

ADORN- Create with AR

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Abstract- In a technical environment that is constantly changing we should expect the unexpected. AR uses can in the near future follow some unexpected new directions. This paper focuses on one such application of Augmented Reality, that is in the field of Interior designing. This study proposes a new technique for applying AR technology to interior designing, where the user can communicate data on 3D virtual furniture and display it using a dynamic and scalable user interface. The AR technology can be considered as a combination of real space along with virtual objects. The user can view and change the virtual furniture in real-time on the screen in an AR environment, that enables an interactive experience for the user with virtual furniture in a real-world setting. Interior designing using AR lets the customer outlook the design before it is built in real world. Using AR in interior design gives freedom to the consumer to model the room as they desire. 3D Virtual Reality and Augmented Reality are technologies which serve new-age consumer needs.

Keywords- Augmented reality, Interior design, Computer vision, Open CV.

I. INTRODUCTION

In our increasingly digitized world, where everything from our phones to our thermostats is "smart," the fact that virtual reality (VR) and augmented reality (AR) are beginning to play a role in the design industry should come as no surprise. Augmented Reality (AR) is one of the main technology developments at the moment, and will only get bigger. While AR primarily relates to the game development and entertainment industries, there are far more practical applications of this flexible technology. It has outgrown the state of being a luxury and is quickly becoming a necessity. Industries like the automobile, retail, healthcare, manufacturing and many more are already profiting from AR capabilities. And the Interior designing field isn't so far behind, as demonstrated by the applications emerging from electronics, major home furnishing, and interior design retailers like Lowe's and IKEA.

Currently the design industry relies on CAD tools, graphic software, models, drawings and sketches. Augmented reality will modify this sector by enhancing the overall process along with visualization, collaboration and efficiency. Unlike existing visualization techniques, such as drawing or print view or screen, Augmented Reality offers the client a full 3D 360°-degree view. The client not only see the final plan but also have a full overview of the design along with editing options. Users can basically edit the entire room and redesign it exactly the way they want it. Although designers already have numerous product and marketing tools, these AR apps can be used as a great communication tool for professionals. It will increase the potential capacity to interact, imagine and personalize the

designs for interior designers, together with their customers, as well as for manufacturers.

II. LITERATURE REVIEW

Paper 1: Placing and presenting virtual objects in an Augmented Reality environment

Abstract-

It explains the development of augmented reality using a real scene. The method involves viewing a real scene through a computer camera, observing a user's gesture through the system's camera, putting the scene and the gesture on display of the screen, create and position a virtual object in real-time location based on the user's observed motion, and display the virtual object in the real scene.

Summary-

Augmented Reality (AR) involves techniques to view virtual objects superimposed on a real-time scenario. Embodiments of the current invention provide end users with more ways to create compelling content. End users are influenced to use the existing technology that provides easy-to-use approaches to create quality AR content. These methods continue to become more captivating as the technologies become smaller, cheaper and allow better resolution and video analysis.

The user will be able to adjust the shape and size of the object. The user can use pinching gestures to adjust the size in height and width, as well as the location on the scene. One of the advantages of gesturing on the "live" content by gesturing in front of the camera is that the user can quickly make additions or deletions across a range of

scenes of the surrounding environment that can be captured by the camera, compared to using touch screen on a stable image of the scene. In other words, the user is not restrained to a screen image alone. The client may make alterations to a real scene that is beyond any one perspective of the real camera. The user can position the rear camera at one site of the real scene and e.g. add virtual objects, then position the camera at other sites on the real scene and add more virtual objects. The AR device or a central device can recollect the actions taken by the user so that whenever the AR device is again positioned at the location, the virtual objects appear again. In one example, the user puts two distinct virtual castles on two different hills. In a game context, the virtual knights and horses of one castle may then be unleashed on the other one and the AR device can be used to watch these actions by moving the device around to obtain different views. As a result, the AR interaction of the real scene is not limited to the field of the rear-camera view. [1].

Paper 2: The Application of Augmented Reality in Interior Design Education

Abstract-

This research concerns the application of Augmented Reality (AR) to the education in interior design. AR has been a widely studied technology in many fields and one of them is education, which is often commonly used in civil engineering, architecture, and interior design research. It is of great importance for interior designers to be able to think in three dimensions, and to imagine projects. The aim of this study is to analyse the impact of using AR in the design process to find the optimal space arrangement under the following criteria: 3D and 2D space perception, space visualization and analysis, and AR usability on mobile devices.

Summary-

As in several other areas, interior design is another where researchers are applying AR technology. For instance, with Ikea's augmented furniture catalog, people became familiar with AR; however, in the background, AR needs a lot of trials to be effectively used in interior design. Siltanen & Karvonen proposed a diminished reality approach targeting applications in interior design (2014). Another application by Wang allowed students to investigate specific buildings and their various systems with additional information using a phone or tablet. The IOS application Magicplan has gained a lot of attention as a leading tool for architectural and interior design for use in creating floor plans quickly, dimensioning interiors and developing 2D Plans using mobile sensors. Also, Unity and SketchUp programs enable the user to venture into the building as a walkthrough. The first-person controller is an asset that allows the user to explore a building. AR has

been seen as a way to present projects and show a better understanding of customers' needs. The augmented reality is the approach for interior decoration future to develop a convenient and effective partnership among designers and buyers. The purpose of this research is to question AR's advantages under specific criteria to find the optimum space arrangement in a given plan, which is an essential step of an interior design project lecture. It also helps to introduce this technology to the students in a way where they can learn to apply basic AR models to their projects. Using AR technology can be an enjoyable experience, as it can facilitate learning to build AR scenes. AR is found to be an impressive learning tool by the students, making it possible for students to interact with the learning content, improving their spatial skills and creativity. [2].

Paper 3: Interior Design with Augmented Reality

Abstract-

On account of huge advancements in computer vision algorithms and cheap hardware, Augmented Reality is becoming mainstream. Furniture retail is a significant aspect of the US economy. However, most of the sales come from physical stores, which is cumbersome and time consuming. AR is changing the furniture industry. Big players like Target, Wayfair, and IKEA are using this technology and are creating engaging Omni channel experience to boost sales. In an AR environment virtual furniture could be placed and manipulated in the physical world in real time which allows the user to have an interactive experience.

Summary-

Augmented Reality (AR) technology is well developed and widely used as an alternative to virtual reality on mobile devices. Design industries are embracing AR widely to create meaningful user experience, as AR enables businesses to build applications that enable users to interact and imagine actual items. AR enables an application to use the camera and sensors on the phone to position a virtual object directly in the camera's viewing space. This is achieved by defining and using a marker in the AR space as a guide for the rest of the room. The application uses marker less AR technology to position objects in a 3d room, without a marker being required. Everything that has been built up to now is on top of Google's ArCore kit doing motion tracking, floor detection, and light estimation. It renders 3d models using ArCore APIs. Once the app starts, one scan the floor through the ArCore API. Upon detection of the floor, it provides user feedback by rendering a coloured plane. The user can then place 3d objects into the environment after this. Input controllers can be considered the mediator between the UI and the logic behind the backend. Its primary function is to handle backend actions for the UI

and trigger events. This part is responsible for detecting rotational movements, moving the 3d models in the area. [3].

III. PROBLEM STATEMENT

Interior designing using traditional methods involved a combination of verbal explanations and 2D drawings. While this has served the industry faithfully, it has principal flaws. Communication process can often leave a lot of room for confusion and disappointment. Even if both the designer and the consumer can express their vision correctly, there is always a risk that the imagination does not completely grasp how those objects function in tandem and how different colours can create particular emotions. Visualizing a piece of furniture, wall colour and floor map for a new project often gets overwhelming. Now, the mood boards are no longer in trend. A modern consumer needs a tailored or personalized approach just as they wish. Augmented Reality in interior design is the innovative solution to the challenge's customers and designers face when it comes to visualizing the actual project as never before.

It's slow and time consuming to purchase furniture from the brick and mortar stores. Printed furniture catalog is essentially a paper-based information with lots of texts and photographs that provides no user interaction. According to the Wall Street Journal report, furniture companies are one of the fastest growing product segments with 15 percent of revenue coming primarily from online sales. Furniture buyers also had reservations about product returns because they weren't sure whether the piece of furniture would fit into a particular space if they would buy online furniture. AR has been seen as the technology that will improve the sales of furniture, as AR allows users to visualize furniture. This also helps users to try out various interior designs.

For instance, users can without any effort imagine walls painted in various colours. They can place an actual table in their dining room with an AR app to find out if the table fits in the space and looks fine. This proposal greatly reduces the costs of the expense of returning the product and logistics. While the rise of online shopping is growing and replacing brick and mortar stores, AR may be seen as a significant contributing factor to online sales. [4].

IV. PROPOSED SYSTEM

The main aim of this project is to develop an interior design application using augmented reality which benefits people. It is to enrich the traditional catalogue which is only printed with 2D images. Users just need to install the application after downloading it on their device. Then the users can play with 3D virtual furniture in the house spaces. Using an interior designing application, users can

see the front view, back view and side view of the virtual model and interact with the virtual model at the same time. With 3D representation, users can also view better graphics of visualization.

In this application the virtual furniture can be placed and modified in real time on the screen that allows the users to have an interactive experience with the virtual furniture in real world environment. There are three types of gestures included in this application which are drag, pinch and rotation gesture. And the users can watch the 3D virtual model of furniture in real-time. Users only need to install the application in their device and start designing the ideal environment with various 3D virtual models of furniture. Then select desired furniture from the list and the virtual model will appear on the device's screen. Users can drag, rotate, enlarge and minimize the 3D furniture models so as to fit the model in the house if needed. They can even resize the things in the house according to their requirements. This technology has great potential to reduce costs, shorten design time to decorate the home space or room. [5]

Also, the functionality of changing the colour of walls is provided. Users can select a colour of their choice from the colour palette provided and visualize in real time whether it is suitable or not. It gives users the ability to try out any colour virtually and select the one they find best. Additionally, a measurement module based on computer vision is also incorporated using which the user can measure any surface or object by putting two points on the detected surface. This would help users in measuring more conveniently even without availability of any measuring instrument. [6]

V. METHODS/ TECHNOLOGY

Methodology

1. Open Application
2. Log In
3. Browse Ideas: Users can scroll through the Timeline for inspiration and can search for a particular color or room.
4. Scan Surface: User scan the surface using mobile phone camera.
5. Place 3D objects: Users can choose from a list of 3D objects to place on the detected surface.
6. Paint Walls: Users can change the color of walls using a color picker.
7. Measure Surfaces: Users can also measure detected surfaces or objects.
8. Save as Image: User can save the virtual setting as an image for further use.

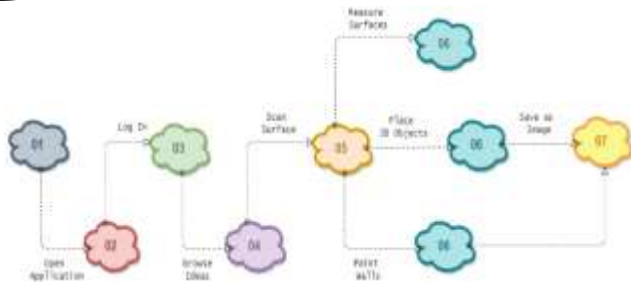


Figure 1 Workflow

Technology Stack

1. Java programming language

Java is a general-purpose, concurrent, object-oriented, class-based, and runtime environment (JRE) consisting of JVM, the cornerstone of the Java platform;

2. Android Studio

Android Studio is the official Integrated Development Environment (IDE) based on IntelliJ IDEA for Android device development. On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance your productivity when building Android apps.

3. Computer Vision (OpenCV)

OpenCV (Open Source Computer Vision) is a library of programming functions that primarily target computer vision in real time. The library is cross-platform and is open-source BSD licensed for free use.

4. AR Core

AR Core is Google's platform for building augmented reality experiences. Using different APIs, AR Core enables your phone to sense its environment, understand the world and interact with information. Many of the APIs are available for shared AR interactions across Android and iOS.

Hardware-

1. Camera
2. Android Smartphone

VI. SYSTEM ARCHITECTURE

Augmented Reality

We used Marker-less AR to build our Interior Design App. Google recently announced its ARCore platform that would allow developers to build Marker-less AR experiences so we developed our app around android ecosystems primarily because of its availability, discoverability, reliability, and agility. Android Studio, Java Programming Language provides the development environment, and we currently only support android devices.

The framework contains a number of components which are used to build the AR world. The first part is a camera

or other video input that generates a digitized real-world video image. Image from the live camera is captured using the Capturing module. The tracking module does the correct calculations of location and virtual overlay orientation. The display module combines the original image captured from the camera and the virtual components using the pose calculated by the tracking module and renders the augmented image. The system also comprises of an AR library (i.e. a virtual object database), a computer that can selectively access and search the library, and a video monitor that is dimensioned and configured to display the camera's real-world digital image, along with the virtual objects that are retrieved from the AR library. The camera returns a real-world digital video stream in operation. Video stream is used to take samples of images and they are then forwarded to the processing computer.

After detecting the surface and selecting an object in the digital video stream, the AR library returns the virtual object, its qualities and its orientation to the video monitor. The virtual object is then superposed onto the image of the real world. The virtual model is placed into the image of the real world. Thus, the AR system allows the customer to experiment on a real-world image of the actual environment that he wishes to design or modify. This is highly beneficiary for the buyers. [3].

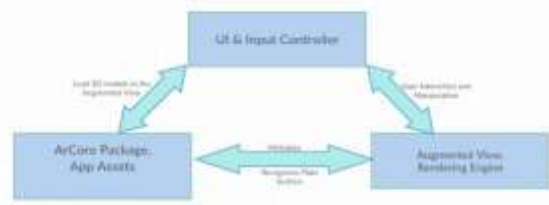


Figure 2 System Architecture

Surface Detection (Marker-less Augmented Reality)

1. Environmental understanding

By detecting feature points and planes we use ARCore technology to enhance its understanding of the real world. We're looking for clusters of feature points that tend to i.e. on-horizontal or vertical surfaces, such as tables, floors, walls, and making those surfaces available as planes for your app. We can also decide the limits of each plane and make that information accessible to your device. This knowledge can be used to position virtual objects that reside on flat surfaces. Since we use feature points to detect planes, flat surfaces without a texture, such as a white wall, cannot be properly detected.

2. Motion tracking

When your phone moves, we use a method called concurrent odometry and mapping, or com, to understand where the phone is connected to the globe around it.

In the captured camera image, visually distinct features called feature points are detected, and these points are used to measure its position change. The visual information and inertial measurements taken from the imp of the device are paired together to estimate the camera's position and orientation relative to the environment over time.

3. Oriented points

Focus points allow you to position virtual objects on angled surfaces. When doing an impact test that returns a feature point, we'll focus at nearby feature points and use those to try to estimate the surface angle at the given feature point. We will then return a pose which takes account of that angle. [7].

Object Detection (OpenCV)

1. Contours

For detecting walls to colour, we use contours that connect all the continuous points (along the boundary), having the same colour or strength. The contours are a valuable method for shape analysis and the identification and recognition of artifacts.

Use binary images to get better accuracy. So, apply threshold or canny edge detection before seeking contours.

Find Contours function modifies the actual image. So even after finding contours, if you want the source image, already store it on some other variables. [8].

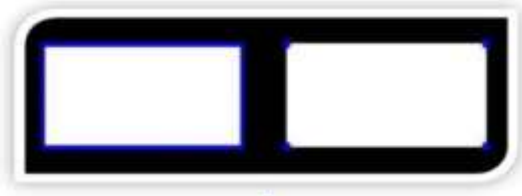


Figure 3 Contours

VII. RESULTS

System Output:

Module 1-



Figure 4 Result-1

Module 2-



Figure 4 Result-2

Module 3-



Figure 5 Result-3

User Interface:

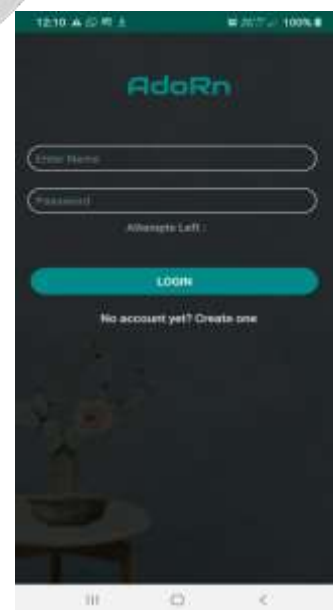


Figure 6 User Interface

VIII. ADVANTAGES

1. The main benefit of this technology would be that designers would find it useful to rectify misinterpretation of the design and uncertainty of what the results were intended. AR would give further confidence to the customers that they get exactly what they desire.
2. One can now see items at home, before actually buying them.
3. Visualizing all the products in actual real-life size, from all possible angles in high quality and trying out different colours.
4. Using AR, designers will find it much easier to show their creative ideas to customers.
5. It increases the chances of adjustment and enhancement, thereby allowing users to achieve the desired results themselves. The client can see what befits the best and compliment his / her sense of style.
6. Given that the models and designs can be used on smartphones or tablets, the portability capability would benefit. It will be less time- and cost-effective for both designers and customers. [9] [10].

IX. LIMITATIONS AND FUTURE WORK

As of now, only the 3d models in the local storage can be visualized by the user. We plan to link the app to a cloud repository from which a user can search and import furniture during runtime.

We are trying to incorporate photogrammetry into our current framework which will allow us to recreate a 3D furniture model from photographs.

To date, a static palette of colors is provided. We can enhance the wall coloring functionality by allowing users to pick colors from a real time image.

User reviews and feedback can be included so that other users as well as designers can benefit from it.

X. CONCLUSION

The smartphone's changed a lot about how we see and communicate with the environment, and Augmented Reality is no exception. In the last 2 years the demand for AR applications has grown a lot, and several businesses have started providing services that we couldn't imagine six years ago. Interior design is another aspect of our life that will be influenced by all those changes in a positive way, allowing us to make better, more educated decisions. The innovative use of indoor AR technology is thought to have a significant impact on the real estate market. Users may display simultaneously with AR the furnished state of the houses they choose to rent or purchase, or the design interventions. AR can also reflect various model designs and locations organised with different products, and alternative design approaches can be provided to the

customers. Augmented Reality has established a great home in the field of property creation right now and enjoys a warm welcome from all owners, designers, sellers and buyers.

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