Capstone Project: VisionARy

Augmented Reality Solution to Online Shopping Issue

Anush Ghazaryan, Linda Sargsyan

Department of Computer Science, American University of Armenia

CS296: Capstone

Arman Atoyan, Artyom Arshakyan

May 20, 2023

Abstract

It's 2023, and it seems that the future has already arrived. Technologies that people once only dreamed of are now widely accessible to everyone. Currently, only 1% of retailers are using AR or VR (Virtual Reality) in their customer buying experience. (THREEKIT INC., 2022)

Over the last few years, Augmented Reality has become a popular tool used in many different fields. Various apps integrating AR, such as *Snapchat* (Shepherd, 2023) and *Pokémon Go* (Krawanski, 2023), have gained immense popularity in the last decade. Lately, AR use has been growing in the fashion industry and online shopping (Boiko, 2022). Various clothing and accessories brands have been integrating AR into their websites and applications to improve the online shopping experience.

AR's vast potential can be used to offer innovative solutions to various problems in the field of online shopping. Therefore, we decided to learn more about it by creating an AR application for our capstone project. It is quite simple. It contains a list of sunglasses and eyeglasses that the users can try on. By clicking on any of them from the list, a page will open with more detailed information about the item. Finally, by clicking the *Try On* button there, users can try the glasses on. Because of time and skill boundaries, the app only includes these items. However, it can be expanded in the future to incorporate other clothing items and accessories as well.

We used Unity to develop our app. To create the AR experience in our project, we used 3D models from the website called Sketchfab.

Table of Contents

Introduction

Augmented Reality is a technology that overlays computer-generated objects in a real-world environment (Hayes, 2023). It has multiple use cases in various fields, such as entertainment, fashion, education, online shopping, etc. (Hayes, 2023). It has already been successfully implemented in these different industries. For example, *Ikea* has introduced an AR-integrated app, which allows customers to place true-to-scale 3D models of furniture from their store in a room (Carter, 2021). Moreover, *Google Arts & Culture* app allows users to view some of the art pieces and cultural artifacts available there with AR (Google, 2015). Augmented Reality has gained immense popularity, especially in the last decade. Examples of popular apps are *Snapchat* (Shepherd, 2023) and *Pokémon Go* (Krawanski, 2023), both of which serve the purpose of entertainment. For this project, we have concentrated on AR used in fashion and online shopping.

E-commerce has become an essential component of global shopping in recent years (Pasquali, 2023). The number of people shopping online keeps increasing worldwide, as it is an ever-growing industry (Pasquali, 2023). However, despite its convenience and other benefits, it has some limitations. For instance, the most obvious one is that customers are not able to see and touch the actual products they are purchasing (Boiko, 2022). This can be a problem specifically while purchasing accessories and clothes. The chosen items might not have the right fit or the desired quality and end up being a waste of money or returned by the customers (Boiko, 2022). Augmented Reality, however, brings innovative solutions to these problems. It allows the customers to “try on” the products before purchasing them and get a good sense of how they will fit them (Boiko, 2022). As of right now, it has its own limitations. First of all, we cannot sense the quality of the product we are purchasing. Also, the fit of the true-to-scale 3D model of an

item might not be very accurate. Despite these restrictions, however, AR enhances the customers' experience and makes online shopping more effective by helping them make better decisions (Boiko, 2022).

As mentioned above, the focus of our capstone project is the use of Augmented Reality in online shopping. Therefore, our aim was to create an Augmented Reality system that would allow users to try on various accessories and clothing items. However, because of time and skill boundaries, we managed to include only the functionality of trying on sunglasses and eyeglasses. Additionally, we created a dummy app and integrated AR into it to simulate an online shopping environment and experience.

Development Details

Necessary Tools and Packages for AR Development

We have used Unity, a 3D development platform, to create all the AR applications in the scope of our capstone project, including the final product. There are some packages that are needed for AR development, such as *AR Foundation, ARKit Face Tracking, and ARKit XR Plugin/ARCore XR Plugin, XR Plugin Management*. We have built our application for iOS devices since the Android ones were not always available for testing the product. However, our app is multiplatform and works fine on both iOS and Android.

AR Foundation allows one to work with augmented reality platforms in a multi-platform way within Unity (Unity, n.d.). This package presents an interface for Unity developers to use but doesn't implement any AR features (Unity, n.d.). To use *AR Foundation* on a target device, we need to install additional packages that are platform-specific for the device and support AR

features (Unity, n.d.). Our application's target platform is iOS. Therefore, we installed the *ARKit XR Plugin* package, which supports Device localization, Horizontal/Vertical plane detection, Light estimation, Image/Object tracking, etc. (Unity, n.d.).

ARKit Face Tracking implements the face tracking subsystem defined in the AR Subsystems package (Unity, n.d.). This package provides additional face-tracking functionality that is specific to *ARKit* (Unity, n.d.). Face tracking requires the use of the front-facing or "selfie" camera (Unity, n.d.). When the front-facing camera is active, other tracking subsystems like plane tracking or image tracking may not be available (Unity, n.d.). If the rear-facing camera is active, face tracking might not be available (Unity, n.d.). To use this package, one must have an iOS device capable of performing face tracking (Unity, n.d.). We need iOS 11.0 or later as well as Xcode 11.0 or later versions (Unity, n.d.).

XR Plugin Management package helps streamline XR plug-in lifecycle management and potentially provides users with build time UI through the Unity Unified Settings system (Unity, n.d.).

Any AR session must contain an *ARSession* component, which is a Class (Unity Learn, n.d.). This can be done by adding an *AR Session* GameObject (GameObject > XR > AR Session) to the scene to which the necessary component is already attached (Unity Learn, n.d.). This component controls the lifecycle of an AR experience, enabling or disabling AR on the target platform (Unity, n.d.). Without this, the application would not be able to track any features in the environment (Unity, n.d.). The Scene also needs to have an *AR Session Origin* GameObject (GameObject > XR > AR Session Origin) with the *ARSessionOrigin* component Class attached to it (Unity Learn, n.d.). It contains a Camera and any GameObjects created from detected features, such as planes or point clouds (Unity, n.d.). The purpose of the *ARSessionOrigin* is to

convert the session space to Unity world space (Unity, n.d.). To facilitate this, *ARSessionOrigin* creates a new GameObject called *Trackables* as a sibling of its Camera (Unity, n.d.). This should be the parent GameObject for all detected features (Unity, n.d.).

For face tracking, we need to add an *ARFaceManager* script that comes from the *AR Foundation* interface (Unity, n.d.). The face manager creates GameObjects for each face detected in the environment. The system only detects human faces (Unity, n.d.).

Faces can be added, updated, and removed (Unity, n.d.). Once per frame, if the application detects a face, the *AR face manager* invokes the face's changed event (Unity, n.d.). This event contains three Lists of faces that have been added, updated, and removed since the last frame (Unity, n.d.). When a face is detected, the *AR face manager* instantiates the Face Prefab to represent the face (Unity, n.d.). The Face Prefab can be left null, but the face manager ensures the instantiated GameObject has an *ARFace* component on it (Unity, n.d.). The *ARFace* component only contains data about the detected face (Unity, n.d.).

For Face Prefab, we have used *AR Default Face* (GameObject > XR > AR Default Face) (Unity, n.d.). The *AR Default Face* Prefab renders a default material on detected face meshes (Unity, n.d.). We have used this prefab as our base face to put glasses on (Unity, n.d.). More details about the project are in the following sections.

The Development Of Our Project

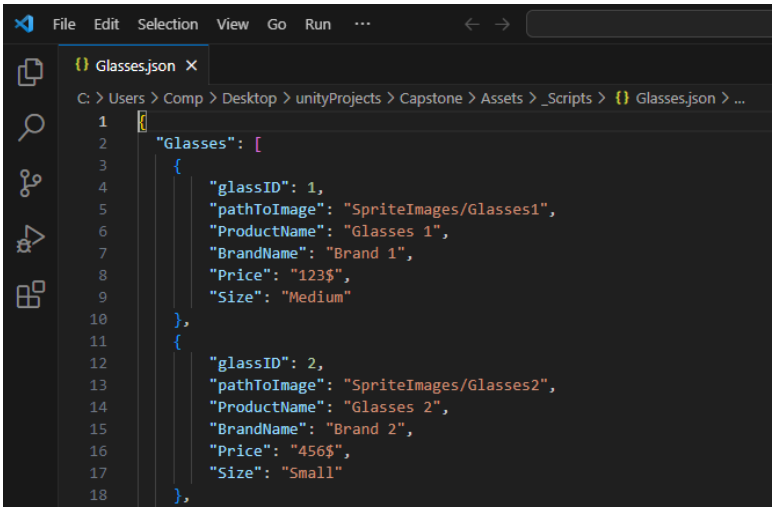
As mentioned earlier, our project is an AR application that allows users to try on virtual sunglasses and eyeglasses. The versions of the Editor used are Unity 2021.3.16f1 and Unity 2021.3.7f1. After creating all the necessary components discussed above in the scene, we needed to get 3D models of glasses to try on. We downloaded several 3D models from a website called *Sketchfab*. Before creating the actual project in mind, we practiced face tracking by following one of the *UnityLearn* tutorials for creating face filters. This way, we got more familiar with the technology. Furthermore, we used a prefab from one of the assets (Basic_Face_Filter_Assets) provided by the tutorial to build our current project. That prefab is Face_Reference_Mesh which we added under *AR Default Face* to have a reference face for putting the glasses on. The reference mesh is only needed for development purposes, and it is disabled throughout the whole working session of the application.

As mentioned in the introduction, for a better experience, we added UI to our project. We created a Main menu that contains a scrollable list of glasses for users to try on.

After clicking any of the glasses, a page opens with more details about the product, such as the name, the price, etc. On this page, a Try On button can be found, which opens a front camera for users to see how the object looks on their faces.

We have created a .json file for keeping detailed information about the glasses.

Each object contains a unique ID. Every one of the glasses from the list on the Main menu is a button. When clicked, it invokes a function that fetches the information of the corresponding object and displays it on the detailed page.



We have two implementations for the application. In the first one, the UI and the AR-related components are in one scene. When the application is running, corresponding panels are enabled and/or disabled after each action. When the *Try On* button is clicked, *AR Face Manager* from *AR Session Origin* becomes enabled. After going back to the detailed page, it gets disabled. In the second implementation, AR-related components are placed in a different scene from UI (Main Menu and Detailed page). Hence, the Try On button changes the scene to open the AR functionality. After building the two versions of the application, we observed that the change from one page to another happens faster in the first one than in the second implementation.

Comparisons With Another Project

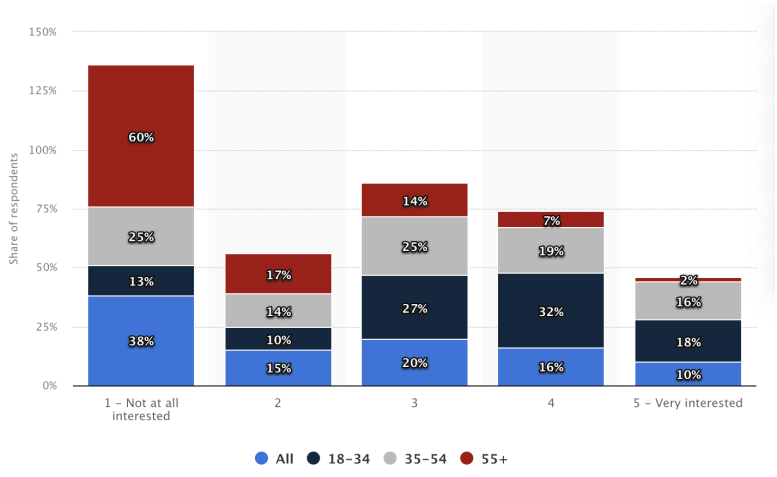
There are other applications that already have the functionality of virtual try-on. Among them is *Lavates* created by ARLOOPA Inc. *Lavates* is the first app in Armenia that allows customers to try on optical products virtually before purchasing them. The UI of our application

is inspired by theirs (in terms of the main menu and the detailed page). However, in contrast to our project, *Lavates* is a fully developed app with advanced features.

One of the significant differences between both applications is the method used for fitting the glasses. As discussed in the development details section, we used a face reference mesh. We manually fitted the glasses on the face. In contrast, *Lavates* developers extracted the indexes of the points from the AR face prefab and chose three of them: the approximate point on the nose bridge and the two temples on each side of the face. This way, the fit of the glasses is more accurate than fitting them on a face manually. Our version is simpler to implement if the project scope is small, like ours. However, adding new glasses to the project would be time-consuming.

Target Audience of the Application

The target audience of our application is people who constantly shop online and have compatible devices for face tracking. Moreover, in the chart below, we can see that people aged 18-34 are most interested in AR (Alsop, 2023). Therefore, we can narrow the target audience down to people who are in this age group and correspond to the characteristics mentioned above.



Interest in augmented reality (AR) in the United States as of October 2022, by age

Improvements For The Future

Our project is the smaller and simpler version of the final idea we had envisioned. There are numerous improvements that can be made in the future. The first one to mention is the method of fitting the glasses. In the current implementation, as discussed previously, we did this manually, which will be a problem when expanding the size of the project. Doing this by a script would be a more optimal and accurate solution. Moreover, to get a better user experience, we can integrate our AR solution into a fully developed application with user login, UI features, purchasing capability, and much more. For the future, to create an app that we envisioned in the beginning, we need to add a body tracking feature as well to be able to include other clothing items and make online shopping a fun experience.

Conclusion

One of the issues connected with online shopping is the inability to try on clothing items and accessories before purchasing them. This usually results in money waste and/or product returns, consequently affecting both the customers and businesses (Boiko, 2022). Augmented Reality brings a new perspective to customer experience and engagement. This technology enables users to virtually try on products before making the decision to buy them. With VisionAry and similar applications, the mentioned problem can be solved, thus helping the decision-making process of the customers.

References

1. *23 augmented reality statistics you should know in 2023*. 3D Product Configurator & Augmented Reality For Commerce. (2022, THREEKIT INC.). *https://www.threekit.com/23-augmented-reality-statistics-you-should-know-in-2023*
2. *Arkit vs Arcore: Which development kit is best for building augmented reality apps?*. Modelry. (2022, March 3). https://www.modelry.ai/blog/arkit-vs-arcore
3. Unity. (n.d.). *About Arkit face tracking: Arkit face tracking: 4.2.7*. Unity. https://docs.unity3d.com/Packages/com.unity.xr.arkit-face-tracking@4.2/manual/index.html
4. Unity. (n.d.-b). *About Arkit XR plug-in: Arkit XR plugin: 4.2.7*. Unity. https://docs.unity3d.com/Packages/com.unity.xr.arkit@4.2/manual/index.html
5. Unity. (n.d.-a). *About ar foundation: Ar Foundation: 4.2.7*. AR Foundation | 4.2.7. https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.2/manual/index.html
6. Unity. (n.d.-c). *About Arkit XR plug-in: Arkit XR plugin: 4.2.7*. Unity. https://docs.unity3d.com/Packages/com.unity.xr.arkit@4.2/manual/index.html
7. Unity. (n.d.-e). *AR session component: AR Foundation: 5.1.0-Pre.4*. Unity. https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@5.1/manual/features/session.html#:~:text=A%20session%20refers%20to%20an,tracks%20features%20in%20its%20environment
8. Unity. (n.d.-f). *Class arsessionorigin: Ar Foundation: 4.2.7*. Unity. https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.2/api/UnityEngine.XR.ARFoundation.ARSessionOrigin.html#:~:text=The%20purpose%20of%20the%20ARSessionOrigin,GameObject%20for%20all%20detected%20features
9. *About the XR plugin management package: XR Management: 3.0.6*. Unity. (n.d.-a). https://docs.unity.cn/Packages/com.unity.xr.management@3.0/manual/index.html
10. *Sketchfab Search*. Sketchfab. (n.d.). https://sketchfab.com/search?features=downloadable&q=glasses&type=models
11. *Create a basic face filter*. Unity Learn. (n.d.). https://learn.unity.com/project/create-a-basic-face-filter-tutorials?uv=2021.3&courseId=6346b7e5edbc2a7caec0f8fc
12. Alsop, T. (2023, March 23). *Augmented reality (AR) interest in the U.S. 2022*. Statista. https://www.statista.com/statistics/1200827/augmented-reality-interest-in-the-united-states/#:~:text=In%20the%20United%20States%2C%20a,were%20very%20interested%20in%20AR
13. Boiko, O. (2022, May 16). *Augmented reality (AR) in fashion - everything that you need to know*. WeAR. https://wear-studio.com/augmented-reality-for-fashion-industry-whats-new/#:~:text=AR

%20clothes%20provide%20more%20understanding,are%20made%20with%20more%20confidence

14. Pasquali, M. (2023, February 27). *Topic: E-commerce worldwide*. Statista. https://www.statista.com/topics/871/online-shopping/#topicOverview
15. Shepherd, J. (2023, May 15). *24 essential snapchat statistics you need to know in 2023*. The Social Shepherd. https://thesocialshepherd.com/blog/snapchat-statistics#:~:text=Snapchat%20Has%20363%20Million%20Daily%20Active%20Users%20Worldwide&text=This%20is%20an%20increase%20from,2021%2C%20which%20had%20306%20million.
16. Krawanski, F. (2023, May 3). *How many people play pokemon go? pokemon go player count*. Dexerto. https://www.dexerto.com/pokemon/how-many-people-play-pokemon-go-pokemon-go-player-count-2132719/
17. Carter, R. (2021, December 7). *IKEA Place Review: IKEA's Arcore App*. XR Today. https://www.xrtoday.com/augmented-reality/ikea-place-review-ikeas-arcore-app/#:~:text=IKEA%20Place%20Review%3A%20Verdict,buy%E2%80%9D%20mentality%20of%20digital%20shopping.
18. Google. (2015, December 1). *Google Arts & Culture*. App Store. https://apps.apple.com/us/app/google-arts-culture/id1050970557