Inter AR: Interior Decor App using Augmented Reality Technology

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Abstract:

This paper focuses on the implementation of the mobile application that gives a virtual view of a reel furniture object in the real world by using Augmented Reality Technology [1]. Augmented Reality (AR) is a technology that overlays the virtual objects in the environment of the real world. AR render's the real-world information and present it in an interactive way so that virtual elements become part of the real world. This application will help the user to have a look and feel of the furniture object in the current environment before purchasing it from the store.

Keywords---Augmented Reality (AR), Render, virtual;

1. INTRODUCTION

Augmented reality (AR), is a technology that overlays computer graphics on the real world and has its applications in the field of engineering and architecture to tackle real life problems. There are many existing systems that uses AR such as clothing, gaming, and navigation which provides an interactive experience in reality [2]. The primary role of augmented reality is that it brings components of the digital world into the existence of the real world. The component does not just appear as simple display of data, but due to the augmentation it is perceived as natural parts of an environment. Using this AR technology, an interior décor app is implemented which will help user to have a virtual view of furniture in the real world before purchasing it. Through this application the user can select a virtual furniture from the options and place it onto the captured space by just dragging the virtual furniture on the real environment. The application will be compatible with all the existing android versions where the mobile camera is an important component. The camera is performing image capturing in real time environment for a panoramic view where the user can manipulate the location of the selected furniture and view it in various angles. With the use of this application the user will be able to save time and efforts for selecting the furniture by visiting the shop physically. The implementation of the AR technology in the mobile application is done with the help of AR SDK tools. In Augmented Reality (AR) various types of 3D objects are placed in the real world.

Before placing of an object, the corner detection and plane surface detection is done in the real time environment. The Harris and Stephens corner detection algorithm focuses on detection of the feature point based on the camera image. This algorithm is basically divided into 5 steps:

1. Colour to grayscale.
2. Spatial derivative calculation.
3. Structure tensor setup.
4. Harris response calculation.
5. Non-maximum suppression.

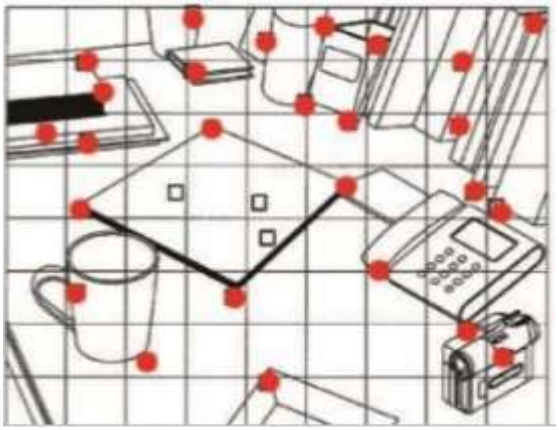

Fig 1. Harris Corner Detection Algorithm.

Plane surface detection in AR is based on the SLAM Algorithm i.e. surface localization and mapping technique in an unknown environment and updating it with the known environment [3].

Thereafter the Tracking and rendering of the surface is done and then the augmented object is rendered and placed on the real time environment.

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2. EXISTING SYSTEM

Recently, AR technology is very much in demand in the field of science and medical but it has also started evolving in the field of engineering and architecture as a result various research are undergoing. Following are the various methods which are used to develop various existing system using AR technology:

2.1 Marker-based Augmented Reality

Marker-based augmented reality (also called Recognition based) uses a camera focuses on recognition of real-world objects or some type of visual markers, such as a QR/2D code or NFT markers, to produce a result only when the marker is detected by a reader. Marker-based applications use a camera on the device to match a marker from any other real-world object. Simple patterns (such as a QR code) or actual real-world image (NFT) or real-world object are used as the markers. The orientation and position are also calculated, where some type of information has been overlaid on the marker. Once the marker recognition is done then the object is placed on it, If the user desire to rotate the object it will rotate the marker hence the object will also be rotated.

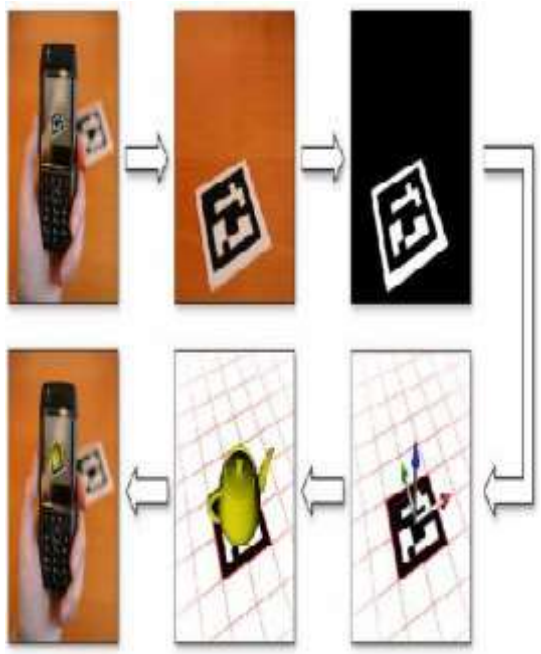

Fig 2. Marker-Based AR

2.2 Location-Based Augmented Reality

As one of the most widely used applications of augmented reality, marker less (also called location-based) augmented reality, uses a GPS, digital compass, velocity meter, or accelerometer which is inbuilt in the device to provide data based on the user's location. A strong force behind the location based augmented reality technology is the wide availability of smartphones and location detection features that the devices provide [4]. It is most commonly used for locating the directions, finding nearby places, and other location-centric mobile applications.

2.3 Projection-Based Augmented Reality

Projection based augmented reality works by the projection of artificial light onto real world scenario. Projection of light on objects

can be used to analyse the position, orientation, and depth of a virtual or real object. In such a case an object is taken into consideration and its structure is studied in depth. Detection of the

user's interaction is done by differentiating between an expected projection and the differentiated projection. One of the interesting applications of the projection-based augmented reality is laser plasma technology to project a three-dimensional (3D) interactive hologram into mid-air [5].

2.4 Outlining Augmented Reality

Though the human eye is known to be the best camera in the world, there are limitations. We cannot look at things for too long. We cannot see clearly in the low light conditions and our eyes cannot see in infrared. For such cases, special cameras are built. Augmented reality apps which perform outlining example AR cameras. Once object recognition sits behind all that outlining AR can do and might look a bit like a projection-based AR. For example, whenever you're parking your modern car in the dark, outlining AR is used.

2.5 Superimposition Based Augmented Reality

Superimposition based augmented reality partially or fully replaces the original scene of an object with a newly augmented scene of that same object. In superimposition based augmented reality, object recognition plays an important role because the application cannot replace the original view with an augmented one if it cannot determine what object it is. For example, whenever the driving person is parking your car in the dark, outlining AR recognizes the boundaries of the road and outlines them for the driver. This method can also be used in architecture and engineering to detect the buildings and their supporting pillars [6] [7].

3. WORKING MODULES

Whenever we want to buy furniture from an ecommerce website, it is a very important task to imagine how the desired furniture will look in the real world environment. It is quite difficult to imagine that which colour, texture, size and orientation will suite in the house. As the imagination of the purchaser may not be the right choice in reality. In the case of interior designing, the designer especially applies the three basic principles of interior design, that is, scale, size and proportion. Thus, the proposed Augmented Reality System is focused on giving the user flexibility to design using the three basic principles. The user is able to adjust the properties of virtual furniture and create different arrangements in real time environment.

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3.1 System Architecture

In the case of interior design, the designer essentially applies the three basic principles that is colour, scale, and proportion within a predetermined space. Thus, the implemented system focuses on giving the user the flexibility to design their home based on these three basic principles using marker-less based AR.
The Data module consists of the 3D objects required for the application. The Position tracker and orientation tracker uses marker less AR to find the coordinates for corner detection and detects a plane surface where the object is to be placed. OpenGL renderer renders the 3D furniture on the detected surface and the user interact with the selected furniture using the interaction routine. The interaction of the user and the application is undergone with the help of camera.

3.2 Requirements

- Compatible Android Device
- Unity Software
- AR SDK Toolkit.

3.3 Use Case Diagram

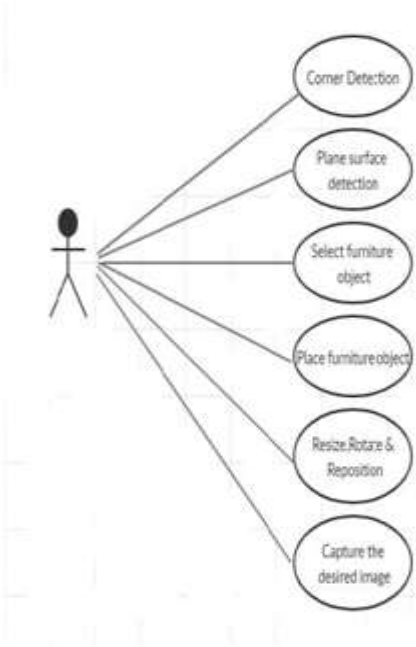

Figure 3. Use case Diagram, Working of Application

4. MODULES OF THE PROJECT

The roles of the modules of the product are given below.

4.1 Camera

A continuous video frame is given as input to the camera of android handset.

4.2 Image Processing Module

The binary images generated by the Image Capturing Module are input to the Image Processing Module. This module process the binary images and detects the marker using image processing techniques. To place the object in the real world, marker position is determined.

4.3 Tracking Module

The location of detected marker is provided to the Tracking module which is the heart of augmented reality system. It calculates the relative pose of the camera in real time.

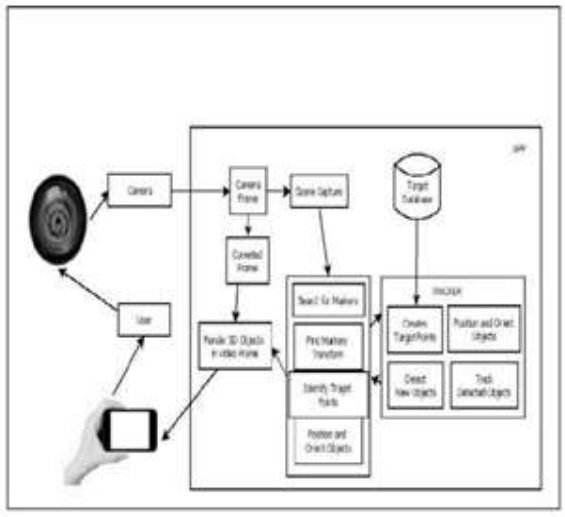

Fig. 4: AR Application Architecture

4.4 Rendering Module

The Rendering Module has 2 inputs. First is the calculated pose from the Tracking Module and the other is the Virtual Object to be augmented. This module combines the original image and virtual components. It displays the augmented view on the screen of Android handset.

5. IMPLEMENTATION DETAILS

The below given steps give the complete flow of the implemented product.

Step 1: Initially, a platform is created to integrate all different entities to accumulate and achieve the objectives described in the paper. The platform will contain requisite user interface of the application. The script will be deployed to the basic object which will be later succeeded with the actual object designed using Unity and 8th Wall software which are specially meant to design Augmented Reality Applications.

Step 2: The script will comprise of all divergent functionalities to provide the user with varieties of viewpoint to test with.

Step 3: To make things simple for the new user, they are provided with few presents which will give the abstraction and flow of the application.

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Step 4: Algorithms for plane detection and 3d object recognition are implemented to mark the target points. ie. Marker less AR.

Step 5: All the modules are integrated and developed into the engine. EG. Unity3d, android studio.

Step 6: The Project is extended to VR using the same script and 3d models using google cardboard SDK.

Step 7: A simulation world is made available to the interior design developer's. This will allow them to visualize the blueprint of a project in distinct environment.

Step 8: A module is created to select the choice of the scenario. This will also include the option to switch the project course .i.e. AR, VR. The plan and design can be saved and exported to interior developer's personal device.

6. RESULTS

The following are the snapshots that convey the details of the implemented product.

Fig 5. Corner and Plane Surface Detection

Fig 6. Object Rotation

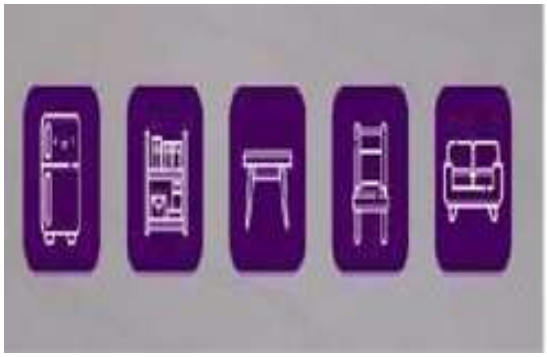

Fig 7. 3D Object Selection

Fig 8. Object placing

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Fig 9. Object Rotation

Fig 10.Object Resizing

7. LIMITATIONS

AR Technology is not widely supported in all android devices , so to overcome the issue 8th wall was used, as 8th wall is still a developing arsdk tool, hence the lack of accuracy in the application is faced.

The furniture object which are seen in the option are imported from the backend and stored locally and hence no existence of photogrammetry which will the enable the application to convert the picture image into 3D object.

The application unable the user to place two or more instances of object on a single surface due to limited features provided by the sdk tool.

8. CONCLUSION AND FUTURE WORK

In this AR environment, the user is able to adjust the properties of virtual furniture and create its own arrangements in the real world. Through the mobile camera the user can detect the plan surface and select the furniture through the application and place it on the screen. Further this mobile application can be integrated with Artificial intelligence to enhance the user's imagination and give an animated experience in real-time environment.

This paper mainly focuses on the implementation of an immersive designing solution on a mobile platform based on the principles of Augmented Reality (AR). As a design solution, this application can help cut the prototyping costs and help simulate a better experience for the customer. It also enables the customer to be the designer themselves and make their home as they want it to be. It also helps them to set a theme in the house and get a feel of it before placing an order. This application will also prove beneficial to the companies for advertisement purpose.

Thus, this system can overcome the following shortcomings:

a) Difficult to fulfil the customer's content to design their room without actual image of the finished room.

b) Catalogues don't provide all the possible views of the furniture.

c) Difficulty in visualizing the furnished space.

d) Constraint in the number of furniture that can be displayed in shop

9. ACKNOWLEDGMENT

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