International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 02 | Feb 2022 www.irjet.net p-ISSN: 2395-0072

Virtual Interior Decor App

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Abstract - *Augmented Reality is a blend of a genuine and a PC produced or virtual world. It is achieved by augmenting computer-generated images in the real world. It is of four types namely marker based, marker less based, projection based and superimposition based augmented reality. It offers a variety of applications in the real world. AR is used in various fields such as medical, education, manufacturing, robotics and entertainment [1]. The following paper focuses on markerless based AR. The team has developed an android application that uses markerless based AR to project various furniture in an augmented environment that will better help the user visualize their home interior decor and be able to make educated decisions based on the visuals provided by the interior decor application. This study proposes another technique for applying Augmented Reality innovation to interior design work, where a client can see virtual furnishings and speak with 3D virtual furniture utilizing a dynamic and adaptable UI*

Key Words: ARCore, Furniture, App Development, Augmented Reality, Marker Based AR, API

1. INTRODUCTION

Envisioning how a specific object will look in a room before it is decorated is a difficult challenge for anyone. Augmented reality is a new technology that includes the placing of some of the virtual objects on the real environment. As an outcome, the end-user can see the real environment augmented with physical objects where you can interact with them [1]. With the recent emergence of better cameras and more accurate sensors in soon-to-be mainstream devices, Augmented Reality is transitioning from image or QR code-based activations to Marker Based Augmented Reality experiences.

In the implementations of marker less AR incorporates graphics, sounds and contact criticism which are then, at that point, added to this present reality. This makes an enhanced client experience AR where we use sensors in gadgets to precisely recognize real world environment, like the areas of dividers and marks of convergence, permitting clients to put virtual objects into a genuine setting without expecting to read an image.

Usually, people tend to buy furniture offline because of a lack of visualization on online furniture apps. They have to undertake a few steps like the exact measurement of the desired furniture to fit their homes. This is a tedious process where a small mistake can make you buy something that does not fit the dimensions and the patron will have to do the entire process again. Generally, people ask for external help like a carpenter or an interior designer to help them fix this issue. Asking for help is advantageous at times, but this will cost money and you will have to wait for the individual to have a visit to your home. This may require a couple of hours to even a couple of days. So, in order to take less time and get the process done for free, the developed application will be very useful. The app will give them an idea of the furniture available in the catalog and display it in an augmented environment so that the patron will the idea of how the furniture will look in actual life.

In order to overcome this problem, we have introduced AR to mobile apps. With this technology, people can overcome the barrier of physically visiting stores to find the perfect fit for their homes. This is especially true given the current situation with the ongoing pandemic. In our application we are using marker-based AR that will use markers as trackers to latch on to the floor and analyze the layout so that it can deploy the augmented models [3]. Other than this there is a possibility of using another AR technology which can help us visualize the product in a private space, it is known as projection-based AR. This AR technology uses projection as a guiding tool to help with visualization [4]. With our AR application we truly bring comfort at your fingertips. People could place the furniture's wherever they want without actually buying them. It would also help them to visualize in a realistic way as we would have 3D and life-sized dioramas of the furniture's. It would help the user decide and help them buy it as per their convenience.

The remaining part of the paper is as follows.

2. RELATED WORKS

In [1] AR furniture arrangement system that recommends a secondary view that can im- prove a user's understanding of a room layout. It uses a custom video see-through headset com- posed of a wide view head mounted display (HMD) (Oculus Rift DK1), stereo camera (Ovrvision), RGBD camera (Asus Xtion Pro), and gamepad. In this paper the subjects were asked to memorize a Furniture layout presented on a desktop monitor. They were allowed to change and manipulate the scene as they wished. Finally, they were given a video see- through headset and used a gamepad to place the furniture objects on their scene. This process was repeated for four different viewpoints. At the end the subjects were asked to fill a 5-level Likert scale based on the ease of grasping the layout from different views.

In [2], the author has proposed a model of WebAR. It elaborated on the different potential Web AR approaches. It spoke about several technological advances such as the 5G networks which would provide higher bandwidth (0.1 1 Gb/s) and lower network delay (1 10 ms). The paper also discussed various challenges and enabling technologies for when AR meets the web. This model offers cross-platform and lightweight approach for Mobile AR, but also shows the limiting computing and rendering capabilities of WebAR

In [3] the, paper gives information regarding different types of AR such Marker Based AR, Marker less AR, Projection Based AR and Superimposition Based AR. The technology of AR still under research and development and is emerging day by day. Many things have been developed recently using this technology. It has entered the world of car repair again after 5 years. In a nutshell, it can be said that AR has a very bright and promising future in spite of having many threats to its success in the near future.

In [4] the DesignAR system is a projection-based, portable, pan-tilt system constructed specifically for interior design prototyping. With DesignAR, it is possible to construct a 3D map by the user inputting spatial information. DesignAR provides an optimal plane through analysis and an interface that can offer various interior designs for its users. Users can perform interior design directly in the projected space via the spatial user interface or even via mobile devices. In order to verify the usability of the DesignAR system, a total of fourteen usability principal items were established and then the usability evaluation results were obtained through proposed scenarios. It became evident through the usability evaluation results that linking DesignAR to mobile devices enhances the system's usability.

The paper [5] is an application that is specialized for the task of supporting teaching activities in interior design. The application was built keeping in mind the learning capabilities of students. The application makes use of the latest AR technology. The AR technology facilitates the students to place D models of virtual objects for example: chairs or tables on top of a design layout plan and interact with these on their personal devices. The application can be a very efficient tool for teaching since the UI is very simple and basic and can be understood easily by undergraduates. Their study included the ARCS theoretical model proposed by Keller as a reference model to verify the effectiveness of the integration of MAR technologies into the syllabus of the students. The main focus of this research was to improve the effectiveness of teaching and improve learning.

In paper [6] the developers used Spatial and functional Links and implemented it on existing computer vision. They have described the use of new PVT based interaction techniques for room-size modelling tasks. The Physical Virtual Tools (PVT) supports the designer in both the design process and designer or client meetings. The PVT supports Cabinet Layout, Design Presets, and Modifying Finishes. Another key feature of this application would be its ability to understand the decision-making process of the client and make adjustments accordingly. The application provides the user with a 1:1 scale of preview design which makes it easier on the eye and the brain to comprehend the design and placement of the model. Therefore, this snatches the chance from the user to implement their own idea using this application. Markerless AR technology is used.

In [7] the application developed has an increased ease of use, independent of external hardware and highly accessible to customers making them plan their floor space efficiently. The system implements the use of Unity, Vuphoria SDK and can be displayed in android, iOS and even WebGL.The developed application was deployed on an Android phone. The app follows the following order Selecting Models and Instant Tracking, Starting the instant tracker, Updating Tracker and Model Manipulation. The process ends with Stop Tracking and the user can select a different item from the list of furniture.

In the paper [8] the designers have created an interior designing system with the use of AR technology for android devices. This application has made use of marker-based AR technology. The marker-based technology uses markers as a reference point to place the objects in the augmented environment. In order to track the scale and coordinate system of the room markers are placed. In this system the user can also manipulate the location of the selected virtual furniture with an environment where the actual furniture is present. This system can also be used and exploited by non-professional users.

2.1 Research Gaps

1) Implementing App-Based AR because hardware-based mobile AR lacks flexibility.

2) A better graphical user interface can be implemented in compared to apps like myty, augmentyAR.

3) Unity and other development platforms are outdated as compared to ARcore.

4) The existing systems in augmented reality were earlier implemented using heads up display wherein the user was able to see through wearable AR displays.

2.2 Problem Identification

The challenge is to create an AR based mobile application that helps any individual to visualize the interior decor of the interior of any house with simple maneuvers on your mobile phones. The main objective thus, is to develop the system that overcomes following fallacies,

1) A better graphical user interface can be implemented in comparison to the other applications already in the market.

2) Our project is a significant step towards automating interior designing of residences, workplace, etc.

3) To provide a realistic decor experience to a user, one that transcends orthodox interior planning. If the user provides an input for a certain floor plan the app should detect the input and provide a feasible option to the user.

4) To capture not just the images captured by the camera on the device, rather by using the orientation of the camera with respect to the ground plane that has to be detected.

5) To design and plan the floor space virtually with a range of options available for selection.

6) To evaluate the system for its deployment time for various models and performance under different distances.

2.3 Abbreviations and Acronyms

Table – 1: Abbreviations

Sr No.	Abbreviations	Full Form
1	AR	Augmented Reality
2	UI	User Interface
3	SDK	Software Development Kit
4	PVT	Physical Virtual Tools
5	WebGL	Web Graphics Library

3. METHODOLOGY

In this section, the detailed implementation of the system has been described.

A. Proposed Solution

In this section we have proposed different methods to overcome the above-mentioned research gaps.

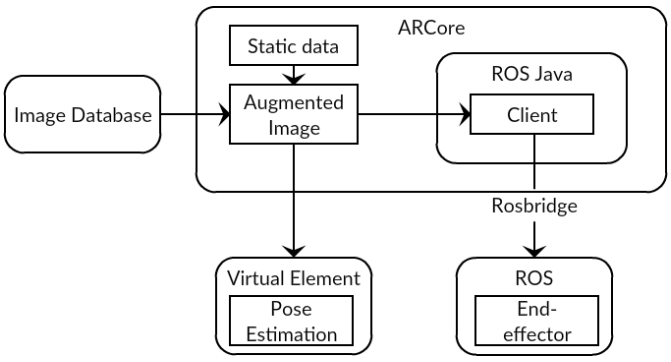
Firstly, there is an increasing demand of a unique and easy to use user interface (UI). In order to achieve this task, we will be discarding redundant functionalities in the app. Also, we will be keeping the UI as simple as possible where only a tap would enable the patron to deploy the model on the augmented surface

B. System Architecture

Our system is an AR based android application that uses ARcore as an augmented reality platform to project virtual furniture models in real world augmented environment. We have used Android Studio as the integration platform. The application basically provides the patron a basic idea of how the furniture will be portrayed in their desired rooms.

The use case diagram shown in fig1: gives us a basic idea of the flow of the application from once it starts. The application starts with a basic login page. The application will ask the patron to enter the login credentials, if they are a new member, there is an option to create a new account. The credentials will be stored in the backend database for which we have used Google firebase (a free to use online database software). If the user is the admin, they will be able to make changes and view login credentials. They can manage assets and change floor plans. Once the patron is logged in, they will be directed to the home page where they can select a new model from the catalog provided. Once they have selected the model the camera API, will initialize the camera of your android device and simultaneously bring you to an augmented environment. The marker-based AR will track the surrounding and place the selected item in a suitable location. The patron can move around and play with the tool and choose the desired place for furniture. They can select from a number of models from the catalog provided and note the desired model.

The application will help to save a considerable amount of time and money that might be spent on professional help. With little or no help, you can design your room to your desire.



The main advantage of using ARcore is that it uses precise plane detection along with motion tracking and light estimation. It also has an ability to determine the position of the phone using the phone sensor.

The product prerequisites for our undertaking are Windows XP, Windows 7(ultimate, enterprise)

- Android Studio
- VSCode

- ARcore

Furthermore, the hardware necessities are as per the following

- Processor - i5
- Hard Disk - 5 GB
- Memory - 12GB RAM
- Android Phone with KitKat (4.4) and higher.

C. AR Development

Our Interior Design App is built using ARCore SDK. ARCore utilizes three critical innovations to incorporate virtual reality with this present reality as seen through the camera of a cell phone or tablet.

1) Six levels of freedom permit the smartphone to com- prehend and follow its position comparative with the world.

2) Its understanding of the surroundings permits the smart- phone to identify the size and area of even surfaces like the ground or a tea table.

3) Light assessment permits the smartphone to appraise the lighting conditions with respect to the present time and surroundings.

Scene form allows you to import models with activity. You can utilize Sceneform APIs to play back and control the movement, and connect hubs to a model's skeleton.

4. RESULTS

In this section, we have displayed the working of "Virtual Interior Design App"

Table - 2: Surface Detection

Surface	Average Time Taken to Detect (seconds)
Even Surface	4.53
Uneven Surface	7.5

Table -3: Deployment

Model (Alpha)	Time Taken to Deploy Model(seconds)
Chair	0.46
Table	0.48
Bookshelf	0.73
Lamp	0.56
Television	0.38

In the above figure, after the surface planes are detected, the furniture is placed on the surface. The patron is free to manipulate the models as per their requirements.

The patron can view the augmented furniture from different views to have a better understanding if the furniture is suitable for their surroundings.

Fig 2. Augmented Reality

Fig. 3. Light Estimation

5. CONCLUSION AND FUTURE WORK

The current application has a limited set of furniture which the patrons can interact with. In the future, we intend to improve our current catalog by providing applicants with more options and variety to select. Also, the application can currently converse only in English language; therefore, in the

future we will incorporate multiple languages so that the patron will find it convenient to interact with the UI of the application.

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