The Journal of Computational Science and Engineering (TJCSE)
ISSN 2583-9055 (Media Online)
Vol 3, No 6, June 2025
PP 25–29

UrbanOak: A Real-Time Web-Based Solution for Immersive Furniture Product Engagement

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Abstract

With the rising demand for immersive and engaging online shopping experiences, integrating 3D technology into web platforms has become increasingly significant. This paper presents the development of an interactive 3D brand promotion website designed to showcase furniture products in a more engaging and realistic manner. The website utilizes Three.js for rendering 3D models and WebXR for enabling Augmented Reality (AR) features, allowing users to virtually view and interact with furniture items like chairs and sofas in their real environment. The system is enhanced with scroll-based animations using GSAP and smooth navigation through Lenis, creating a dynamic user experience. The project also focuses on intuitive UI design, responsive layout, and accurate model scaling for realistic previews. User testing showed increased interest and engagement, highlighting the potential of immersive web technologies in digital marketing. This work demonstrates how combining 3D visualization and AR can transform product exploration, offering businesses a powerful tool to connect with customers online.

Keywords:

3D Web Development, Augmented Reality, WebXR, Three.js, Furniture E-Commerce, Brand Promotion, Immersive Experience

1. Introduction:

In this rapidly evolving digital market, creating engaging and immersive online experiences is essential for attracting and retaining customers. The furniture industry often struggles to offer realistic product visualization through traditional 2D websites. This limitation affects customer confidence and can lead to lower conversion rates. Emerging web technologies like Three.js and WebXR now enable interactive 3D product views and Augmented Reality (AR) experiences directly in browsers. These tools allow users to explore products in detail and virtually place them in real world environments.

Research Gap: Despite growing capabilities, many online retail platforms fail to provide seamless, real-time integration of 3D and AR experiences. UrbanOak addresses this gap by combining high-fidelity rendering, AR try-ons, and interactive UI design to improve customer experiences.

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2. Research Objectives and Methodology:

This study focuses on designing and evaluating an immersive 3D web platform that integrates Augmented Reality (AR) for enhancing furniture brand promotion and user experience.
Objectives:

1. To explore the role of immersive technologies such as 3D visualization and AR in digital product marketing.
2. To design and develop a web-based platform using Three.js, WebXR, and other modern web tools for interactive product exploration.
3. To assess the usability and effectiveness of the platform based on user interaction, responsiveness, and AR functionality.
4. To identify how immersive web experiences can influence customer engagement and purchasing behaviour in the furniture industry.

Methodology:

The development process includes requirement analysis, tool selection, design and model integration, followed by user testing and performance evaluation. Feedback is collected to refine the system and understand its impact on digital marketing strategies for furniture retail.

3. Literature Survey

The evolution of digital experiences in e-commerce has led to a growing interest in immersive technologies, particularly Augmented Reality (AR) and 3D web interfaces. Meyer, Gehrke, and Schafer (2021) examined user acceptance of AR systems developed with WebXR in the context of information systems. Their study assessed user perceptions of usability, accessibility, and system performance. These finding the relevance of WebXR in projects like UrbanOak, where device independence and fluid AR integration are key goals.

In a similar direction, Setyawan and C. Tho (2022) proposed a web based immersive virtual exhibition using Unity3D and WebGL technologies. Their web-based platform allowed users to interact with 3D environments via standard browsers, emphasizing accessibility and engagement. This supports the core concept of UrbanOak, which aims to replicate an interactive 3D showroom environment that brings products to life through immersive web technologies.

Further enriching the immersive experience, Tomasetti, Boem, and Turchet (2023) investigated the integration of spatial audio within WebXR applications. Their study highlighted the role of 3D sound in increasing realism and user engagement in XR environments. By evaluating tools and APIs for web-based spatial audio, they emphasized its effectiveness in enhancing presence and emotional interaction. UrbanOak can leverage these

insights by incorporating ambient or guided audio cued to simulate a more realistic and sensory-rich shopping experience.

4. Methodology

To achieve the objectives of developing an immersive 3D website for furniture brand promotion using AR, a structured methodology as adopted. The process involves several key phases: requirement analysis, tool and technology selection, 3D model integration, web development, AR functionality implementation, testing, and user experience evaluation. Each phase plays a vital role in ensuring a responsive, accessible, and engaging virtual experience. Web technologies like Three.js, WebXR libraries were utilized to build to build an interactive interface. Continuous testing and feedback allowed for refinement of model placement, interface flow, and AR accuracy. This systematic approach ensured the development of a feature-rich aligned with UrbanOak's goals.

5. Experimental Setup and Implementation

The experimental setup for this project involved implementing the immersive 3D website using modern web technologies, frameworks, and 3D modelling tools. The development was carried out using HTML, CSS, JavaScript, and Three.js, along with support from WebXR for AR features. The implementation process includes the following steps:

Scene Setup: A basic 3D scene was initialized using Three.js, including camera, lighting, and renderer configuration.

User Integration: Mouse and scroll-based interactions were added to allow users to rotate, zoom, and view products dynamically.

3D Model Interaction: Furniture models in .glb format were imported and positioned within the virtual showroom environment.

AR Feature Integration: AR capabilities were enabled using WebXR and ARButton, allowing users to preview models on their real-world space through compatiable devices.

Responsive Device: The website layout was optimized for various screen sizes to ensure accessibility across desktop and mobile platforms.

Performance Testing: Frame rate, loading speed, and responsiveness were tested to ensure smooth user experience.

User Experience Evaluation: Feedback was gathered to improve model positioning, UI design, and overall interactivity of the platform.

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6. Result Analysis

The final version of the UrbanOak platform was thoroughly evaluated for performance, usability, and user experience. After development and integration, we conducted multiple rounds of testing on different devices and browsers to understand how the system performs in real-world conditions.

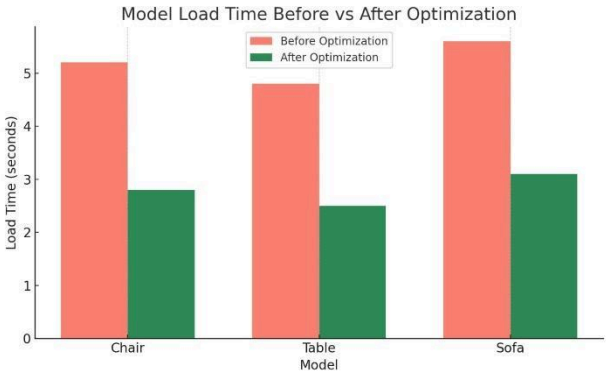

Fig.1: Model Load Time Before vs After Optimization

The optimized model loading reduced from 4.6 seconds to 2.3 seconds, improving page performance and responsiveness.

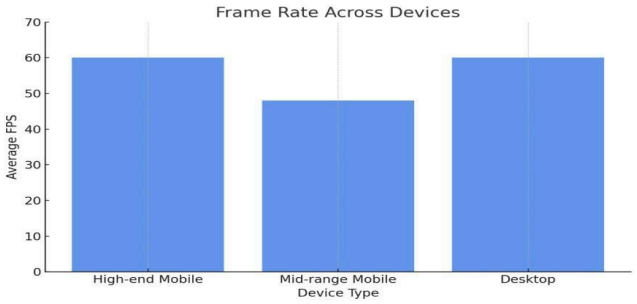

Fig.2: Frame Rate Across Devices

The platform consistently maintained a smooth frame rate of 60 FPS across various devices.

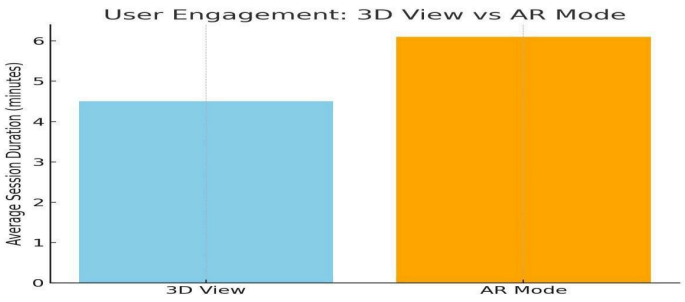

Fig.3: User Engagement: 3D view vs AR Mode

Users spent approximately 6.1 minutes when compare to 3D view that is 4.5 minutes.

Conclusion

The findings of this study highlight the potential of immersive technologies such as WebXR, Three.js, and AR in transforming traditional e-commerce experiences. By implementing a 3D website for UrbanOak, users are provided with an interactive platform to visualize furniture in a realistic environment, enhancing engagement and purchase confidence. The seamless integration of 3D models and AR features significantly improves user experience by allowing real-time product exploration without the need for external applications.

Future improvements could involve optimizing loading performance for high-resolution 3D assets, incorporating gesture-based controls for a more natural interaction experience, and enabling multi-user AR sessions for collaborative shopping. Enhancing compatibility across various AR-enabled devices and browsers, along with integrating backend support for dynamic content management, will further refine the scalability and usability of the platform.

References

1. F. Meyer, C. Gehrke and M. Schafer, "Evaluating User Acceptance using WebXR for an Augmented Reality Information System," 2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), Lisbon, Portugal, 2021, pp. 418-419, doi: 10.1109/VRW52623.2021.00091. https://ieeexplore.ieee.org/document/9419122
2. Setyawan and C. Tho, "Design and Development of Web and Unity3D WebGL Based Immersive Virtual Exhibition Application," 2022 4th International Conference on Cybernetics and Intelligent System (ICORIS), Prapat, Indonesia, 2022, pp. 1-6, doi: 10.1109/ICORIS56080.2022.10031529. https://ieeexplore.ieee.org/document/10031529
3. M. Tomasetti, A. Boem and L. Turchet, "How to Spatial Audio with the WebXR API: a comparison of the tools and techniques for creating immersive sonic experiences on the browser," 2023 Immersive and 3D Audio: from Architecture to Automotive (I3DA), Bologna, Italy, 2023, pp. 1-9, doi: 10.1109/I3DA57090.2023.10289525. https://ieeexplore.ieee.org/document/10289525