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Augmented Reality based Interior Designing Applications

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Abstract – This paper studies the evolution of the augmented reality and the changes that this technology is going to bring in fields like interior designing. Imagining how a piece of furniture would look like in a given space has always been a barrier for the consumers and interior designers. We may now have a feasible solution to this inconvenience with the help of augmented reality. Through augmented reality we can now offer services that retailers and consumers could not imagine 10 years ago. As augmented reality becomes more mainstream because of its recent integration into smartphones, the market for augmented reality applications has evolved and a lot of companies have started picking up on this. In this article we are going to look at augmented reality based interior designing applications that already exists like the IKEA Place application and the Houzz application and also give a brief overview of a similar application that we built with some useful added features.

Keywords — Augmented Reality (AR), Interior designing, AR Core, Sceneform tools, Android applications.

I. INTRODUCTION

Augmented reality is a technology that allows us to place a virtual 3D object on our screen and look at it as an enhanced version of the real physical world. It overlays digital content and information onto the physical world. Augmented reality has a lot of potential to improve the quality of our day-to-day lives. It is a constantly evolving technology which already has a lot of practical applications like Education, Healthcare, Navigation Systems, Tourism, Public Safety and even Gaming. In this article, we are going to emphasize on the role that it could play in the field of interior designing.

We have created an android application that allows users to place a 3D object of a furniture in a room. We have used AR core as a platform of our application to build our augmented reality scene and used Sceneform tools to work with the 3D models. In this paper we will be comparing various application available and also be looking at future scope of augmented reality in this field.

II. EVOLUTION OF AUGMENTED REALITY

Augmented reality was developed by Ivan Sutherland (named the "father of computer graphics") in 1968 at Harvard. He created an AR head mounted display system. 40 years later, we got the first commercial use of AR. MINI, a car manufacturer in Germany designed a printed magazine advertisements for one of its cars. When this printed paper was held in front of a computer screen, the users were able to see the car on the screen and they were able to view different angles of the car just by moving the paper.

Figure No. 1 First Commercial use of AR in advertising

Soon after this release, other brands started picking up on this innovative idea of advertisement. This became a popular trend in the early 2010s for products like watches, jewelry and cloths. Augmented reality allowed users to try on a product virtually. Holition, an AR agency, developed a smart mirror which allowed users to virtually try on makeup on themselves in real-time. The same AR agency has recently developed an application which allows users to scan the makeup of a person via an image and then try on the same makeup on themselves. Google's "google translate" also makes use of AR in a very creative way by letting users point the camera at any text like on a road sign or a restaurant name. The application then uses Augmented reality to replace the original text with the translated text on the screen itself.

Just 10 years ago Augmented reality was a technology that was only limited to research labs at universities with high end equipment and professionals to handle the

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technology. But due to the capabilities of modern smartphones and tech companies like Apple and Google making it easier for developers to develop AR based application on IOS and android, we have just started to see how much AR can impact our day-to-day lives.

III. CREATING AN AR SCENE

Augmented reality can be displayed on a variety of devices like smart glasses (google glass), headsets like HMD glasses, heads-up displays that we see on cars or on helmet visors and also smartphones. But to create an AR scene we first need augmented reality SDKs like ARKit, ARtoolkit, AR core, Vuforia etc. To create an AR scene, we first need to use computer vision to scan and understand the world around the user via a camera. Humans are extremely good at understanding images but we need computer vision for a computer to understand the world around the user in terms of semantics and 3D geometry to create an accurate AR scene. We use semantics to scan and understand the objects in the environment and 3D geometry to understand where these objects will be placed.

Figure No. 2 Detecting flat surfaces

Without this, our 3D objects cannot be placed accurately on the virtual environment. Once our software has used computer vision to understand the surrounding environment, digital content like 3D objects can be placed in a realistic way. In figure 2, you can see two applications using the augmented reality SDKs to detect flat surfaces. The image on the left in Figure 2 is an application called Homestyler and one on the right is the android application that we have developed. The software detects the flat surfaces and indicates the users that they can tap on the dotted area to place the 3D object. Once the object is placed, the user can move around the object to get a view from different angles. Augmented reality is a real-time feature so all of this has to happen every time the camera captures a new frame. Smartphones nowadays work at 30-60 frames per second so our software has to be able to do all of this in 30-60 milliseconds.

There are two main types of augmented realities i.e., marker based and markerless. Marker based AR uses image processing and Fiducial markers to identify objects that have been programmed in our AR software. Image processing is done in grayscale to get an optimal processing time. When it detects the marker (something like a QR code), the software uses the marker's information to create the AR scene by displaying the 3D object at the exact place. The problem with this type of augmented reality is that when the camera is moved away from the marker, the AR object disappears and the marker has to be scanned again for it to reappear. Also, the software would not be able to scan the marker if the marker reflects light in certain situations. Marker has to have a distinct contrast between black and white colors to make tracking possible. To overcome these issues, the industry is moving towards markerless augmented reality. Markerless AR makes use of camera systems, dedicated sensors, and algorithms to try to detect the real-world environment like walls, points of intersections by looking for patterns, colors and or other visual features that can be used. Basically, markerless AR displays digital content or virtual objects on a 2D image in real time. This method is easy to implement and it is a new way of creating an AR application for the best user experience.

We have used markerless AR in our application because modern smartphones have the processing power needed to run these types of applications.

IV. DEVELOPING AN AR APPLICATION

To develop an application that uses augmented reality, we need an augmented reality SDK that will allow us to create the AR scene. There are already a lot of companies offering AR SDKs that developers can directly integrate into their application. Since all the SDKs that we currently have available have been developed in the past decade, we are yet to see the different types of applications that can be created with these SDKs. Apple's ARKit SDK launched in 2017 allowed iOS developers to integrate augmented reality on their applications. ARKit used SLAM to perform space recognition and its main features are object detection, light estimation and uninterrupted AR experience through multiple sessions. Just a year later, Google launched ARCore which allowed android developers to build augmented reality-based Android applications. The key features that ARCore offered were motion tracking, environmental understanding, light estimation, user interaction, oriented points, anchors and trackable, augmented images, and sharing. Both of these SDKs were based on markerless augmented reality. The release of these SDKs meant that the developers of both operating systems could make the most use of the hardware on these smartphones to create AR mobile applications. Before the arrival of these SDKs, AR mobile application development required a deeply specialized set of skills.

ARCore and ARKit both are Unity framework-

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compatible, both have similar capability of sensing changes in lighting and accessing motion sensors. ARCore has been proven to be better that ARKit when it comes to mapping. ARCore has a larger mapping dataset that increases the speed of mapping the user's environment through the camera. However, ARKit is better than ARCore when it comes to recognition and augmentation. Marxent's MxT Tracking is another excellent SDK which helps AR mobile application developers. MxT Tracking uses a relative tracking approach. The tracking space is scaled based on an estimation of how user is standing or sitting with the software. MxT Tracking offers instant initialization compared to ARKit and ARCore. ARKit and ARCore are relatively slow at establishing a tracking plane and rendering a 3D object into the scene. MxT Tracking can also be paired with ARKit and ARCore. So, the developers can access each SDKs best parts to develop a quality application for the best user experience.

Since our project is an android application, we have used the ARCore SDK. ARCore requires 3 main technologies from the smartphones. First, it uses the accelerometers and gyroscopes on our phones to accurately estimate the position of our phone in relation to the world around it. Simultaneously, it uses the phone's camera to study the world around the user. The SDK is basically trying to find flat surfaces to place the virtual objects. Lastly, it tries to predict the lighting conditions to determine the lighting setting required to set on the virtual object for it to blend in with the environment.

V. AR MOBILE APPLICATIONS FOR INTERIOR DESIGNING

There are a lot of AR applications for Interior design but Houzz's "Houzz Interior Design Ideas" and IKEA's "IKEA Place" stand out for their user experience, AR scene quality and variety of 3D models to chose from. IKEA is one of the largest international furniture brand in the world and its effort to create an augmented reality application might really change the way people buy furniture forever. IKEA uses its wide range of furniture available to let users experiment with a variety of models and chose what suits them best.

Figure No. 3 IKEA Place application by IKEA

But the application has some drawbacks too. Despite the IKEA Place application having a lot more 3D furniture to choose from than its competitors, majority of users still complain about the lack of variety. Also, the application sometimes is not able to accurately scan the environment and it places the 3D objects at an incorrect angle or on top of other objects and sometimes the 3D objects just float in the air.

Figure No. 4 Houzz Application's View In My Room Feature

The Houzz application does a much better job at creating the AR scene than IKEA's Place app. It is able to accurately detect flat surfaces to place the 3D objects. It is a much-refined experience for the end user. The Houzz application has a "View in My Room" feature which allows the users to use augmented reality to place the virtual furniture in their room. But unfortunately, it is not available in a few countries like India. In these countries, a 2D image of the selected furniture is displayed on the screen in real time instead of the actual 3D virtual object. It is basically a real-time photoshop simulator instead of an actual augmented reality mobile application.

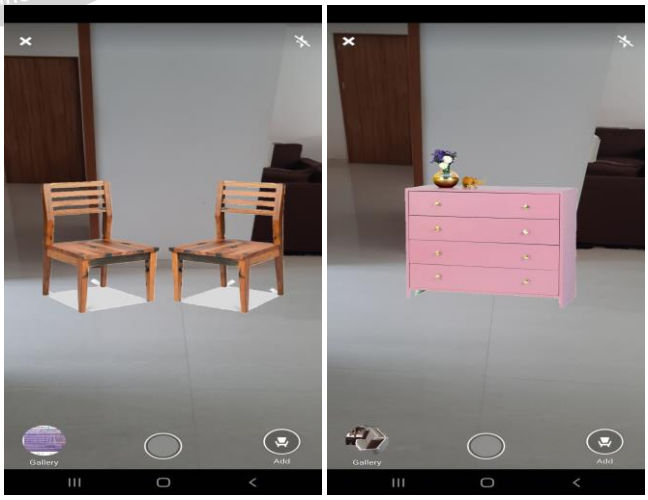

Figure No. 5 Houzz application's 2D approach

The Beijing Easyhome Shejijia Furnishing Chain Store Group's "Homestyler" application is also a great application

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for interior designing using AR. It initially shows the accurate size of the 3D model in the AR scene to let the users know the exact size of the furniture but the user can choose to resize it if he/she wants. It also has a feature where we can redecorate an entire virtual room in the application. The augmented reality scene in this application is more accurate than the IKEA Place app and the Houzz app.

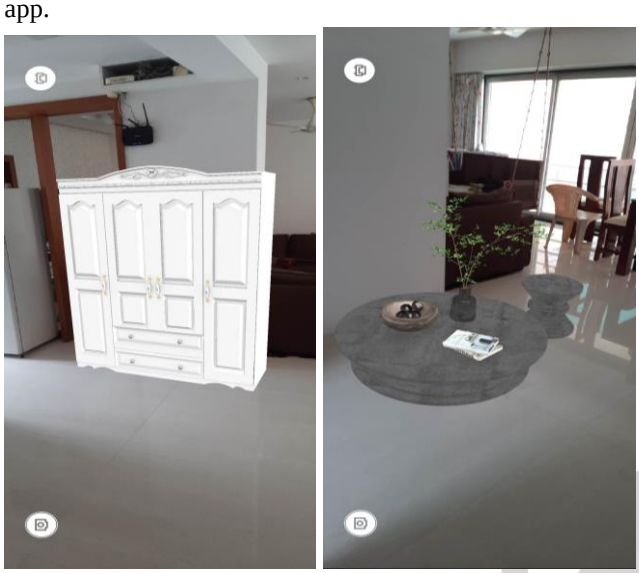

Figure No. 6 Homestyler Android Application

All of these applications allow users to take photos of the AR scene that they have created. The user can take photos from different angles to capture the AR scene. The application then allows the users to share these photos with other people or on social media. This doesn't really do justice to the experience of these augmented reality scenes. A video is a much better way of accurately capturing the entire AR scene for other people to see. We aim to solve this issue with our application. We have added a feature through which the user can capture the video of the AR scene with multiple angles. We have also added the option to add multiple models of the same type or different type in the same AR scene. The above applications also have this feature but due to the way it is designed, the application sometimes crashes while adding the second object. Our aim is to solve this issue with a simple adjustment in the user interface.

VI. ENVISAGE

Envisage is the name of the Android Application that we have developed. Envisage means forming a mental picture of something not yet existing or known. We used android studio to develop the application. Although the user's phone storage was our primary destination to store the AR scene videos that he/she creates, we used firebase too as our backend to store user login information and to store the information of the project that the user creates. Firebase authentication was used for user registration and login.

As mentioned above, we used ARCore to create the AR scene. But to place the 3D objects, we needed SFA and SFB files of the 3D models. We used Google's Sceneform Tools to convert the OBJ files into SFA and SFB files. Sceneform Tools used to be a plugin available in android studios which allowed developers to work with 3D models but recently Google archived the Sceneform repository which means that Google will no longer be actively maintaining Sceneform. Google open sourced Sceneform tools version 1.16 so now developers can still use this in their augmented reality applications. Since Sceneform is not available on the android studio plugin list, we could not directly convert all of our 3D models. We had to find a way to manually convert each OBJ file into SFA and SFB file using open sourced Sceneform that was available on GitHub. We wrote the below code in the build gradle file.

```
sceneform.asset('sampledata/arobjname.obj',
      'default',
      'sampledata/arobjname.sfa',
      'src/main/assets/arobjname'
)
```

After writing this code for each of our 3D models, the OBJ files were converted into SFA and SFB files and stored into the location that we have mentioned in the code i.e., the assets folder.

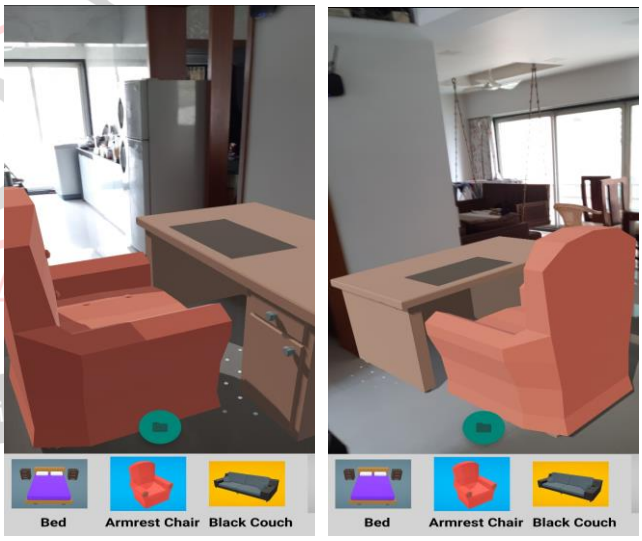

Figure No. 7 Envisage Application's AR Scene

While using other applications we faced an issue that when we placed a 3D object and wanted to place another object, a new activity was started. So, the AR scene was minimized and was kept running in the background while we looked for another object in the catalog. The problem with this was, when we selected the 2nd object, most of the times the first object would disappear or the software sometimes had to scan the environment again to find flat surfaces which took 10-15 seconds each time. So, we have added a horizontal scroll view of all the 3D models available on our application at the bottom for a better user experience. With the help of this feature, user has the freedom to get creative with multiple 3D objects of furniture and create a scene as

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shown in Figure 7. The chair and the desk in figure 7 are two separate 3D objects used in one AR scene.

Figure No. 8 Envisage application's video recording feature

This is the recording feature of our application. With this, the users can capture the AR scene that they have created using all the angles possible. The video is stored in the device's local storage.

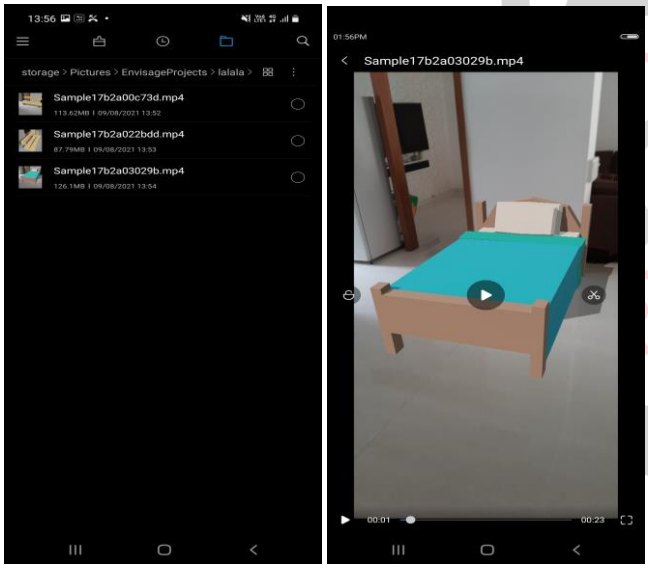

Figure No. 9 Envisage application's Video Storage

GitHub link for the application that we developed: https://github.com/abhishekkocharekar2000/Sem2MADProject

VII. Conclusion and Future Scope

Augmented Reality is a technology that is relatively new and is still constantly evolving every year. Initiatives by big tech companies like Google and Apple with SDKs like ARCore and ARKit has allowed developers to be more creative with augmented reality applications. It has become very easy to integrate augmented reality into our applications to get our users the best user experience possible. Apple is going to launch its Smart Glasses next year and augmented reality is going to be crucial for it to have a quality user experience. It will bring information that we have on our phone directly in front of our eyes. This would not have been possible without augmented reality.

The market for mobile applications based on augmented reality has evolved exponentially since the last decade. Every year more and more companies are starting to develop useful applications with AR for the consumers. Interior designing is another field that is going to evolve due to augmented reality helping us take measured and informed decisions. Due to the COVID-19 pandemic, more and more people have shifted to online shopping and these types of applications are only going to make things much easier and cheaper for them.

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