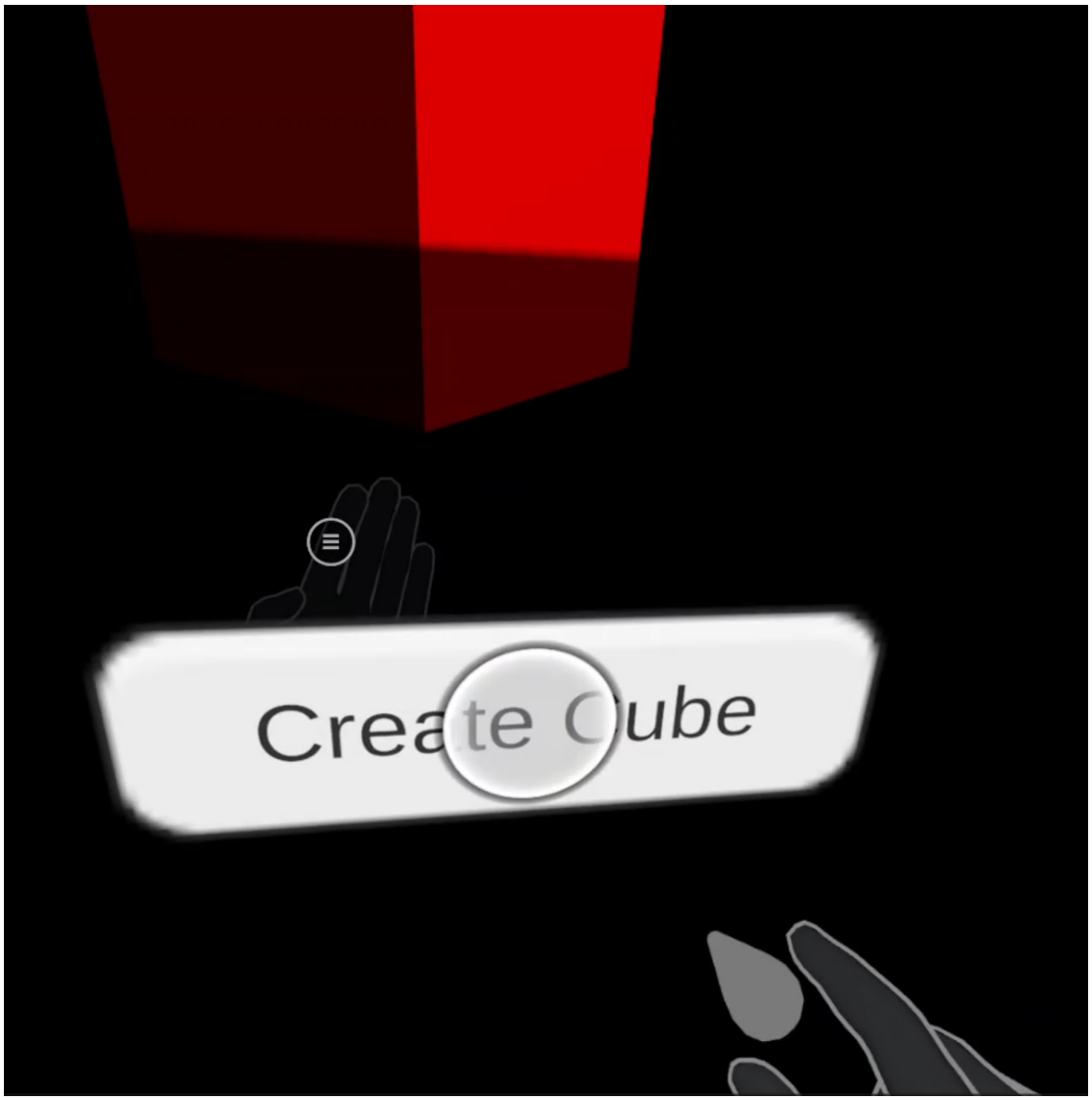
Furniture Preview Mixed Reality

TYLER SCHWITTERS, University of Washington



Consumers face a significant challenge when considering the purchase of expensive furniture for their homes. Determining the comfort, aesthetics, and fit within their living spaces is crucial, but visualizing how the furniture will look in their homes remains inconvenient. Traditional methods fail to adequately address this issue, resulting in uncertainty and potential regret after making a purchase. However, by leveraging Mixed Reality (MR) technology, consumers can digitally preview furniture in their homes before committing to a purchase.

Author's address: Tyler Schwitters, tschwi@cs.washington.edu, University of Washington.

1 INTRODUCTION

The process of purchasing furniture has long posed a significant challenge for consumers, particularly when it comes to envisioning how the furniture will fit and look within their own homes. This challenge can be attributed to the difficulty of mentally visualizing the spatial arrangement and overall aesthetic impact of the furniture in a specific environment. However, recent advancements in technology, specifically in the realm of mixed reality, have shown promise in alleviating this obstacle by providing consumers with the ability to virtually place furniture within their homes before making a purchase decision.

One such technology that has emerged as a potential solution is the utilization of mixed reality through Meta Quest 2 pass-through technology. By leveraging this technology, consumers can employ hand tracking to virtually position and preview furniture objects within their living spaces. This immersive experience allows users to perceive the furniture as if it were physically present, offering them a more accurate representation of how it would look in real life.

While the use of mixed reality and pass-through technology has proven effective in enabling users to preview furniture within their homes, it is important to acknowledge certain limitations associated with this approach. One significant drawback pertains to the realism of the virtual furniture's appearance due to the inherent limitations of color pass-through. The visual clarity of the pass-through technology may not accurately capture the true colors and textures of the furniture, potentially leading to discrepancies between the virtual representation and the actual product.

Additionally, object occlusion presents another challenge in the mixed reality experience. Object occlusion refers to the virtual furniture appearing behind physical objects in the real environment. This limitation can hinder the user's ability to fully assess how the furniture interacts with other existing elements within their homes, potentially resulting in an inaccurate representation of the final arrangement.

In summary, the challenge faced by furniture consumers in envisioning the appearance of furniture within their homes has long been a significant hurdle. However, with the advent of mixed reality and the application of Meta Quest 2 pass-through technology, consumers now have the opportunity to virtually place and preview furniture before committing to a purchase. While this technology offers an immersive experience, it is essential to recognize the limitations surrounding color pass-through, visual clarity, and object occlusion, as these factors may impact the accuracy and realism of the virtual representation. Nevertheless, mixed reality presents a promising solution that has the potential to revolutionize the way consumers visualize and make informed decisions about furniture purchases.

2 RELATED WORK

The Ikea Place app for iPhone leverages Apple's augmented reality kit to allow users to visualize furniture within their homes. Users can scale their living spaces and select 3D models of furniture, which are accurately dimensioned and capable of recognizing existing furniture and available space. This app offers a widely accessible solution, as most people own a smartphone or tablet, making it convenient to preview furniture without specialized hardware.

However, using a phone or tablet for augmented reality furniture preview has a limitation: the field of view. Users may struggle to assess how furniture will look in the broader context of their home, limiting their ability to gauge overall visual impact and arrangement accurately. To address this limitation, pass-through and mixed reality technologies provide a more immersive experience. By seamlessly blending virtual and real-world environments, these solutions offer a broader field of view and a more accurate representation of furniture within the home.

In summary, the Ikea Place app enables iPhone users to visualize furniture in their homes using augmented reality. While phone or tablet-based augmented reality is accessible, it has a drawback in terms of limited field of view. Pass-through and mixed reality technologies overcome this limitation by providing a more immersive experience, allowing users to make informed decisions about furniture purchases.

3 METHOD AND IMPLEMENTATION DETAILS

The implementation of the augmented reality furniture application involved utilizing the Unity Game Engine in conjunction with the Oculus integration package obtained from the Unity Asset Store. This package provided a comprehensive collection of scripts and game objects that served as the foundation for developing the application. The chosen hardware for this project was the Meta Quest 2 headset, primarily due to its advanced pass-through technology, which utilizes infrared sensors to capture a real-time view of the user's surroundings.

With the pass-through feature serving as the core functionality of the application, hand tracking capabilities were integrated using the Oculus integration package. By utilizing hand tracking, users were able to manipulate virtual objects within their environment by employing a pitching motion with their hands. This interaction method provided a seamless and intuitive way for users to position and preview furniture objects within their physical space.

Additionally, hand pose tracking from the Oculus integration package was implemented to enable the user to access a user interface. By directing their gaze towards their left hand with an open palm, users could trigger the opening of the interface. This functionality allowed for a more immersive and user-friendly experience, enabling users to access additional features and controls within the application.

In summary, the implementation of the augmented reality furniture application involved utilizing the Unity Game Engine and the Oculus integration package. The Meta Quest 2 headset with pass-through technology formed the basis of the application, providing a real-time view of the user's surroundings. Hand tracking and hand pose tracking functionalities were integrated to enable intuitive object manipulation and user interface interactions, respectively. These implementation details combined to create an immersive and interactive experience for users as they previewed and positioned virtual furniture within their physical environment.

4 EVALUATION OF RESULTS

The development of the mixed reality application successfully enabled users to select virtual furniture and place it within their homes using hand tracking. However, several significant limitations were identified in both the application and the hardware used. The foremost limitation was the visual clarity of the pass-through feature on the Meta Quest 2 headset. In addition to the absence of color pass-through, the real-time view of the user's surroundings often exhibited blurriness and lacked clarity. This limitation negatively impacted the overall realism and visual quality of the augmented reality experience.

Another notable limitation pertained to the latency of the hand tracking functionality. Despite the application and hardware's ability to effectively track the user's hand movements and recognize various hand poses, there was noticeable latency in the hand tracking response. This latency introduced a slight delay between the user's hand movements and the corresponding manipulation of virtual objects, leading to a somewhat frustrating user experience.

However, the most significant limitation revolved around object occlusion. The inability of virtual objects to appear realistically behind real-world objects posed a substantial drawback, diminishing the overall authenticity of the application. Addressing this limitation would necessitate users to manually scan their surroundings and construct a 3D model of their environment to implement object occlusion. While this solution could potentially alleviate the limitation, it would place an additional burden on users and introduce complexity to the application.

In summary, the evaluation of the developed mixed reality application revealed notable limitations. The visual clarity of the passthrough feature on the Meta Quest 2 headset was compromised, and there was observable latency in the hand tracking functionality. Moreover, the absence of object occlusion significantly detracted from the realism of the application. Despite improving upon some limitations of phone or tablet-based augmented reality furniture placement by creating a more immersive experience, the application fell short in providing a highly realistic representation, particularly without the incorporation of object occlusion.

5 FUTURE WORK

Continuing the development of this application to improve the occlusion and enhance the realism of the mixed reality experience would require the implementation of a robust environment scanning feature. By incorporating a mechanism that allows users to manually scan their environment, the application can generate an accurate 3D model of the physical space. This scanning process would involve capturing and inputting the dimensions of the room and selecting an anchor point to align the virtual objects with the real-world environment. With this information, the application can intelligently render virtual objects to properly occlude physical objects, creating a seamless integration between the virtual and real elements. By investing in advanced computer vision techniques and integrating depth sensing technologies, this application can ensure accurate spatial understanding and occlusion, ultimately delivering a more convincing and immersive mixed reality experience for users.

6 CONCLUSION

In conclusion, the development of the mixed reality furniture application showcased the potential of augmented reality in revolutionizing the way consumers visualize and assess furniture within their homes. While the application provided users with the ability to select and place virtual furniture using hand tracking, several limitations were identified. These included the visual clarity of passthrough on the Meta Quest 2 headset, the latency of hand tracking, and the absence of object occlusion. To overcome these limitations and further advance the application, future development efforts should focus on improving occlusion to enhance the overall realism of the mixed reality experience.

To achieve this, implementing a robust environment scanning feature would be essential. By enabling users to manually scan their surroundings and input room dimensions, along with anchoring the 3D model to a specific point, virtual objects can be accurately positioned and occluded by physical objects. This would require leveraging advanced computer vision algorithms and depth sensing technologies to ensure accurate spatial understanding and seamless integration between the virtual and real environments.

Continued research and development in the field of augmented reality can contribute to creating more immersive and realistic mixed reality experiences. Overcoming the limitations identified in this project would lead to enhanced user experiences, empowering consumers to make informed decisions about furniture purchases with confidence. The potential for augmented reality in the furniture industry is vast, and further advancements in hardware and software will undoubtedly shape the future of how consumers interact with and visualize furniture within their living spaces.