtual Reality for Interior Design and Furniture Modeling	MDPI	2020	Focuses on using VR to create immersive interior spaces for furniture modeling
4	User Interaction with Virtual Furniture Models	IEEE Xplore		Analyzing user interaction with virtual furniture in simulated environments
5	Design and Application of AR Furniture Modeling	Springer	2019	Examining AR applications in real-time modeling of furniture in real-world settings
6	Exploring AR and VR in Product Customization for Furniture	Taylor & Francis	2022	Studying the impact of AR/VR on customized furniture design
7	Integration of AR and VR in Virtual Showrooms for Furniture	Elsevier	2021	Explores how AR/VR are used to create virtual furniture showrooms.
8	An Evaluation of AR for Real-Time Furniture Visualization	MDPI	2020	Evaluates how AR helps in real-time visualization and decision-making in furniture purchases

9	Augmented Reality for Online Furniture Retailing	Springer	2020	Investigating AR's role in online furniture retail to enhance customer experience
10	Virtual Reality and Augmented Reality in Furniture Design and Architecture	ACM Digital Library	2017	Overview of VR/AR technologies applied in furniture and architectural design.
11	Using AR/VR for Interactive Furniture Design Prototypes	IEEE Xplore	2019	Discussing the use of AR/VR for creating and testing interactive furniture prototypes
12	Enhancing Consumer Decision Making through AR in Furniture Stores	Wiley Online Library	2021	Analyzing consumer behavior when using AR tools for furniture selection.

III. PHOTOREALISTIC 3D FURNITURE PLACEMENT

The application should not avoid using high quality and detailed 3D models of furniture items for a real virtual authentic experience. These components have to be accurate with respect to the texture, coloring and intricate details of the physical products. 3D models appear more realistic which help the customer in deciding the look and feel of the furniture. The specific attributes of high- resolution textures and geometric structure detailing allow virtual objects to be more realistic. Photorealistic advancements should be used in the display of the items to make them look veristic.

Using room scanning feature, users can build a precise map of the space they want to furnish. This activity utilizes the device's camera and its sensors to record the dimensions and arrangement of elements in the room along with the 3D walls and floors and the furniture that already exist there. If the room is well mapped, the app will allow to position virtual furniture items realistically so that the objects feel as if they are in the correct surroundings. This indicates that factors such as the placement of light sources and the shadows should be taken into consideration so that the virtual objects do not conflict with the real surroundings. More advanced room scanning technologies may also find items that obstruct normal view and recommend more appropriate locations for placing items, improving methods for using the entire space.

IV. COMPARISON OF VARIOUS ALGORITHMS USED AND AR/VR

Table 2. Comparison Of Various Algorithms for Furniture Visualization

Algorithm	Purpose	Use in AR/VR	Example Tools/Frameworks
3D Rendering Algorithms	To render realistic furniture models in AR/VR environments	Used to visualize furniture models in real-time	Unity 3D, Unreal Engine, Three.js
Computer Vision (Feature Matching)	To recognize and track surfaces in the real world for AR	Enables AR applications to place furniture in real-world scenes	OpenCV, ARKit, ARCore
Simultaneous Localization and Mapping (SLAM)	To create a map of the environment while tracking the device's position in real time	Used for real-time tracking of device movements for AR furniture placement	Google Cartographer, SLAM Toolbox, ROS
Deep Learning (Object Detection)	To identify furniture pieces in real-time or pre-recorded 3D images	Helps identify and position furniture models in virtual space	TensorFlow, PyTorch, YOLO
Pathfinding Algorithms(A or Dijkstra)	To navigate virtual objects or users within a 3D space	Used in VR for moving users or objects through the 3D space	Unity NavMesh, Unreal AI Pathfinding
Physics-Based Algorithms (Collision Detection	To simulate realistic interactions and collisions between furniture and environment	Ensures furniture models behave realistically in AR/VR environments	NVIDIA PhysX, Bullet Physics, Havok

Table 3. Comparison Od Augmented Reality and Virtual Reality

Aspect	Augmented Reality (AR)	Virtual Reality (VR)
Immersion	Partial immersion by blending virtual models with the real world	Full immersion into a simulated virtual world, isolated from the real world
User Interaction	Users can interact with virtual furniture placed in their real environment	Users interact with virtual furniture in a completely digital setting.
Hardware Requirements	Requires a camera (smartphone or tablet) and a screen	Requires VR headset and possibly motion controllers
Environment	Real-world environment is visible and augmented with digital models	Entire environment is simulated, no real-world visibility
Applications	Ideal for placing and customizing furniture in actual rooms	Ideal for exploring different room layouts and visualizing furniture in various settings
Use Case Exam	Visualizing how a sofa fits in a living room before purchasing	Exploring a completely virtual house setup with multiple furniture styles

V. METHODOLOGY

1. Application Development and Setup

The development process begins with building the augmented reality (AR) application using Android Studio. The application is compiled into an APK and installed on compatible devices. It incorporates Google AR Services and utilizes 3D object files in .obj format for rendering furniture models.

2. Initialization and Interface

- Upon launch, the application presents a menu interface, enabling users to select various options such as viewing furniture, contacting support, or exiting the application.
- Selecting "product" from the menu initiates the category selection process, allowing users to choose from predefined furniture categories.

3. 3D Model Selection and Marker-Based Augmentation

- Users select a product from the chosen category, after which the application provides two options:
- Default Marker Selection: Users can choose an existing marker to display the furniture model.
- New Marker Registration: Users can register a custom marker for displaying augmented objects.
- The AR application tracks the selected marker, performs calibration, and generates the augmented view by overlaying the 3D furniture model in the user's environment.

4. ARKit Integration for Scanning and Rendering

The application uses ARKit to scan the floor and render 3D objects in the surrounding environment. Key functionalities include:

- 3D Object Placement: Accurate placement of virtual furniture in real-world space.
- Light Rendering: Adjusting lighting to match the real environment, enhancing visual realism.

5. User Interaction and Visualization

- Users can interact with the augmented furniture, rotate it, or reposition it within the scene.
- Captured images and videos of the AR view can be saved directly to the local gallery for later use or sharing.

6. Application Workflow

The user workflow ensures an intuitive experience:

- Exit Confirmation: At any point, users can exit the application after confirmation.
- Augmented Visualization: The process ensures seamless integration of 3D models into the real environment, providing users with an immersive visualization of furniture.

7. Output

The final output is a realistic AR visualization of furniture, captured as images or videos, which can be saved or used for further purposes.

VI. ACCURACY OF ALGORITHMS

Table 4. Comparison Of Accuracy Of Various Algorithms

ALGORITHM	PURPOSE	TYPICAL ACCURACY
Object Recognition(e.g. YOLO)	Detecting and identifying furniture models in the real environment	92%
SLAM	Understanding and mapping room environments for AR placements	91.64%
Maker Based Tracking	Anchoring furniture in AR space	97%
Rendering Algorithms	High-fidelity visualization of furniture	94.33%

VII. EXPLORING AR/VR INNOVATIONS IN FURNITURE

Instant Engagement Solutions

These types of engaging solutions are completed within a few seconds to half an hour. For instance, in the realm of any AR/VR visualization in real-time tools that lets a user to visualize a piece of furniture in their own space-the tools powered by ARCore and ARKit-would grant them to see whether it fits or how it would look in their expanse. This addresses customer ambiguity about proportions and elegance, as well as where and if it fits, using techniques like motion tracking, real-time rendering of 3D designs and comprehending environment.

To improve execution for such affairs, issues like real-time asset loading, or efficient calculation, have been dealt with enhanced textures and marker-less tracking systems. With these enhancements, accurate and flawless placements of virtual furniture will be available for a superior user experience.

Advanced Personalization features

This solution summons for interactive and tailored experience anywhere between half an hour to few hours. The furniture dimensions, shades as well as substances can be modified according to the customer. The deep learning systems look how users interact with the site to put forward the most tailored recommendation while hybrid AR/VR delivers functionality over a wide range of devices.

These improvements can support the live promotional crusade strategies of merchandising. Considered resource demanding, they are known for their stability and efficacy, thus increasing one's shopping experience.

Immersive Strategic Approaches

These methods are aimed at an attitude extended engagement that may take several days, if not weeks, to fulfil. Virtual showrooms deliver an extensive, immersive browsing experience, showcasing large collections configured into lifelike expanse. Meanwhile, active AI-enabled predictive tools such as recurrent neural networks (RNNs) provide actionable insights against future trends and inventory management to ensure improved efficiency and customer retention levels.

Integration with IoT-enabled smart furniture and secure blockchain transactions makes it possible for these approaches to scale, to add reliability, and adaptability. These push operational excellence while expanding market outreach and attaining cost efficiencies which may be recurring, thus sustaining growth in the furniture e-commerce sector.

VIII. DISCUSSION

The transformation in the interaction mode between designed products and consumers might have become very abrupt when augmented reality and virtual reality technologies were introduced in the industry of furniture. This is the case as they integrate into consumer behaviour the visualization of furniture in concrete settings before making decisions over purchasing, thereby affecting one critical aspect of online shopping—whether the furniture would fit in terms of expanse, flair, and elegance. As the report states, AR/VR is not just about enhancing customer experiences; it is also about connecting proprietors and consumers through attuned and individualised recommendations and experiences. Short-term goal: This is a rapid roll-out and engagement goal that will soon lend itself to harvesting user analysis and honing the benefaction. During this phase, features will be enhanced or built on, and e-commerce links will include this helping aspect of shopping. Finally, this would be for the long term, to have AR/VR as the common standard across entire dimensions in the furniture-shopping experience. Thus, it provides the edge to companies as market leaders because it can continuously develop based on what consumers will say. The first and foremost, as mentioned, realistic rendering, user acceptance, and technology limitations must be managed. However, with a selfless focus and the harrowing of data, this should not be a problem with any technology investment capable of bringing business success to the full value of AR/VR.

IX. CONCLUSION

To amplify this dramatic effect even more, furniture shopping can apply augmented reality and virtual reality. These enable consumers to enhance their confidence in buying products, thereby reducing return rates, hence increasing sales, through the visualization of objects in their environment. A phased approach with short term, mid-term, and long-term models provides to a business a staged structured pathway to be able to apply and develop these technologies appropriately. By digitizing the traditional furniture market, the companies which implement AR/VR in their portfolio would certainly gain a competitive advantage and lure expert consumer audiences into transforming traditional avenues of customer engagement. The future of furniture retails lies in the immersive personalized experiences, bringing the virtual world of e- commerce and real-world brick-and-mortar showrooms closer to reality, where it stands to benefit the most from AR and VR technology transform an act where an object from the physical world is brought into virtual reality remarks in their form of an image, sound, sensation, action, or any other sensory element.

X. REFERENCES

1. Studio, J., & House, H. (2020). The Impact of Augmented Reality on Furniture Shopping. Journal of Design Technology, 15(2), 126-142.
2. Philip Lackner– YouTube channel for Android Development.
3. Official ARCore Documentation
4. Kotlin Cookbook by Ken Kousen (Book), pg.no. -65
5. Thompson, L. (2019). Augmented Reality in Home Decor: An Exploration of User
6. https://firebase.google.com/docs/android/setu p
7. https://developers.google.com/ar/develop/java/quickstart.
8. https://developers.google.com/ar/develop/java/enable-arcore.
9. https://developers.google.com/ar/develop/java/emulator
10. https://m2.material.io/
11. https://razorpay.com/docs/payments/payment- gateway/android integration/standard/
12. https://proandroiddev.com/jetpack-compose- otp-input-field-bcfa22c85e5f
13. https://docs.unity3d.com/Packages/com.unity. xr.arfoundation@4.1/manual/index.html
14. https://developer.apple.com/augmented- reality/
15. Rashid, A., Ahmed, M., & Smith, R. (2020). "User Experience in AR-Based Furniture Visualization: Design and Interaction Paradigms." ACM CHI Conference on Human Factors in Computing Systems, 1-12
16. Chen, X., & Li, Y. (2022). "Augmented Reality Enhanced Furniture Visualization: A Comprehensive Review." International Journal of Human-Computer Studies, 154, 102-118
17. https://developers.google.com/ar/develop
18. Chakrabarti, D. (2022). "Psychological Impacts of Immersive Furniture Visualization Technologies." Journal of Design Psychology, 16(2), 88-105
19. Jones, D., & Wilson, K. (2021). Implementing AR in Furniture Retail: A Case Study. Journal of Retail Technology, 12(3), 78-85.
20. Chen, L., & Zhang, H. (2020). Virtual Reality Applications in Furniture Design and Marketing. International Journal of Virtual Environments, 9(2), 101-110.
21. Garcia, M., & Lopez, R. (2019). Enhancing Customer Experience in Furniture Shopping Using AR Technology. Journal of Business Research, 22(1), 45-53.
22. Kim, S., & Park, J. (2021). User Acceptance of AR Applications in Furniture Shopping. Journal of Consumer Behavior, 18(4), 321-330.
23. Nguyen, T., & Tran, P. (2022). A Comparative Study of AR and VR Technologies in Furniture Retail. International Journal of Advanced Computer Science, 14(6), 234-240.
24. Li, X., & Wang, Y. (2020). The Role of Augmented Reality in Online Furniture Retailing. Journal of Interactive Marketing, 33(2), 112-120.
25. Martinez, A., & Rodriguez, B. (2019). Augmented Reality for Furniture Customization: A User-Centred Design Approach. Design Studies, 40(3), 89-97.
26. O'Connor, J., & Murphy, D. (2022). Virtual Reality Showrooms: Transforming the Furniture Shopping

Experience. Journal of Retail and Consumer Services, 29(5), 150-158.
27. Singh, R., & Gupta, P. (2021). Evaluating the Impact of AR on Consumer Purchase Decisions in the Furniture Industry. Journal of Marketing Analytics, 7(3), 205-213.
28. Wang, L., & Chen, M. (2020). Augmented Reality as a Tool for Furniture Design Visualization. International Journal of Design, 14(1), 67-75.