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Augmented Reality

PROJECT- 1 SEMINAR

Submitted in partial requirement for the degree of

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in

COMPUTER ENGINEERING

by

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1. INTRODUCTION TO AUGMENTED REALITY

Many of us are familiar with the concept of virtual reality, either from films like Avatar and The Matrix, or from science fiction novels and video games. Virtual reality is a computer-generated, interactive, three-dimensional environment in which people become immersed. But in the past few years, a new spin on virtual reality known as augmented reality has emerged as a major focus of many companies' marketing efforts. More than just science fiction, augmented reality is an exciting new way of creating richer, more interactive experiences with users and future customers. Augmented reality differs from traditional virtual reality because users of augmented reality (also called AR) tools maintain a presence in the real world.

1.1 What is Augmented Reality?

Augmented Reality (AR) refers to the technology that offers a real-time view of one's immediate surroundings altered or enhanced by computer generated information. When users examine their environment through AR devices, they see information superimposed on the objects around them.

The technology used to enhance images with multiple layers of other information is useful in fields where visualising images can be difficult.

A few quick examples will make the idea clearer:

- While walking the streets of London, England one suddenly comes across an amazing bit of architecture. What is this fantastic building? Who was the architect? Is that really titanium? One has a lot of questions in mind but no access to the building and hence there's no information about it at all. The person simply takes his/her cell phone out and point the camera at it. The phone uses its built-in GPS (satellite navigation) system to figure out roughly where one is, then quickly searches Google Images to find similar photos taken in the same neighbourhood. In a couple of seconds, it has identified the building and displays information about it on the screen.
- If a fighter pilot is flying over a warzone with anti-aircraft fire shooting up at him/her. He/She really has to concentrate and looking down at all the gauges on his/her instrument panel is a distraction he/she can do without. Fortunately, the pilot is wearing what's called a heads-up display (HUD), a set of goggles with built-in, miniaturized computers that automatically project instrument readings so they "float" in front of his/her eyes. The pilot can find out everything he/she needs to know without taking his/her eyes off the sky.

It can be seen that augmented reality is actually a mixture of real life and virtual reality, somewhere in between the two, so it's often referred to as **mixed reality (**refer figure 1).

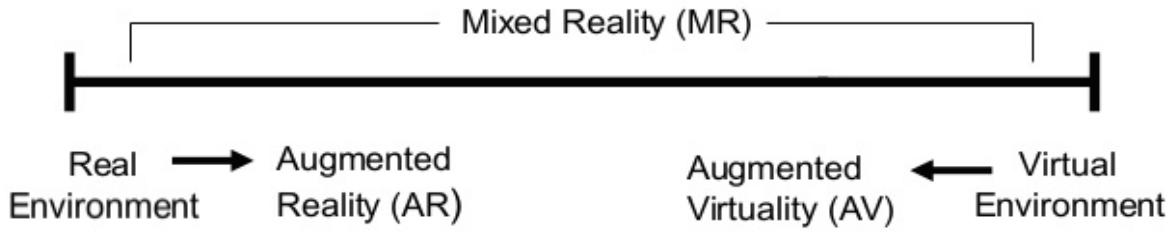

Figure 1: REALITY-VIRTUALITY CONTINUUM [1]

1.2 Problem Statement

With the increase in need for houses, demand for furniture and interior design is on rise too and these days, markets have a variety of options in furniture, be it the materials, colour, texture or size. It's often difficult for a customer to choose one amongst all the options. It would be of great help if the buyer could visualize a set of sofa or dining table in his living room, whether it suits at a particular place or fits in size rather than being disappointed later. Hence, our mobile application, helps the user to visualize the furniture from the database options and creates 3D model of the product, allowing the user to place the item in the space they're shopping for, view them from different angles, and determine if they're the right size for their home or office.It helps the user simulate furniture and interior design products of their choice in 3D augmented reality in real time in the real environment from the convenience of their smartphone or tablet.

1.3 Scope Of Project

Augmented Reality aims at simplifying the user's life by bringing virtual information to his immediate surroundings. Virtual objects added to the real environment show information that the users cannot directly detect with their senses. After installing the app, users can try a variety of products at home before buying from the shop. The entire augmented product line of a shop can be made accessible via a virtual product showroom in 3D augmented reality, to the users from anywhere at anytime,thereby allowing users to try products at home before buying from their shop .There is a great opportunity in using Augmented Reality. The users will be more engaged when using the augmented product catalogue compared to a traditional printed one. And more, it will reduce the number of physical samples and costs.

2. REVIEW OF LITERATURE

Augmented Reality is a real-time direct or indirect view of a physical real-world environment that has been enhanced or augmented by adding virtual computer-generated information to it. The new mobile devices, such as iPhone, Android-based devices, and iPad are not well used in augmented reality. Indeed, most of the current applications include gaming, entertainment and education are amazing apps, but they have not yet reached their potential in terms of possibilities, opportunities and usefulness. AR enhances the user's perception of and interaction with the real-world, thus making it more user friendly and interesting to use.

2.1 Evolution of AR

The first Augmented Reality(AR) device was born in the late 60s, called the Sword of Damocles [2] and created by Ivan Sutherland at Harvard University. Research into AR continued well into the 90s where it really flourished and much experimentation was done in the military and in space programs like NASA. It wasn't until phones could handle the processing power required by AR that it started to really show up in the consumer space with QR code scanning and apps.

In the 2000s, German researchers Daniel Wagner and Dieter Schmalstieg, now lauded as pioneers in augmented reality, were the first to create a framework[3] to run AR on a mobile device. With the new fangled smartphone devices growing in popularity and advancing in hardware and software, AR was becoming the latest fad for companies to combine with products. But AR still didn't really take off. Cut to 2014 when Google Glass arrived on the scene. All of a sudden, AR was relevant again for the masses. Adding to it is the success of AR games such as Ingress and Pokémon Go! which has attracted widespread attention and investment.

2.2 Types of AR

Currently there are two forms of AR available:-

1. Location aware AR
2. Vision based AR

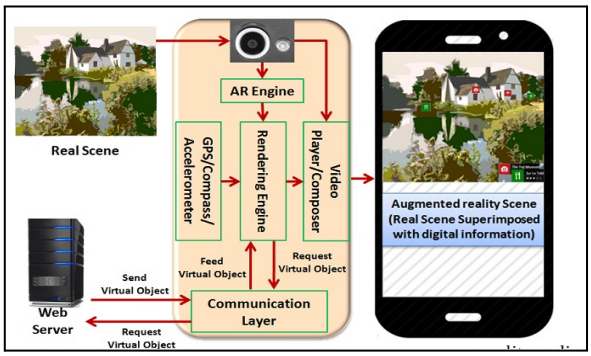

Figure 2.a: Location aware AR.

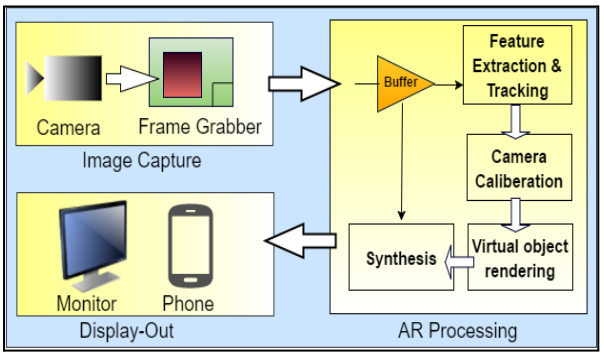

Figure 2.b : Visual based AR.

As shown in Figure 2.a, location aware AR presents digital information to the users as they move through physical areas with GPS enabled smartphones or similar devices. The media augments the physical environment with information related to the location.
In contrast, vision-based AR presents digital information to the users as they point camera to a particular object. Working of vision based AR is depicted in the Figure 2.b.

2.3 AR Displays

AR cannot only be viewed on smartphones but also on head-mounted displays(HMD), monitor based displays, handheld, and projective devices [4]. Users mount HMD on their heads, providing imagery in front of their eyes, overlaying AR objects over the background. AR systems can also be built using monitor-based configurations, instead of see-through HMDs. One or more video cameras view the environment, which may be static or mobile. The video of the real world and the graphic images generated by a scene generator are combined, and displayed on a monitor in front of the user. Some AR systems use handheld displays that has a camera attached to it to provide video see-through-based augmentations. The handheld display acts as a window or a magnifying glass that shows the real objects with an AR overlay. Eg: smartphones, flat LCD displays, etc. In projection displays, the desired virtual information is projected directly on the physical objects to be augmented. In the simplest case, the intention is for the augmentations to be coplanar with the surface onto which they project and to project them from a single room-mounted projector, with no need for special eyewear. Figure 3(below) shows the different handheld devices and displays mentioned.

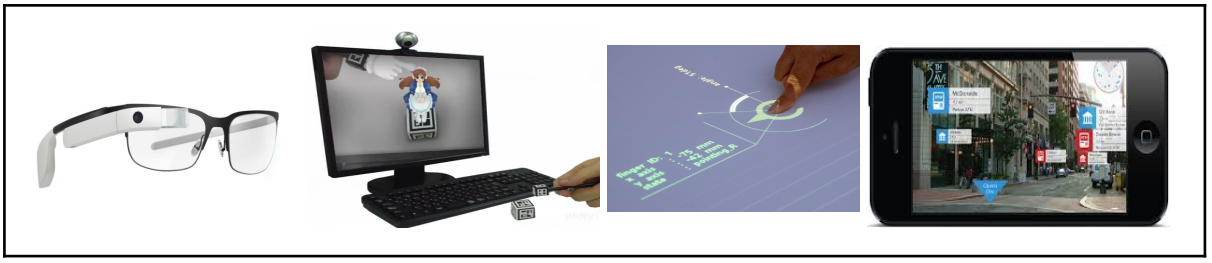

Figure 3: HMD, Monitor display, Projection display, Handheld devices.

2.4 Modes Of Tracking

AR applications based on tracking can be classified into the following:

1. Markerless AR
2. Marker-based AR

In a marker-based AR application the image or image descriptors (features + key points) are provided beforehand. In this case, one knows exactly what the application should recognize while acquiring camera data. Most of the AR apps dealing with image recognition are marker-based as it's much more simple to detect things that are hard-coded already in the app. Usually an AR marker is a black-&-white square image. These are easily recognized and

tracked, and not a lot of processing power on the end-user device is needed to perform the recognition.

Example:A good example of marker-based AR can be seen in an ad BMW produced for its Mini Cooper brand.This amazing new advertisement for MINI uses augmented reality (AR) technology to create a truly interactive media piece out of a 2-dimensional magazine ad. Using AR tracking technology, as you hold the ad up to your computer's webcam, you'll see a 3D model of a MINI Cabrio convertible that moves as you turn the sheet of paper around.

On the other hand, a marker-less AR application recognizes images that were not provided to the application beforehand. Tracking doesn't find anything on its own. Instead one can place an object at runtime somewhere in their field of view. Markerless tracking is then used to keep this object in place. It's most likely uses a combination of sensor input and solving the SLAM(simultaneous localization and mapping) problem at runtime. This scenario is much more difficult to implement because the recognition algorithm running in the AR application should identify patterns, colors or some other features that may exist in camera frames.

Example:An example of markerless AR in action is Ben & Jerry's Moo Vision feature in its iPhone app. With this app, viewers point their iPhone cameras at the lid of one of several qualifying pints of B&J's ice cream, and, after a few seconds, they're staring at the lid with an odd 3D image atop of it.

2.5 AR Restrictions

Despite the many recent advances in AR, much remains to be done.These few areas require further research if AR is to become commonly deployed.

2.5.1 Ubiquitous tracking: Several impressive AR demonstrations have generated compelling environments with nearly pixel-accurate registration [5]. However, such demonstrations work only inside restricted, carefully prepared environments. The ultimate goal is a tracking system that supports accurate registration in any arbitrary unprepared environment, indoors or outdoors.

2.5.2 System portability: Allowing AR systems to go anywhere also requires portable and wearable systems that are comfortable and unobtrusive [5].

2.5.3 GPS accuracy: GPS is only accurate to within 30 feet (9 meters) and doesn't work as well indoors, although improved image recognition technology may be able to help [6].

2.5.4 Visualization paradigms: New visualization algorithms are needed to handle density, occlusion, and general situational awareness issues.

2.5.5 Photorealistic and advanced rendering: Although many AR applications only need simple graphics, the ultimate goal is to render the virtual objects to be indistinguishable from the real. This must be done in real time, without the manual intervention. Some steps have been taken in this direction, although typically not in real time [5].

2.5.6 Privacy Concern: The concept of modern augmented reality depends on the ability of the device to record and analyze the environment in real time. Because of this, there are potential legal concerns over privacy. Legal complications would be found in areas where a right to certain amount of privacy is expected or where copyrighted media are displayed. In terms of individual privacy, there exists the ease of access to information that one should not readily possess about a given person.

2.6 Applications of Augmented Reality

Applications for augmented reality are wide ranging. They are included in different areas such as the following:

2.6.1 Direction:

Direction finding applications also known as navigation are mostly the natural fit of augmented reality. Enhanced systems like GPS are being used to make it easier for the user to get from one point to another.
Eg.:Yelp Monocle app developed by Yelp, Inc.

2.6.2 Sightseeing:

There are a various applications for augmented reality in the sightseeing and for tourism industries. The sightseeing application has been made more enthralling with the use of augmented reality. A smart phone equipped with a camera, vacationers can walk through any historic events and see the facts or figures overlaid on their live camera screen.
Eg. Field Trip app by Niantic, Inc.

2.6.3 Military:

The HUD (Heads-Up Display) is the prototype of augmented reality when it comes to military applications. Data like elevation, airspeed and the prospect line and any other critical data can be shown in the form of a transparent display which is directly positioning the fighter pilot’s view. The term "heads-up" came from the fact that the pilot doesn't have to look down at the aircraft's instrumentation to get the data they need.
Eg:US Army integrated the SmartCam3D [7] augmented reality system into the Shadow Unmanned Aerial System to aid sensor operators using telescopic cameras to locate people or points of interest.

2.6.4 Medical:

There have been truly remarkable progresses in medical sciences application. Visualizations explain obscure medical conditions to patients. AR can minimize the risk of an operation by giving the general practitioner an enhanced sensory acuity. AR can also be combined with the technology like MRI or X-ray systems which can bring everything into a single view.
Eg. VeinViewer (near-infrared vein finder).

2.6.5 Gaming:

With the advanced progresses in computing systems and related technology, gaming applications in augmented reality are on a peak. Many new games use the features of Augmented Reality which makes the environment more mesmerizing and agreeable.
Eg: Ingress developed by Niantic, Inc.

2.6.6 Education:

Augmented reality applications can complement a standard curriculum. Text, graphics, video and audio can be superimposed into a student's real time environment. Textbooks, flashcards and other educational reading material can contain embedded "markers" that, when scanned by an Augmented reality device, produce supplementary information to the student rendered in a multimedia format.
Eg: Star Walk developed by Vito Technology [9].

2.6.7 Entertainment:

With the reviews on AR, the marker based AR is a great source of entertainment nowadays. This AR category allows the users to interact with objects on your computer screen in 3D.
Eg: Snapchat Filters, AR coloring books, etc.

2.6.8 Manufacturing, Maintenance and Repair:

Instructions are easier to understand as they are available as 3D drawings superimposed upon the actual equipment showing step-by-step the tasks to be done, instead of appearing as manuals. Augmented reality can also be extremely helpful when interacting with complex machinery and structures.
Eg: iQagent is the practical Augmented Reality Manufacturing app.

2.6.9 Home Decor:

Furniture arrangement in house or in office can be a tedious job if there are too many items to be placed in the room or simply people don't have any idea how to lay out the furniture. People can either draw up the room and furniture in paper or they can just arrange furniture right away to see how it looks and fits in the room which may be tiring and one may not be satisfied with the final result, which would lead to the same task being done again and again till the desired result is achieved. Augmented reality aids people with visual effects that relate to the environment of the space and with this concept people can view the furniture in the room without actually placing it in.

Using Augmented Reality, Interior Illusions is an app that allows one to virtualize the decoration of his/her home,office etc‘s interior in a matter of seconds. It proposes a Markerless application for interior decoration purposes, in which any novice user can easily decorate his/her home. The Augmented Reality virtualization allows one to put his/her selection of objects inside one’s own interior to allow him/her to make a better evaluation of how it will fit in his/her own space.No longer will one have to guess if the sofa and side table will work with the size, layout and design of the room. The entire process of designing one’s interior can be carried out easily from the comfort of the very place they want to design as opposed to the current process of interior decor wherein the user has to go visit several shops,take measurements,samples,change placements as per the look,need ,etc which is a lot of work.

The user can also try out different wallpapers colours,etc through the app instead of having to try a particular sample of paint on one small ‘patch’ of the wall ,which might not give the user an idea of how the entire wall will look with the same colour or whether it will complement other interior items in the room. Thus,instead of trekking down to the showroom with a measuring tape, camera, and color swatches, the user can now shop comfortably in their own room without the fear of buying something that does not fit with the rest of the decor. Not only does it make the whole process simple but also gives the user a wide variety of items to try out and experiment with. Using Interior Illusions, one can visualize multiple models at the same time to find the perfect configuration.One can thus create his/her own custom home design in high quality 3D Augmented reality right on the spot at home and see how well everything fits by choosing from a wide variety of home furnishing products. Interior Illusions thereby provides a platform to the user to picture his perspective.

2.6.10 Other applications may include Advertising and Promotion etc

Of course, the augmented reality technology is a bit crude yet and still in its infancy. But we foresee its fast development and evolution because of some key drivers as an increasing number of phones and tablets and their extended functionality or increasing internet speed.

3. DESCRIPTION

Our application, Interior Illusions, uses AR to overlay 3D objects like furniture and interior design products over the real environment, enhancing the user's perception. It allows users to visualize their selection of objects inside their own room and to make a better evaluation of how it will fit in the room.

All the furniture in the catalogue is realistic and reproduced in size as they would be in real life. Users can immediately understand what table is best fitted for the dining room or whether a cabinet can fit in a tiny space. Once the user has found the furniture that fits better in the room, he/she can start configuring it by choosing his/her favorite setup, color, material or texture or the user can combine it with other objects to complete the décor of the interior.

However, what goes inside the processing is more complex. Figure 4, shows the block diagram representation of the involved tasks. The tasks involved in the processing are:-
1. Acquisition,
2.Tracking,
3.Rendering,
4. Displaying.

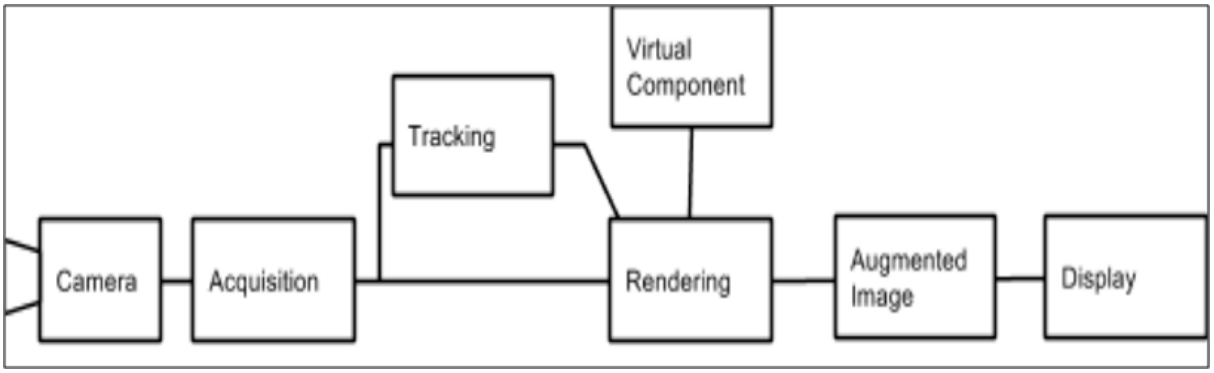

Figure 4: Procedure Description Block Diagram

3.1 Camera, Acquisition & Tracking

There are many types of input devices for augmented reality systems, but smartphones and tablets such as Android-based phones, iPhones and iPads are currently the most useful type of input devices. They are most handy and they come with built-in cameras.

Mostly, the previous developers used markers based augmented reality systems. However, those systems actually hide the reality and it was also difficult to keep the markers everywhere. Smartphone camera is matured enough that it can recognize real world objects without markers.The app works with the camera device to interpret the angles and distance of

mobile phone from where the object is to be placed. Due to the number of calculations a phone must do to render the image or model at the right place, often only smartphones are capable of supporting augmented reality with success.

3.2 Virtual Component

3D artists use one of several software programs to create 3D models which will be used as virtual component; the most popular of these include SketchUp, 3DS Max, and Blender [11]. We will be mainly using Blender for the process.

Starting with a rough sketch of what the final model will look like, the image will typically go through an approval process that refines the idea. Once they have been approved, the modeling begins. The more complex the model, the longer this stage will take.Their details are also more intricate, so texturing these models requires more time. Next, a texture map, which is the model's 'skin', is applied. The texture map can be styled to fit the needs of the project, and it is where much of the realism of the model is conveyed. Because it is an image being placed on the model, its level of detail will determine how realistic the finished model will look.

3.3 Rendering

Although AR is not exclusively focusing on visuals, most research focuses on graphics augmentations, making rendering the second important aspect after tracking.

In this stage, the virtual object created is overlaid on the real world. It takes care of aligning, positioning the virtual component and projects it in the scene. Scripting languages like C# and Javascript are used for implementing the application. Unity, Kudan provide good rendering engines which take care of occlusion, smoothness, resolution, texture, shadows, ambient light analysis etc. This helps CG better match the environment and create a more realistic rendering.

3.3.1 C# Code for placing an object on Touch Input

```
using UnityEngine;
using System.Collections;
namespace Kudan.AR.Samples
{
        public class SampleApp : MonoBehaviour
        {
    public KudanTracker _kudanTracker;// The tracker to be referenced.  Kudan Camera object.
    public TrackingMethodMarker _markerTracking; // The reference to the marker tracking
                                        method that lets the tracker know which method it is using
    public TrackingMethodMarkerless _markerlessTracking; // The reference to the markerless
                                    tracking method that lets the tracker know which method it is using
    public void MarkerClicked()
```

```
    {
        _kudanTracker.ChangeTrackingMethod(_markerTracking); // Change the current
tracking method to marker tracking
    }

    public void MarkerlessClicked()
    {
        _kudanTracker.ChangeTrackingMethod(_markerlessTracking);
        // Change the current tracking method to markerless tracking
    }

    public void StartClicked()
    {
        Vector3 floorPosition;            // The current position in 3D space of the floor
        Quaternion floorOrientation;  //The current orientation of the floor in 3D space,
                                          relative to the device
        _kudanTracker.FloorPlaceGetPose(out floorPosition, out floorOrientation); // Gets the
        position and orientation of the floor and assigns the referenced Vector3 and
        Quaternion those values

        _kudanTracker.ArbiTrackStart(floorPosition, floorOrientation);// Starts markerless
        tracking based upon the given floor position and orientations
    }

void Update(){
        int k = 0;
        while (k <Input.touchCount) {
                if(Input.GetTouch(k).position.x){
                        if(Input.touchCount > 0)
                                StartClicked();
                        }
                }
                k++;
        }
   }
  }
}
```

3.4 Augmented Image & Display

Figure 5 shows Augmented Table placed in real background.
As can be seen in the image, an augmented object, in this case a table has been placed in the real life environment pointed by the camera. The object is movable as well as resizeable as per the user's view and satisfaction.

Figure 5:AR display

3.5 Why Interior Illusions?

Augmented Reality is a technology that is sneaking up on us. Perceived as the technology of the future, it is making its way in the marketplace with its increasing advantages. To list a few, here are some reasons as to why Interior Illusions is better than the traditional method of just viewing 2D images of furnitures before purchasing them.

3.5.1 Removing Barriers to Purchase

When it comes to ecommerce, today's customers expect a shopping experience tailored to their unique interests. Interior Illusions application deliver highly personalized experiences that capture the attention of shoppers and stimulate them to engage with products rather than casually browsing the brand's offerings online. A greater level of customer engagement means higher conversion and loyalty rates. Interior Illusions will provide customers with a preview of how items will look in their homes before they commit to a big purchase. Thus, retailers avoid losing sales that would not have materialized due to customer indecision. It will help decrease common objections furniture shoppers often have when making the decision to purchase. Will it fit in my living room? Will this look okay in my bedroom? Augmented reality for retail is helping customers answer these questions themselves, thus raising a positive excitement about their purchase.

3.5.2 Increasing engagement

When it comes to ecommerce, today's customers expect a shopping experience tailored to their unique interests. Interior Illusions application deliver highly personalized experiences that capture the attention of shoppers and stimulate them to engage with products rather than casually browsing the brand's offerings online. A greater level of customer engagement means higher conversion and loyalty rates. Engaged shoppers are also more likely to forego searching for the lowest price in favor of a more informed, enjoyable shopping experience.

3.5.3 Minimizing Returns

Ikea reports that up to 14 percent of its customers buy furniture that turns out to be the wrong size. Interior Illusions uses technology that accurately represents the scale of furniture and appliances, thus allowing customers to preview how they will fit in their rooms before taking them home, minimizing the probability that the items will need to be returned.

3.5.4 Without marker

The most popular existing app in market, IKEA[10], uses markers to let the customers view the augmented image of furniture. The use of markers everytime can be annoying, also

markers need to be taken proper care of as they are specific and cannot be replaced for markers designed for other objects, unless a totally, new, similar unscratched marker is used. Interior Illusions, focuses on creating and displaying the augmented image without markers.With the help of new plug-in, Kudan, markerless display of images can be achieved.

3.5.5 Better Marketing

Interior Illusions uses Augmented reality which is fresh, fun technology that customers can play with and share with their friends through social media. It allows users to save and share images of their room makeovers and product picks, thus creating powerful user-generated marketing content and improved brand recognition via word of mouth.

3.5.6 Wide range of products

Augmented reality technology makes it possible for the customer to test drive different products in real time.In Interior Illusions, users can see how the different selected products will look at home before buying. This is an interesting way to link the on- and offline worlds via a smartphone and yet another attempt to improve customer proximity at every consumer touchpoint. The app gives the users more flexibility to shop however, whenever and wherever they like.

3.5.7 Increase in sales

AR technology is becoming much more of mainstream among retail businesses. Consumers are increasingly tech savvy who tend to make their purchasing decision from home or on a mobile device. AR is the segway for retailers to create more meaningful, memorable shopping experiences for customers while leveraging their digital audience in the process. AR solutions can help customers try specific products in the store. This not only saves the shopper valuable time, but increases the likelihood of making more sales. According to the Accenture 2014 AR Survey [8], 61 to 88 percent of the respondents are more likely to make a purchase based on their AR app experience.

It is certain that the smartphone population is rising, and with this, the level of processing power is too. More and more consumers are carrying phones capable of displaying augmented reality, and once our app is downloaded it can be used anytime. As long as the augmented content remains engaging and innovative, consumers will certainly adopt augmented reality as a new and fun twist to conventional services.

4. PROPOSED IMPLEMENTATION

We now know that, Augmented Reality turns the environment around us into a digital interface by placing virtual objects in the real world, in real-time.This chapter explains in brief, the working as well as the softwares that are required for the implementation of Interior Illusions.

4.1 So How Does It Work?

Our augmented reality app is designed such that you first select item,and then point the phone's camera in the room where you'd like the piece of furniture to be. Tap on the location where you did like it to be placed. The result of this procedure is shown figure 6.

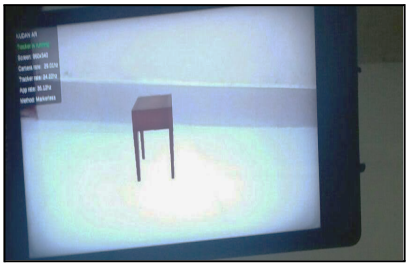

Figure 6:AR implementation

You then view the room "through" the app on the screen of your smartphone or tablet, which displays a live virtual
preview of how the product would look in your target location. You can view the 3D furniture from any angle and move it around the room.

While the app's interface is simplistic, it's easy to navigate and doesn't require the user to read extensive instructions to figure out how to use it. Best of all, it instantly creates crisp, high-resolution graphics that speak for themselves.
The app does not process transactions, but you can click on 'buy' option that will redirect you to the manufacturer's website.

4.2 Software Used for Interior Illusions

- Kudan
- Unity
- Blender

Let's take a brief look at what these softwares' IDEs do before noting the importance of each of these applications in the implementation of Interior Illusions:

4.2.1 Kudan

Founded in 2011 with prior experience in the Japanese market, Kudan is a rarity in Augmented Reality circles. The Kudan SDK gives developers a robust and lightweight Augmented Reality engine for iOS, Android and Windows powered devices. Compared to what is currently available in the Augmented Reality market today it offers greater flexibility and more features to aid the creation of quality computer vision based applications, without the need for specialized knowledge.

The Kudan AR SDK offers developers significant differentiators to existing solutions.

- A built-in suite of modern tracking capabilities including on unlimited, local marker (image) based and markerless tracking (SLAM, Arbi-Track).
- A 3D rendering engine facilitates realistic, animated 3D models and HD video.
- The SDK has a very small footprint, meaning that devices with limited storage space, for example Smart Glasses, Machine Vision applications and Internet of Things (IoT) sensors, will also benefit from the lightweight SDK.

Use in Interior Illusions:
Kudan will be used to build major components of our app. Some of them being

a. Superimposing objects(furnitures,etc) in environment without marker.
b. Tracking the object placed.
c. Camera acquisition and placing objects at desired position.

4.2.2 Unity

Unity is a cross-platform game engine developed by Unity Technologies and used to develop video games for PC, consoles,mobile devices and websites. First announced only for OS X, at Apple's Worldwide Developers Conference in 2005, it has since been extended to target 21 platforms.

Unity allows specification of texture compression and resolution settings for each platform that the game engine supports, and provides support for bump mapping,reflection mapping, parallax mapping, screen space ambient occlusion (SSAO), dynamic shadows using shadow maps, render-to-texture and full-screen post-processing effects.

Use in Interior Illusions:

- Kudan supports unity 64-bits.
- It will be used as the platform for developing and combining all the components of the app.
- It also deploys the app in mobiles, tablets,etc.
- It will allow resizing of furnitures i.e. zoom in and zoom out.

4.2.3 Blender

Blender is a professional free and open-source 3D computer graphics software product used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications and video games. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation. It also includes 3D modeling, UV unwrapping, texturing, sculpting, animating, camera tracking. It further features an integrated game engine.

Blender is cross-platform and runs equally well on Linux, Windows, and Macintosh computers. Its interface uses OpenGL to provide a consistent experience. It is well suited to individuals and small studios who benefit from its unified pipeline and responsive development process.

Use in Interior Illusions:

- Blender is important for creating 3D models of furniture.
- It allows modelling, sculpting and animating objects, to look closest to real life objects.
- It also lets us add texture and colors to the furniture, thus letting us customize it as per manufacturer's demands.
- This 3D models are later imported as assets in unity.

4.3 Features Of System

This is basically a very rough idea of what the main menu should look like in our application. Most beginner scan use the app without help, with it's user-friendly interactive UI.

We are providing users with all furniture types in a particular category on the models screen. E.g., If there are 3 categories namely tables, chairs and luminary in the Kitchen, all these are shown to the user on the Home screen so that he can visualize multiple types of furniture in the same scene. In the main UI, there are 4 categories, Living Room, Dining Room, Kitchen and Bedroom. We've made efforts to include different types of furniture models even in the same categories.

In the Camera screen the user has to select a model directly, which will then be overlaid in real time in the live camera feed. The user also has an option of saving the current screen to view it later again. The screenshot will appear in the gallery in Android. There is also an option to reset the screen if the user is not satisfied with the image or wants to overlay another model after discarding current one. We also provide the user with a "Info" screen.

The Info screen will allow the user to change app settings like dimension of selected furniture model, buy from the website, etc.

5. COMPARISON AND DISCUSSION

Over the last few years, we've been witnessing a growing and evolving Augmented Reality ecosystem. Image recognition has become more stable, facial recognition more popular through Snapchat and Facebook , and of course Pokemon Go's arrival on the scene has introduced the majority of consumers to Augmented Reality. However, as Augmented Reality has evolved and become more diverse, it's also become more complicated to define Augmented Reality technology.Augmented Reality is also available on multiple platforms thereby creating different challenges and opportunities. We've outlined a few existing methods through which an AR app can be developed and discussed in brief how our app fits in all of this.

5.1 3D AR with marker

This type of AR uses a camera and a visual marker baked into the content that a marketer wants to present, as shown in Figure 7. The viewer holds up the content to the camera to see the AR in action.

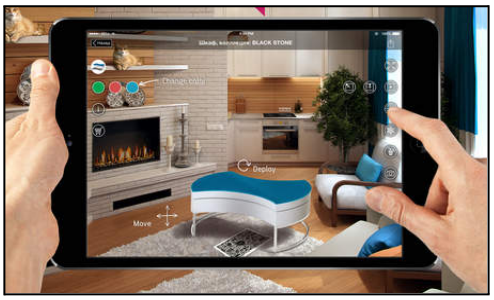

Figure 7: 3D AR with Maker

In such apps, core components of the solution include the store's catalog application, used as a digital layer on top of the print catalog, and image-recognition technology that identifies the catalog pages without the need for QR codes or symbols [8]. The readers simply scan the catalog pages with their smartphones or tablets to unlock a world of new content. They can, for example, see what's behind a closed closet door, launch a 360-view of a room set, and display how to assemble products. They even have the ability to place virtual, life-size pieces of furniture in their own homes to determine if the color, style and size fit their needs. This all but eliminates a major barrier to online purchases, and signi cantly reduces the risk of returns. Going to a store may be difficult for many customers so giving them the ability to see virtual images of products will help customers to make purchase decisions and buy online.

The service works by users scanning selected pages in the store's printed catalogue with the catalogue app or by browsing the pages in the digital catalogue on a smartphone or tablet. After selecting a piece of furniture, users put the catalogue itself on the ground, where it acts as a sort of anchor i.e marker for the 3-D image of the chair or table. If the furniture needs to be rotated, the user simply rotates the catalogue.

Demerits:

- Visual markers have been widely used in Home Decor apps. In most of these applications, the performance of an AR system depends highly on the tracking method for visual marker detection, pose estimation, and so depending on the particular application.
- The visual marker's design can differ from one to another. But the use of these visual markers limit the interactivity and are constrained to a range of photos or objects encapsulated within a border to create the marker. Therefore, in order to use this approach, these visual marks have to be printed previously and also be kept for future uses which can also be considered as visual clutter.
- The use of markers increases robustness and reduces computational requirements. However, their use can be very complicated, as they require maintenance.

Direct use of scene features for tracking, therefore, is desirable. Therefore, a markerless tracking approach is strongly advised in such scenario.

5.2 3D markerless AR

As its name suggests, this type of AR uses a graphic instead of marker. As a result, AR implementation and use is easier. Markerless Tracking is one of best methods for tracking currently. It performs active tracking and recognition of real environment on any type of support without using special placed markers.

Figure 8: 3D markerless AR

As shown in the figure 8, with 3D markerless AR one can easily picture the placement of furniture inside their home. It uses a tablet or smartphone camera and sensors to position the virtual object in a room without the need for physical markers. It is better than previous one as in 3-D marker based tracking users will likely need to point their smart device's camera at the kind of markers found in the store's catalogue,brochure,etc. The device's camera gives a view over the room, while the clever software lets one place items (actual-sized) in real-time. The app is marker-less, meaning one doesn't have to place markers on the floor to show furniture in their home, unlike other AR apps that attempt the same thing.With this freedom in one's hands, one can freely combine home furnishings into his/her dreamed-of decoration.

This technology uses a combination of internal sensors in the device and image processing that continuously scans the environment the camera sees, resulting in a near reality visualization of the product. Before the markerless magic on the smartphone or tablet screen happens though, a retailer will need to integrate the app's augmented reality system into its online or printed catalog. If suitable 3D models already exist, these can be uploaded to the app's cloud servers, but renders will be created as a professional service if needed.

Each retailer's product catalog and related information is accessed by the customer .The augmented catalog content can be accessed and visualized by clicking a button near the product image . The customer frames up the desired location using the device's camera and the app scans the area. The virtual product rendering then bounces into position, and can be twisted and turned for precision placement thanks to a 360-degree Super Reality technology, while the built-in tracking engine maintains scale and position as the user moves around. Usually apps of this type , use real time feature extraction and matching combined with it's own algorithms and device sensors. Basically a user looks at the scene that is being recorded, extracts certain features and uses it in order to continuously place the product in the right location and scale.

Demerits:

- Tracking and registration techniques become more complex.
- The recognition algorithm running should identify patterns, colors or some other features that may exist in camera frames. Hence, more processing is required.
- All models in a particular room are locally stored and immediately loaded when activity for that room starts, resulting in high memory usage,high size of application and loading times.
- Models possess low shadow and reflection effects, resulting in a not-so-realistic feel.In the future, models can be improved for cutting edge hardware.
- Application works perfectly on high end phones but performance degrades on low end phones.

5.3 Interior Illusions

In this project we are using AR to create an application which can aid in interior designing. When designing interior of the house, one has to imagine how the things will be placed or look like. If we create an application via which, the user can virtually place various furniture or interior design elements in the house or space which is to be designed ,the user will get a real time scenario of how the house or space will look like after interior designing.

This is an application which allows users of Android smartphones to visualize different types of furniture in their homes, offices, etc. The user directs his camera towards the scene he/she wants to decorate and selects among different types of furniture models, which will then be overlaid on the scene giving an illusion that the objects are actually present in the environment.

Whenever a user wants to decorate his/her home/office or other interior environments or simply rearrange furniture, there isn't currently any convenient and quick way to do so. In such scenarios a user must visualize through imagination, instead of actually being able

visualize in real time. By harnessing the power and convenience of modern technology on smartphones and tablets, we can create an app that allows a user to do so.

The proposed system is a tool for design style of building interior 3D objects using markerless based Augmented Reality, the proposed system uses a markerless based AR system .

A few features of Interior Illusions are as follows:

- It provides a wide variety of furniture for the user to choose from.
- Also lets the user visualize a wide number of artifacts,showpieces.
- User can also visualize different wall paints,wallpaper designs for their room / office etc.
- Once the user is happy with the product of his/her choice ,the app will redirect him/her to the respective product's site for pricing,purchase ,etc

With Interior Illusions we attempt to combine all aspects of interior designing in one single app to make the process of interior design simple,fast and more interactive. It lets the user design his room according to his/her imagination and change it as many times as he/she wants till the user is satisfied .

No longer will the user have to test physical wall paint samples on the wall for colour or imagine how a particular piece of furniture,artifact,etc will look in a particular corner of the room instead with Interior Illusions, the user can envision how his newly designed room will look .

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