'Ghadi' - A 3D Watch Customizer with Augmented Reality

Girban Adhikari\(^1\), Jivan Acharya\(^1\), Arjan Sapkota\(^1\), Subarna Ghimire\(^1\), and Umesh Kanta Ghimire \(^1\)

\(^1\)Affiliation not available

May 20, 2024

Abstract

In response to the growing demand for personalized online shopping experiences, the primary goal of this initiative is to provide users with an engaging platform to customize wrist watches before making purchase decisions. This project introduces an advanced 3D Watch Customization application that seamlessly combines the capabilities of Unity for 3D rendering and for an interactive user interface. Leveraging Unity's powerful 3D rendering, the app allows users to explore an extensive collection of watch models recreated in three-dimensional space. Through an intuitive Unity-based interface, customers can personalize various watch aspects, such as dial design, strap material, and case finish. A standout feature of the app is the incorporation of AR technology, allowing users to visualize their customized watches in real-world contexts. By utilizing device cameras, users can superimpose the virtual watch onto their wrists, offering a realistic preview of how the customized timepiece will appear and fit. This AR functionality seamlessly integrates into the application, enhancing the overall user experience and instilling confidence in the purchase decision.

Introduction

The 3D Watch Visualizer App 'Ghadi', an interactive mobile application, constructed on the sturdy Unity game engine, revolutionizes the online watch shopping encounter. Even in the context of Nepal as well as globally, the concept of product visualization, immersion and try-on is limited and inadequate. The use of AR/VR and mixed reality has transformed businesses and products all around the world. This advanced platform not only redefines the conventional online watch shopping experience but also elevates it to unprecedented levels. Providing an immersive and interactive environment, our app empowers users to engage in real-time customization of intricately detailed 3D watch models. This revolutionary approach enables users not only to explore and adjust but also to vividly visualize their envisioned timepieces with unmatched realism, marking the advent of a new era in personalized and visually captivating online watch retailing.

The project aims to implement a customization feature set, to modify dial, strap, needle and body of watch in real-time 3D environment and to implement AR after customization to visualize the customized watch on the wrist of the user.

The motivation behind developing our 3D Watch Visualizer and Customizer App stems from a vision to revolutionize the online watch shopping experience. In a digital age where customization and immersive interactions are increasingly valued, we recognize the need for a platform that seamlessly blends cutting-edge technology with the world of luxury watches. We aim to provide users with a unique and engaging space to explore, customize, and visualize high-fidelity 3D watch models in real-time. Our motivation lies in creating a user-centric, visually rich, and interactive environment that not only meets but exceeds the
expectations of modern consumers, offering them an unparalleled and personalized journey in the realm of luxury timepieces.

The deficiency in the current online shopping landscape lies in the lack of immersive and personalized experiences, resulting in a noticeable gap between consumers and the luxury watch market. Conventional platforms fail to provide real-time customization and interactive exploration of high-fidelity 3D watch models. This existing challenge emphasizes the necessity for a solution to redefine the user experience. The problem to be addressed revolves around the absence of a platform that seamlessly incorporates advanced technologies, enabling users not only to explore but also to dynamically customize and visualize their preferred timepieces within a realistic 3D environment. Resolving this gap would not only bridge the disconnection between consumers and the luxury watch market but also establish a new benchmark for online watch shopping, offering users a personalized and visually immersive experience.

This project encompasses the creation of a versatile 3D Watch Visualizer and Customizer App, with applications spanning the domain of online luxury watch retail. The primary objective is to offer users an unprecedented level of customization, enabling real-time modifications to key elements like watch faces, straps, and colors within a realistic 3D environment. The project establishes a new benchmark for personalization and engagement in the luxury retail sector.

BACKGROUND AND RELATED WORK

Over the last two decades, there has been a notable surge in the exploration of 3D visualization and virtual reality (VR) applications within discrete-event simulation (DES) contexts. Despite ongoing debates about the necessity of transitioning from traditional 2D interfaces to 3D environments, numerous studies have delved into the comparative advantages of these technologies. A comprehensive meta-analysis of 162 previous publications sheds light on the impact of 2D versus 3D/VR displays on user performance in DES tasks. Contrary to prior beliefs, findings indicate that 3D and virtual reality often lead to superior outcomes, including better performance and the creation of higher-quality models during development stages. Additionally, in terms of model validation and verification, 3D/VR displays consistently outperform their 2D counterparts. While it may take longer to construct models in 3D/VR environments, this investment is offset by reduced time requirements for experimentation, validation, verification, and result analysis. Moreover, the study suggests that the efficacy of 3D/VR displays in DES tasks remains consistent across various application domains and problem characteristics (Akpan, 2019).

Meanwhile, addressing the under-utilization of depth data in augmented reality (AR) applications, a cutting-edge software library known as DepthLab has been introduced. This innovative suite offers a wide array of depth-related UI/UX features, including geometry-aware rendering, depth-interacting behaviors, and visually captivating effects. By deconstructing the utilization of depth maps into distinct categories and providing real-time methods for each use case, DepthLab aims to centralize and expedite the creation of interactive depth features. Furthermore, by collaborating with external engineers and open-sourcing the program, the creators of DepthLab aim to empower mobile augmented reality developers to enhance their prototyping efforts and seamlessly integrate depth into their experiences (Du, 2020).

In the realm of AR technology, ARCore stands out as a pioneering platform that leverages the capabilities of smartphone cameras and motion tracking to create immersive experiences. By detecting features and tracking their movements over time, ARCore enables precise positioning of virtual content within real-world environments. This capability allows users to seamlessly interact with virtual objects, annotations, and other content, enhancing the overall AR experience (Developers, 2023).

In 1963, Ivan Sutherland developed Sketchpad, an interactive drawing program that revolutionized commu-
nication between individuals and computers by enabling direct conversation through line drawings. Unlike traditional methods reliant on written statements, Sketchpad facilitated real-time discussions without extensive typing, particularly beneficial for conveying complex information like mechanical part shapes or electrical circuit connections. This novel approach prioritized line drawings over typed statements, opening new possibilities for man-machine interaction (Sutherland, 1963).

Sutherland’s groundbreaking work extended beyond Sketchpad; he also created the first head-mounted display system in 1966. Collaborating with David Evans from the University of Utah’s Computer Science Department, Sutherland co-founded E & S in 1968. Initially focusing on hardware production, particularly frame buffers, the company thrived as graphics usage expanded in the early 1970s. Despite Sutherland’s departure in 1975 and Evans’ retirement in the early 1990s, E & S remains a prominent provider of equipment and expertise in various graphics sectors, supplying training simulators for military and commercial applications, and serving planetariums and interactive theaters (Sutherland, 1968).

IKEA Place exemplifies the convergence of cutting-edge technology and retail, offering customers an unparalleled shopping experience through augmented reality. By leveraging Apple’s ARKit technology, IKEA Place allows users to visualize furniture and decor within their own living spaces with remarkable accuracy. The app’s lifelike representations and precise scaling capabilities ensure that users can confidently make informed purchasing decisions, enhancing convenience and personalization in the retail experience (S, 2018).

**SYSTEM ARCHITECTURE AND METHODOLOGY**

![Top Level System Architecture](image)

The user opens the Unity application. The app retrieves the material and color data of the 3D model. The Unity application starts the AR session and superimposes the 3D model of the watch onto the user’s real-world environment. The user can tap the "View in AR" button to see the AR scene. The user can tap the "Customizer" button to customize the appearance of the watch.
Scene Loader

Figure 2: Scene Loader
The scene loader is responsible for initiating and managing the 3D scene within the watch customizer. It sets up the foundational 3D environment where the watch model will be displayed by establishing the camera position and rendering setting. It also positions the light sources with their predefined intensity and target setting to illuminate the watch model effectively and clearly. Now it loads the watch model in the scene and enables users to examine the watch from different angles by implementing orbit controls.
Customizer

User

Watch Selection

Select Component

Select Material

Customize Color

View in AR
The customizer is a key component of our app that incorporates the scene loader presenting the 3D watch model in a customizable environment. By examining the user preferences, including dial design, strap material, and case finish, we allow users to select from a palette of colors and library of materials to apply to various watch elements offering a visual preview of changes in real time. It also generates the metadata for sharing and exporting the customized design for AR model conversion. Its functionalities are to allow users to personalize and modify the visual appearance of the wrist watch by offering options to adjust colors and materials within the customizer scene and interact with the scene loader to implement changes.

The user interacts with the app through their mobile device. The user selects a watch model from a library of options through a dropdown menu. The user can then select different components of the watch to customize, such as the watch body, strap, dial, and needle. The user can choose different materials for each component, such as different metallic, rubber, and matte. Once the user has finished customizing their watch, they can tap the "View in AR" button to see how it would look in the real world using augmented reality.
AR Viewer

User - This refers to the individual using the application. They’ll need a smartphone or tablet equipped with a camera and the app itself. The smoothness of the application depends on the generation of the smartphone used and its specifications.

Image Target - Image Targets represent images that Vuforia Engine can detect and track. This is a specific image that the Vuforia software recognizes as a reference point for augmenting the 3D model. The images are referenced from an image dataset in the developer portal on the Vuforia development site. This image database is added into the Unity application.

View In AR - This button triggers the AR experience to begin. Once tapped, the app activates the device’s camera and searches for the image target.
Check Camera Permission - This block ensures the app has permission to access the device’s camera. If not, it prompts the user to grant permission, this is generally asked on the application’s startup but in some devices it is prompted later on.

Open Camera - Upon granting permission or if it already has access, the app opens the device’s camera to scan for the predefined image target.

Detect Placement Marker - To determine the image target, the camera stream is evaluated. By comparing the retrieved natural features from the camera image with a known target resource database, the Engine is able to detect and track the image. Using the greatest image tracking technology available on the market, Vuforia Engine will monitor the image and seamlessly augment the watch once it has been recognized.

Get Scene Depth - With the image target detected, the app retrieves depth information from the camera to establish a realistic spatial positioning for the 3D model based on the tracking information of the image target.

Dynamic Material Instantiation - This step involves generating a material (material and color) for the 3D model based on the passed data from the customizer scene of the application. The different portions of the watch such as body, strap, etc. when assigned different colors and materials need to be passed to the AR scene for syncing them. This could create a more immersive experience by adapting the watch’s appearance to the lighting and surroundings.

Assign Material - The generated material is applied to the 3D watch model.

Show AR Model - The 3D watch model, now textured and positioned accurately based on the image target and scene depth, is displayed on the camera screen, augmenting the user’s real-world view.

End AR Session - When the user exits the AR experience, this block ends the camera session and removes the 3D model from the view.

Take Snapshot - This button allows the user to capture a still image of the AR scene, including the 3D watch model and the real-world background. This allows users to save and capture the virtual experience and different versions of the watches into the device memory.

Adjust Watch Size - This functionality enables the user to resize the 3D watch model to their preference within the AR scene, making the experience more user engaging.

**Implementation Details**

**Modeling and Texture Mapping**

The 3D watches are modelled in an open-source 3D modelling and animation software 'Blender'. The required meshes for the watch are modelled separately and joined together. Other watches are downloaded from the web and changes are made on the watches for visual and performance improvements. The different components of the watch i.e. the body, strap, needle and dial are separated so that they don’t interfere in the customization of each other in the application. They are then given the same origin point and exported as .fbx file to Unity. The textures are imposed on the watches and corresponding materials are introduced which are different for every component of the watch. Materials added to the different components are transferred to unity which are then made accessible to the user for tweaking the RGB values. The watches are mapped to the textures to ensure proper alignment of the textures with the corresponding components of the 3D watch. The components are then decimated so as to increase AR performance. Decimation iterations are limited as heavy decimation may increase visual disruptions and anomalies. The 3D watches are then exported to Unity after applying the added modifier tools like Decimation, Mirroring and Subdivision.
Unity

Unity Engine empowers Android app development, facilitating interactive 2D, 3D, and VR experiences. With its robust UI, users can customize watches seamlessly, adjusting features via interactive components like sliders and buttons linked to 3D models. Users customize watch parts with unique colors, ensuring visual accuracy. Unity optimizes app performance on Android, integrating smoothly with Vuforia for AR features. AR targets link to specific watches, viewed through Unity’s camera system for an immersive experience.

Unity Canvas and UI

Implementing UI in Unity involves setting up the canvas, organizing buttons and sliders, and designing layouts for user-friendly navigation. Dynamic customization requires UI elements to adapt in real-time to user interactions, ensuring engaging interactivity through Unity’s event system. Setting the render camera to Canvas Camera in Unity displays an orthogonal camera for the UI canvas, separate from the watch model view. This enables perspective adjustments without affecting the watch view, ensuring compatibility across mobile screens with a dynamic canvas size referencing 1920x1080 resolution.

Unity XR Tech Stack

![Unity XR Tech Stack Diagram]

The Unity XR tech stack is a set of tools and technologies that enable the development of virtual reality (VR), augmented reality (AR), and mixed reality (MR) applications within the Unity game engine. It involves deep platform integration, engine improvements, and XR tech stack optimizations for each platform. The XR tech stack includes the XR Interaction Toolkit, which is a high-level, component-based system for creating VR and AR experiences, providing a framework for 3D and UI interactions, cross-platform XR controller inputs, haptics, visual feedback, basic canvas UI, and more. Unity’s XR platform offers a new architecture and custom resources to bring immersive visions to life, with tools purpose-built for AR development. In general, XR covers the hardware, software, methods, and experience that make VR, AR, MR, and other...
related technologies a reality, and Unity’s XR tech stack is designed to support the development of these immersive experiences.

**Color Picker**

The Color Picker offers an intuitive interface for real-time color selection in projects, from UI components to 3D models. Users navigate hues and saturation levels effortlessly, with selected colors updating dynamically. Behind the scenes, the Color Picker’s ColorData class ensures global access and seamless integration. Encapsulating complex logic, the Color Picker promotes code reusability and enhances user experience, empowering creative control over color customization in Unity projects.

**Result and Analysis**

The project has effectively implemented the customizer and AR viewer functionalities within Unity, offering users an immersive experience for customizing and viewing watches in augmented reality.
Figure 6: Customizer
Here are the key outcomes and analysis of the project:

Firstly, the customizer feature provides users with a seamless experience to modify various aspects of the watch, including color, texture, and design, all through an intuitive user interface embedded within Unity. The integration of customization controls ensures easy manipulation of watch attributes, thereby enhancing user engagement and satisfaction. Moreover, the AR viewer component delivers a realistic representation of the customized watches on users’ wrists, leveraging Unity’s 3D rendering capabilities and augmented reality technology. Users can visualize the watches in diverse environments and lighting conditions, enriching the overall viewing experience and providing a more immersive interaction.

One notable achievement of the project is the implementation of dynamic watch models that can adapt to different customization options. This flexibility empowers users to create personalized watches that align with their individual preferences and style, thereby enhancing the appeal and utility of the application. Furthermore, the interactive user interface embedded within Unity facilitates seamless interaction with the customization controls and AR viewer, enabling users to effortlessly navigate between customizing the watch and viewing it in augmented reality. This ensures a smooth and intuitive user experience, which is crucial for user satisfaction and retention.

Conclusion

In conclusion, the completion of this project signifies a significant achievement in providing users with an interactive and personalized experience in the realm of watches. It showcases innovation and collaboration, aiming to enhance user satisfaction. The success of integrating these features highlights its ability to deliver captivating experiences. Future enhancements such as database integration and social media features promise further growth. From the user-friendly interface to the seamless integration of dynamic watch models, every aspect of the application has been carefully crafted to ensure a seamless and immersive experience for users. As users continue to explore, customize, and exchange their watch designs, the project’s influence will extend beyond its digital confines, making a lasting impact on the world of watches and beyond.

ACKNOWLEDGEMENT

We extend our heartfelt appreciation to the Department of Electronics and Computer Engineering for granting us the invaluable opportunity to pursue research in this field and for their unwavering support throughout the duration of this project. Their guidance, motivation, and provision of necessary resources have played a pivotal role in the successful execution of our research. We are deeply grateful for their continuous encouragement and assistance, which have been instrumental in our exploration and advancement of this topic.

References


Head-mounted three dimensional display. (1968). *Proceedings of the November 4-7, 1968, Fall Joint Computer Conference (AFIPS ’68).*