Augmented Reality Implementation for Virtual Furniture

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Abstract—The Real environment is supplemented or augmented with the computergenerated virtual objects or image is known as Augmented Reality. Augmented Reality adds thing to the existing world. It is an enhancement of real world where we mix the real world with the virtual objects. In this paper we are proposing methodology that builds preview of the interior decoration of the room which contains the virtual object alongside the real environment. Using this methodology user can place the selected objects such as furniture, lamps, paintings etc in their personal space. This eventually reduces the challenging task of purchasing and adjusting non suitable objects to his room as user gets the preview before purchasing the actual item. This methodology is more suitable for this busy and digitalizing world.

Keyword: Augmented Reality, Virtual Objects, Real Environment, Furniture

1. INTRODUCTION

People of today's generation are particular about their house and its interior design. Purchasing and transporting Furniture and other large and heavy interior objects is a tedious job. If the purchased furniture doesn't fit in the respective space it is very difficult and time consuming to return and replace the item. In this modern world day by day people are adapting to different technology. One among them is Augmented Reality. This technology is used in different field and it is gaining popularity. As computer technology is getting better AR is developing more rapidly. AR user image processing, computer vision and graphic techniques to merge a virtual content in tothe real environment. One of the finest tool for personalization of customer needs is Augmented Reality. User requires an ability to check how the items of his choice will look at his home or office.In this paper we are proposing amethodology for purchasing Furniture using Augmented Reality.

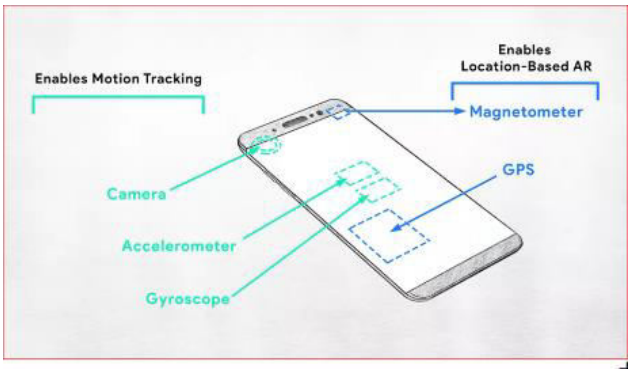

Fig 1: Working of location based AR system in a smartphone

This methodology provides the interactive experience to user. User can overlay the virtual interior objects to the physical world using a smartphone. AR uses the mobile's camera and sensors to virtually place the interior object in the space seen by the camera. This allows users to visualize how the house will look after placing the objects without actually purchasing or placing it the actual space. With this methodology there is no need of traditional methods like measuring the dimensions of the room and then buying the furniture. In this user can place multiple combinations virtually without physical movement of the real objects. The main motto of the methodology is to reduce the time consumption improve the accessibility of the furniture try-on.In this paper we are proposing a methodology that uses location based Augmented Reality.

2. RELATED WORK

Augmented Reality, as we use it today, has been the result of advances in handheld and mobile devices. The beginning of Augmented Reality can be dated back to the year 1960 when a research scholar at Harvard named Ivan Sutherlanddeveloped a Head Mounted Display (HMD) to display virtual objects. Though the features were primitive, that was the first ever display that realized Augmented Reality. From very long time AR has been in use. It is being used in education to superimpose text, graphics into a student's real time environment, in medicine, to provide surgeon the patient's data, in fighter jets to display the flight path and in tourism, to access real-time information about a monument using the location and (or) picture of the monument. AR has profound applications in interior design. A background study of the current systems that are in place for visualizing furniture's in real world has been carried out and a brief report of the same is presented in this section.

In the research article "AR Furniture: Integrating Augmented Reality Technology to Enhance Interior Design using Marker and Markerless tracking" published by WaraporнViyanon [1] et al, the system proposed makes use of Kudan SDK to analyze and track the images and camera data (frames). Both marker-based AR and marker-less AR supported by Kudan SDK. The drawback of the system was that user had to create a 3D model on his/her own, and no prebuilt models were provided. There was a weakness when this application was given to user experience evaluation when the user founds a problem in the application they require time to solve it. The users gave rating of 2 out of 5.

Jeff K. T. Tang [2] et al in the paper entitled "AR Interior Designer: Automatic Furniture Arrangement using Spatial and Functional Relationships" have developed a windows application that can be used to arrange furniture in the available space. They have used the Microsoft's Kinect Depth camera to find the supporting surfaces and calculate the spatial and function relationships between the virtual and real objects and arrange the furniture. The system proposed in this paper was based on RANSAC algorithm for simultaneous tracking. The drawback of this algorithm is that it does not produce results in real-time and involves large number of un-necessary calculations in finding the spatial and functional relationships. Similar applications can be built using much simpler and cheaper methods.

Paper entitled "Furniture Layout Application Based on Marker Detection and Using Augmented Reality" was proposed by Khushal Khairnar [3] et al. The application developed was a windows application developed using Unity Engine, the same application could be extended to phones with Android OS. Application processes captured RGB image into Grey scale image using OpenCV libraries to detect the Marker, which is not efficient and add up an extra work. The drawback of the application was that the application didn't support translocation and rotation of the furniture object. As this application didn't support rotation of the furniture object users faced the same problem as they were facing during the traditional method that is users could not view the different angles of the same furniture object. Since application uses webcam it is not portable and affordable by all users. The dataset provided is not scalable. Hence user cannot access many furniture objects and as well as new times cannot be introduced.

Benjamin Neurneberger [4] et al in the paper entitled "SnapToReality: Aligning Augmented Reality to the Real World " developed a system that precisely aligns the AR virtual objects to the real world subject to the constraints of the real world in real-time. In this paper they have discussed the unique design challenges of snapping in AR, including the user's limited field of view, noise in constraint extraction, issues with changing the view in AR, visualizing constraints, and more. This proof of concept systems extracts the 3D planar surfaces and edges and aligns the objects by assigning a cost metric to each of the edges of the object. This research work was undertaken by University of California and Microsoft Research.

Kriti Motwani [5] et al in the paper "Furniture Arrangement Using Augmented Reality" proposed a interactive system for furniturearrangements which includes translation, rotation and scaling of the 3D objects, as per the choice of the user that made use of Vuforia SDK to augment furniture on to the real world. In the proposed system lays emphasis on creation of 3D mesh, unwrapping mesh, texture creation and mesh rendering it. This paper mainly deals with arrangement of furniture like rotation and scaling by creating mesh, marking seams, unwrap mesh and other processes. Which is tedious process and only rotation is possible. This task is tedious for a person who does not have knowledge about the mesh and 3D objects. This became the major drawback of the system.

Deepak Uplaonkar [6] et al in "Virtual Furniture Application based on Augmented Reality", have proposed a new model for trying virtual furniture. This methodology makes use of marker detection procedure which is to find the outlines of potential markers and then to deduce locations of marker's corners in the image. This includes procedure like RGB to GRAY scale, thresholding, marker detection, superimposed 3D objects and 2D and 3D transformation. This method does not include user's evaluation of the system which is an important issue, since the developer can't know the problem faced by the user. The main disadvantage was that it was useful for single object.

Paper entitled "Furniture Layout AR Application Using Floor Plans Based on Planar" was published by Vaibhav Raut [7] et al, proposed a new system. Here application uses webcam to capture 2D image frame and the processed 3D objects are overlaid on those captured 2D image frame. The use webcam limits the application by accessing image through

smartphones. Since application uses webcam it is not portable and affordable by all users. The shortcomings of the system were user had to capture pictures of furniture that was already there. Hence there was no need of application to envision the furniture.

Raviraj Patkar [8] in "Marker Based Augmented Reality Using Android OS", proposed a marker based augmented reality application usingAndroid operating system which helps to combine virtual object with the real environment facilitating various application. The system is customer oriented, thus allows user to augment product of their choice. This paper gives an idea how a marker based AR system can be built for an android phone, even though the system did not include any SDK to augment the furniture, we will get some basic knowledge of it's working. There were too many calculations that could have been reduced if SDKs were used, thereby improving the efficiency of the system.

Taiki Fuji [9] et al in "Furniture Layout AR Application Using Home Plans Based on Planar", Mai Lee [10] et al in "An Augmented Reality Application Previewing 3D Décor Changes" and many others have proposed many such systems. In this paper they have proposed a system which converts 2D images of the furniture to 3D model. This will help the users to visualize the furniture, but users are not able to fit it in the real environment. Hence it will not be that helpful for the users to purchase the furniture as they won't get the preview of the furniture in their personal space. Some of these systems never considered evaluating user experiences, some were simple prototypes limited to only one furniture object, limited to only one platform using old techniques and inefficient methods that involve too many calculations and some of them made use of expensive hardware such as head mounted displays (HMDs).

3. PREREQUISITES

- Unity AR Foundation, ARcore XR Plugin(package), ARkit XR plugin(package), AR camera, AR plane, Android Studio.
- This methodology uses Model View Controller architecture because whenever the user invokes a functionality, UI Controller receives requests for the application and then works with the Model to prepare any data needed by the View. The View uses generated data to create the final presentable response and updates the UI.
- For instance, when the user selects 3D Furniture from the UI, It is mapped to the Controller which grabs the 3D Furniture from the Model and updates the View component which is UI.

4. EXPECTED OUTCOME

- A GUI that enables user to use select, place, remove and modify 3d models in an interactive way by using different touch gestures, at any time, over 90% of the screen is filled by camera stream and rendered models.
- A solid backend that handles app's core functionality like detecting the gestures, modifying rendered 3d models, loading 3d models from local storage.
- The app which is made that's ready to render different furniture models and be able to interact with them using different gestures.
- Rendering: A responsive application which sends queries to the device's sensor, gets the location of the item and judge whether it should add the virtual object or not based on the acquired data.

5. CONCLUSION

This augmented reality methodology will help and assist the user to view the interior objects virtually on their smartphone along with the real environment before buying the object. This methodology will be based on marker-less AR system. As the main requirement is the smartphone, can be easily implemented and accessed by people. By using this methodology we can reduce cost and time of interior designing which makes the good design available for larger group of people. This methodology reduces the risk of product return hence purchasing furniture and designing the interior of the space will be convenient. The user will come to know the exact view of the office, house or any space before actually setting up the space. The main advantage of this methodology is that multimedia augmentation of high vivid simulations for user in real time. In addition, it allows the customer to understand the concept of the project and thus enable them to achieve the customized requirements and better design affection.

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