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Interior Design Using Augmented Reality

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Abstract: Augmented Reality (AR) technology is used in various products and fields. It is often used in the application that simulates an arrangement of furniture. This paper presents an application of Augmented Reality technology for interior design. Augmented Reality offers many advantages for digital architectural design and construction fields. AR is also being considered as a new design approach for interior design. In an AR environment, the virtual furniture can be displayed and modified in real-time on the screen, allowing the user to have an interactive experience with the virtual furniture in a real-world environment. Nowadays, there are lot of people familiar with computer system and communication technologies. Hence this application helps to explore the prospect of new form of Virtual Reality (VR) application called Augmented Reality. This application is based on Augmented Reality (AR) for Interior Design, which supports real time tracking with Identification Markers. Also the system uses FAST corner detection and local window matching algorithms to establish 3D maps.

Keywords: Augmented Reality, Tangible AR, AR Tool Kit, Interior design, Feature detection.

I. INTRODUCTION

It seems that every few years, people all over the world are increasingly using Augmented Reality [1] and 3D technology in their daily life. As computer technology getting better, augmented reality and 3D technology developed more rapidly.

Augmented Reality (AR) employs computer vision, image processing and computer graphics techniques to merge digital content into the real world. It enables real-time interaction between the user, real objects and virtual objects. Augmented reality technology allows the user to have an interactive experience with the real world.Recently augmented reality (AR) furniture arrangement systems help users overlay virtual furniture onto the real world [2].

Such systems allow people to see how the room will look with new furniture without actually buying or moving real furniture. To date, conventional AR systems have only shown an augmented view from a single viewpoint (the camera's), which is not always ideal for understanding how the room will look in reality. Thus, the user needs to physically move around the room every time he or she wants to view the room at a different angle. Some systems have been proposed that switch between AR and virtual reality (VR) modes, and allow free viewpoint navigation in the VR mode [3,4]. Augmented reality technology is categorized into two types: Marker-based AR and Marker-less AR. The project is based on Marker-based AR with identification of marker which is inexpensive and also very easy to use. The project is an android mobile based application which will be compatible with all the existing and upcoming versions of android handsets. The user has to install the application and run it on the android handset or tablet. Then place the markers on the floor at required positions. Start the application which will allow starting the camera. Project the camera on the marker. The marker will be detected, the co-ordinates of marker will be calculated and 3D objects will be generated over the marker dynamically. This application can detect single markers and generate single virtual objects. The objects are viewed virtually in the real world and the user can move, scale and rotate it virtually. Also user can browse different furniture and select the best suitable furniture design for the house.

II. INTRODUCTION OF RELATED TECHNOLOGY

A. Augmented Reality Technology

Augmented Reality (AR) is a new technology that involves the overlay of computer graphics on the real world. As a result, the user can see the real world augmented with virtual objects and can interact with them. Within a more general context, AR is also termed Mixed Reality (MR), referring to a multi-axis spectrum of areas that cover Virtual Reality (VR), Augmented Reality (AR), telepresence, and other related technology.

A particularly important property of AR is locating virtual objects in the right place and position, which makes the Tracking System one of the most important components of an AR system. Essentially, an AR system must be able to follow the user's point of view dynamically and keep virtual objects aligned with real world objects. The basic components of an AR system are a display, camera for graphic captures, and computer installed application software, plus various different kinds of hardware can be used, for example, camera phones, PDAs, laptops, HMDs, and wearable computer systems.

B. FAST Operator

Feature from accelerated segment test(FAST) is a corner detection method, which could be used to extract feature points and later used to track and map the objects in many computer vision task.This project uses the Fast tracking mode. The algorithm has very fast processing speed, can implement real-time feature point detection. It's different with most of the methods used by the feature detection, through calculating response function of the corner among the whole image range to determine the corner of the image, the FAST corner detection uses accelerated fragment test, detects corners with the fragment test as criteria, add machine learning to accelerate the corner detection.

C. AR ToolKit

AR ToolKit is an open-source computer tracking library for creation of strong augmented reality applications that overlay virtual imagery on the real world. An AR ToolKit library is used to determine the relation between the real and virtual world. The AR ToolKit uses a computer vision technique to define the position and orientation of the real camera viewpoint relative to a real world marker. Next, the AR ToolKit defines and calculates the position of the virtual coordinates.

D. Vuforia Augmented Reality SDK

Vuforia is an Augmented Reality(AR) Software Development Kit(SDK) for mobile devices that enables the creation of Augmented Reality application. It uses computer vision technology to recognize and track planar images and simple 3D objects.

The Vuforia SDK supports a variety of 2D and 3D target types including "Markerless" image targets and 3D multi-target configurations. Vuforia is a cross-platform Augmented Reality (AR) and Mixed Reality (MR) application development platform, with robust tracking and performance on a variety of hardware including mobile devices and mixed reality Head Mounted Displays (HMD) such as the Microsoft HoloLens.

It uses Computer Vision technology to recognize and track planar images (Image Targets) and simple 3D objects, such as boxes, in real-time.

This image registration capability enables developers to position and orient virtual objects, such as 3D models in relation to real world images when these are viewed through the camera of a mobile device. The virtual object then tracks the position and orientation of the image in real-time so that the viewer's perspective on the object corresponds with their perspective on the Image Target, so that it appears that the virtual object is a part of the real world scene.

III. REQUIREMENT ANALYSIS AND DESIGN

This system is a Home Exhibition developed by Vuforia SDK Augmented Reality technique. It is an application where the furniture and furnishings will develop in three dimensional surface of abject and present by using Augmented Reality(AR). It is an application that can be used in mobile phones and tab etc. It can realistically display the virtual models on the user's real scene, realizing the user's operation to home and the real-time photo to AR scene.

A. System General Design

The system basically uses mobile phone build-in camera to collect image as the real scene image observed by human eye and stacks the 3D furniture models on the screen display image.

First of all, we need to do the feature detection description to the images collected by the camera, choose tracing image and do 3D registration, establish initial 3D map and obtain the camera pose. Next, in the software development period, we build 3D furniture models by MAYA and use programs to import the models into software.Through identifying and tracing marker images, the camera obtains external parameters matrix and establishes projection models, at last stacks the imported 3D virtual models on the tracing image. Because Android smart phone has touch-screen interface function, we can place the furniture by sliding screen. The system framework is as shown in Figure 1.
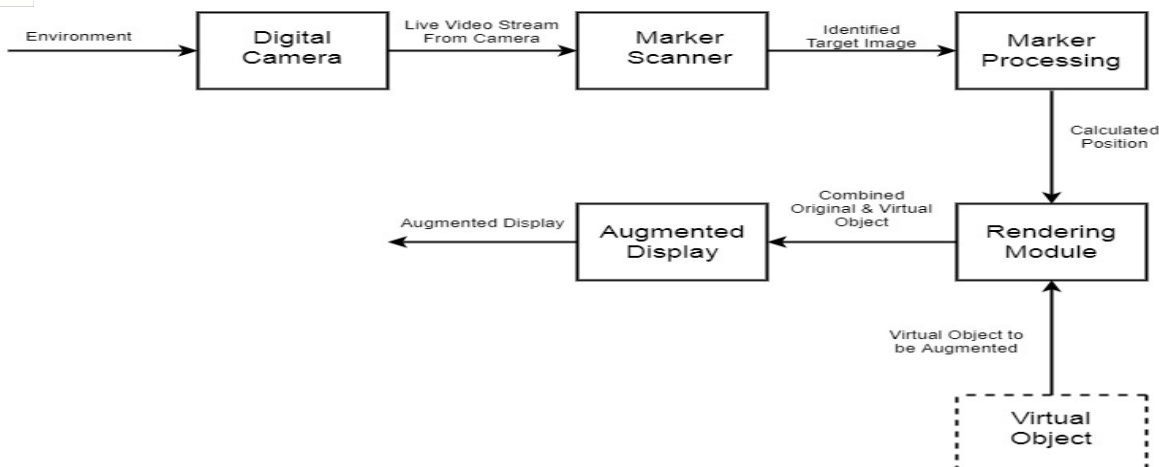
Figure 1. System Architecture Diagram

B. Analysis and Design of Capturing and Tracking Module

Augmented Reality system, we hope to establish only need the user interact with the mobile phone without any other auxiliary operations, which can experiences the virtual interior augmented reality in any unknown indoor scene. The difficulty of the problem is how to establish the fast stable 3D registration system. The earliest researches of this aspect are the SLAM algorithm put forward by Davision, the Real time localization and 3D reconstruction put forward by Mouragnon in 2006 [5] and 3D reconstruction using Kinect depth transducer popular in recent years [5], but the methods not only have high algorithm complexity but also have high calculation requirement to hardware, furthermore, at present, mobile phone can't configure Kinect sensor. So this paper uses the marker based concept.

The capturing module captures the image from the camera. The tracking module calculates the correct location and orientation for virtual overlay. The tracking module consists of two major steps. Firstly, the system detects the marker and estimates the co-ordinates of the markers in the room, and hence decides on the available space. The user can drag-and-drop virtual furniture models according to his/her desired in the real scene via user interface provided at this stage. The tracking module is "the heart" of the augmented reality system as it calculates the relative pose of the camera in real time. The term pose means the six degrees of freedom (DOF) position, i.e. the 3D location and 3D orientation of an object. The tracking module enables the system to add virtual components as part of the real scene. As the start of the whole AR scene, tracking mode starts with launching an AR camera. The video gives feedback to the AR camera in real time. The camera assesses every image in the scene and identifies the markers. The marker coordinates are decoded and marker poses are calculated and sent to the AR camera. The coordinates are passed to the Image rendering module where an object associated to the marker is rendered on it.

C. Analysis and Design of Interactive Module

There are many reference factors for the determination of the interactive mode of home selection functions, such as this kind of selection mode should let the user understand how to operate at a glance, in addition, based on the large quantity of the home service, home sort selection also should be considered. Therefore, the home selection can firstly enter into home species selection by clicking a plus sign on the screen, after selecting users can browse the content After fulfilling the primary need that can select model to display, interacting with the home service appeared in the AR scene became the new requirement for user. The operation which user needs to do to the home is no more than moving, rotating and scaling. As the most visual and convenient interactive mode, gesture operation became the first choice. When user wants to move the target home, he only needs to drag and drop the home. When user wants to rotate the target home, he only needs to use two fingers to rotate the home to the desire direction. When user wants to scale the home, he only needs to use two fingers to spread.

IV. SYSTEM IMPLEMENTATION

A. Implementation of Tracking Module

This system uses 3D registration method which based on marker, it need to match with the marker image or real-time identify and track the markers the only thing we need to do is just matching and tracing the feature of two key frame images shot through different angles, determine the camera's initial position using five points algorithm.

B. Implementation of Exhibition Function

This system is implemented in the android mobile phone, it uses Vuforia SDK to render, models and exports the model information by MAYA First, we should establish virtual models. This paper uses MAYA software to create 3D furniture models and flash materials, the models mainly uses Polygon and NURBS modeling methods, draw texture in Photoshop, the animation mainly uses key frame and expression animation technology. After establishing models in MAYA, four important information of the model will be stored in the file of each model, they are the model's vertex coordinate, texture coordinate, normal coordinate and the total number of triangles, these data are the main data when rendering model. Application will store them in memory and read them to render models when calling rendering function. The data quantity of the model is very huge, so we need a loading module of the model to make it loaded into program conveniently. In this paper, we first export the model data, the file exported by MAYA is .obj file, which stores above information, next convert the information to file which is available in program by model loader and obtain the model data by calling head file. After loading model data, we can render and display it in the scene through Vuforia SDK.

C. Implementation of Interactive Function

The main interface interacts by sliding browsing and selecting the key. The main interface contains furniture column, home classification column, Adding key, Photo key, Help key and so on. The furniture column stores the key of all furniture, display certain furniture through the home classification which also supports sliding browsing. In order to implement these functions, first we should use vertical Linear Layout to pack the homes belonged to the same kind of classification, next use Scroll View control to pack these Linear Layout which have been classified.

V. CONCLUSION

The Augmented Reality Technique has become a hot issue in the field of computer vision technology, with its different user experience, slowly and deeply changing people's life, which includes many different fields such as education, medical, advertising and so on. The study on Augmented Reality Technique is mainly divided into two directions, one is implementing camera 3D registration by identifying the markers in scene, the other is updating camera pose by doing 3D reconstruction to the unknown scene, rendering the virtual objects in real-time. This paper mainly used the second method to research, realized the Virtual Home Augmented Reality System, which can support auxiliary information to people when decorating and selecting furniture, help users feel the placement of furniture in the room in advance before putting them in.

VI. ACKNOWLEDGMENT

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