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Inti-AR-i: Designing Living room using Augmented Reality based on Markerless Technique

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Abstract— Large advancements are being made in the digital world, but the digital architecture is unable to cope up with it. In traditional interior designing scenario, customer has to visualize the look and feel of the furniture design in particular room unless he/she has very strong visualization skill. The customer is not able to effectively articulate his idea to the designer. Augmented Reality can bridge the gap between what the customer thinks and what he communicates to the designer. This paper focuses on narrowing the gap of interaction between the client and the designer. We are providing them with an Interior designing application that resembles the real-world scenario in the augmented world without actually buying the furniture for living room. The user can portray the 3D virtual objects in the living room with the help of dynamic user interface.

Keywords—Augmented Reality (AR), Marker-less Technique, 3D Object Models, Simultaneous Localization and Mapping (SLAM), Living Room, Interior Design

I. INTRODUCTION

In real estate business, the designing of the houses is done with the help of drawings that the designers make on the request of the client which make them carry paperwork, as the client changes his demand the paperwork increases and makes it difficult to carry all of them. The amount of paperwork depends on the capability of the client to make the designer understand what he wants. The situation worsens as most of client are not able to portray their views to the designer and in turn make him confuse.
We are going to provide the client with an application that will help them to better understand and portray their views to the designer. This application will make use camera to capture the plane and let the client decide what they want in their living room. This will be done with the help of marker-less technique Simultaneous Localization and Mapping (SLAM) and the models that are provided will be made on Blender and unity3D will be used to develop the application.

II. LITERATURE SURVEY

In [1], the Cirulis and Brigmanis focuses on emphasizing on urban planning process and architecture of it. Though modern technologies provide photo realistic models but for the improvement of immersion level of planning process, Augmented Reality technology is required. This helps in merging real city with 3D virtual buildings. The main challenges faced in this are depiction of heavy and bulky 3D models which are to be displayed in outdoor environment. Nowadays, entertainment and mobile AR systems use multiple tracking technologies like optical and wireless sensors, accelerometers, gyroscope, Radio-frequency identification. Further in this paper two AR technologies are discussed which are mainly marker based and marker-less.
In [2], the Renukdas, Ghundiyal et al have focused on Interior decoration using Android application developed using Metaio SDK, which is a comprehensive modular framework for AR application. The developed application is able to place the object only at the centre of the whole view. They have also discussed various hurdles encountered while achieving fast tracking.

Disadvantages:
I. In this, the object can be placed in the plane but can't be rotated.
II. User can move the object only in linear fashion.

In [4], the Lim, Kim, Park et al have proposed an approach for implementing marker-based AR on smartphone. In practical applications, breaking sense between markers creates difficulties and hence markers are excellent alternative. Binary markers like AR Toolkit and ARTag are easy to detect and can be tracked actively even in poor scene conditions. Further author has demonstrated a proof-of-concept system for the pose computation of IR marker in smartphone. Adding an external camera to estimate geometric relationship between object and marker was the main motive in this paper.

In [6], the Park, Yang et al proposes system for interior design on portable- type projection-based AR and is named as DesignAR. Earlier projection-based AR studies were able to project new colours, patterns and textures onto objects. Now with the help of advanced technology not only objects can be projected but is also possible to expand them to spaces and applied to numerous fields. This DesignAR system consists of portable pan-tilt mechanism which is the main component. It provides users with interface that can offer them various interior designs and optimal plane by analysis. In order to increase usability, both 2d and higher dimensional interior design should be integrated.
In [7], the Yang, Chen et al explain the approach to deal with 3D mapping and primarily focuses on SLAM (Simultaneous Localization and Mapping) technology. The 3D map technology classification along with its analysis is discussed further. The various maps are topological, landmark, metric, grid, semantic, point-based and signed distance function (SDF) based maps are elaborated and compared based on various parameters.

In [8], the Sharma, Kaikini et al have created marker-less AR application using wikitude SDK. This application can detect the plane in real-world environment, such as points of intersection and the locations of walls, allowing users to place only single virtual object into a real context without the need to read any image.

Disadvantages:

I. There is no plane initialization
II. In this, the user can place only one object in the view.

III. PROPOSED SYSTEM

The core of the system is developed using Unity 3D. In our current implemented system, the user interacts with the system by using set of inputs with help of android device. On initialization, the plane on which the objects are to be placed is selected and the data is saved in plane storage. The objects can be placed by user only if the plane is in the view of display. The system matches this data with preloaded models in database and loads the particular 3D model. Once the models are set, the user can rotate and scale the objects as per requirement. When the user is satisfied with the layout, it is saved and then referred by the designer.

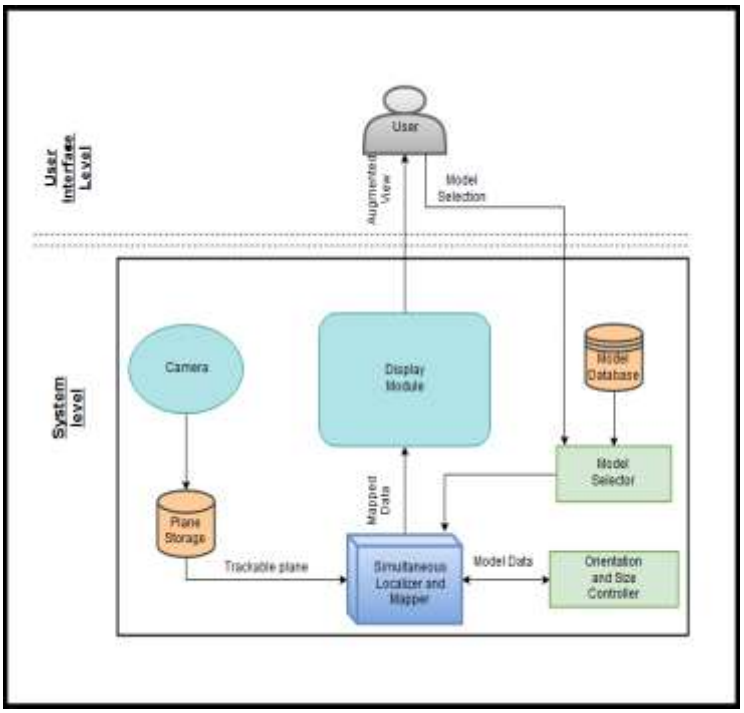

Fig 3.1: System Architecture

IV. IMPLEMENTATION

The proposed system uses Marker-less Augmented Reality as a basis for a user experience. Marker less tracking is a kind of positional tracking that does not need any kind of pre-knowledge and the position of the object is done in the space with respect to the point. This is very important feature in Augmented Reality (AR) as it enhances the user experience and removes the concept of marker thus it helps with correct positioning of the augmented reality object in the real.
While marker-based augmented reality methods use specific optical markers to track the object, marker-less approach do not need any such marker which makes it more flexible method. This marker-less approach allows user to walk freely in the room.
The basis aim of the proposed system is to place the 3D augmented object on the top of real things using a camera.

The implementation steps are as follows:
Step 1: The models are selected for which the proposed system is to be build.

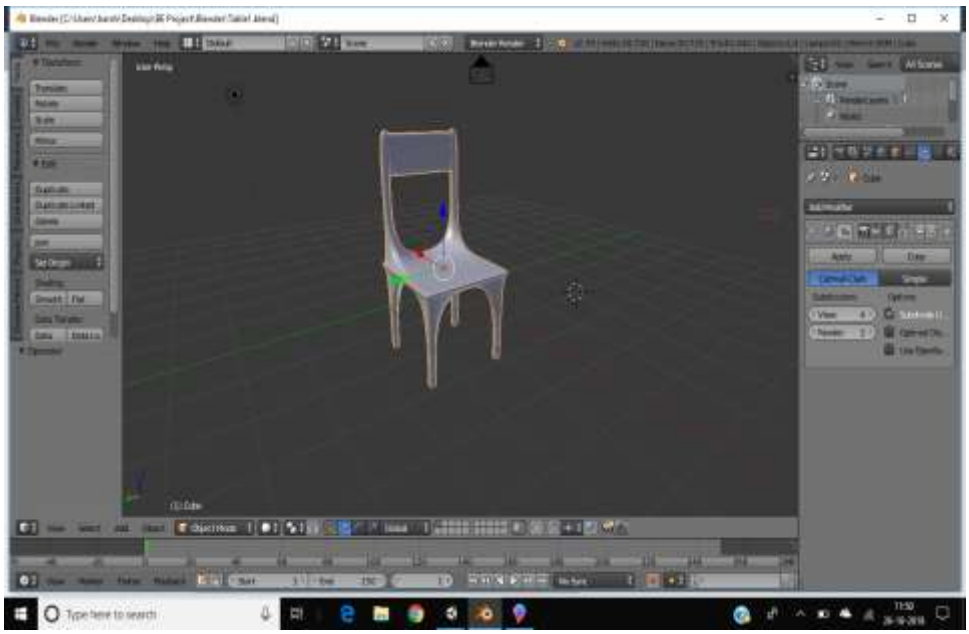

Fig 4.1: Creating 3D models using blender

Step 2: After selection the 3D models are to be designed, this is done by using the Blender.
Step 3: The next steps is edge smoothing and texturing of the objects. This gives the realist view to the objects
Step 4: When the objects are ready it need to be imported in the Unity Software.
Step 5: Using the SLAM technology the grids are developed in the Unity for the placement of the models.

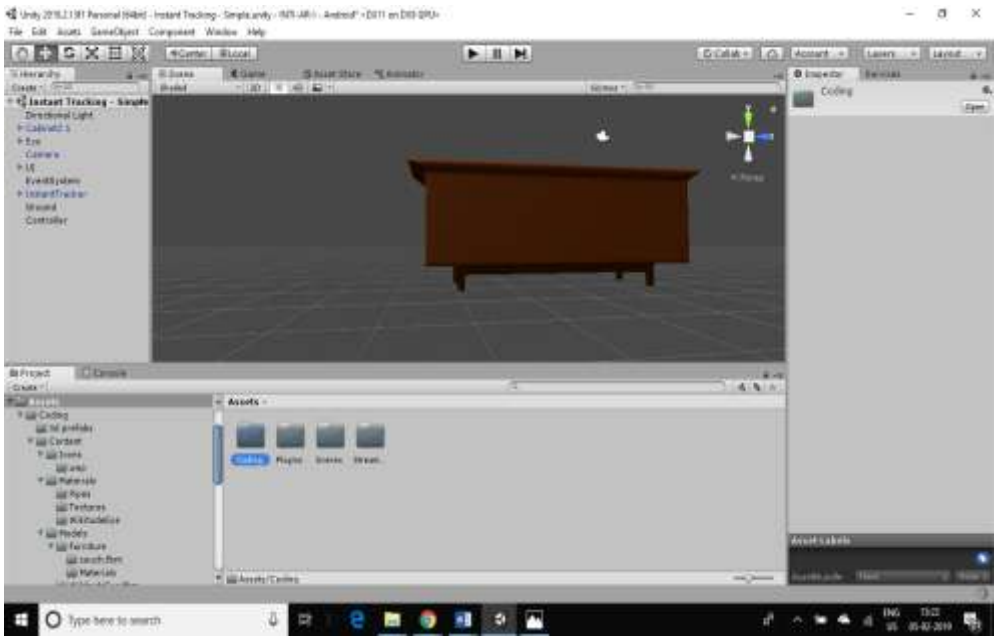

Fig 4.2: Importing 3D models to Unity

Step 6: The developed models are saved in the database in the Unity, which can be fetched when needed.
Step 7: The models are adjusted with respect to the plane.
Step 8: The models are then processed with precision and the models are rendered to be loaded. The android application is then built and run.
Step 9: User initialize the plan and mapping of grid is done on it using camera enabled smartphone which decides the dimension of the plane.
Step 10: User can position the model as per its choice and re-orient it too.

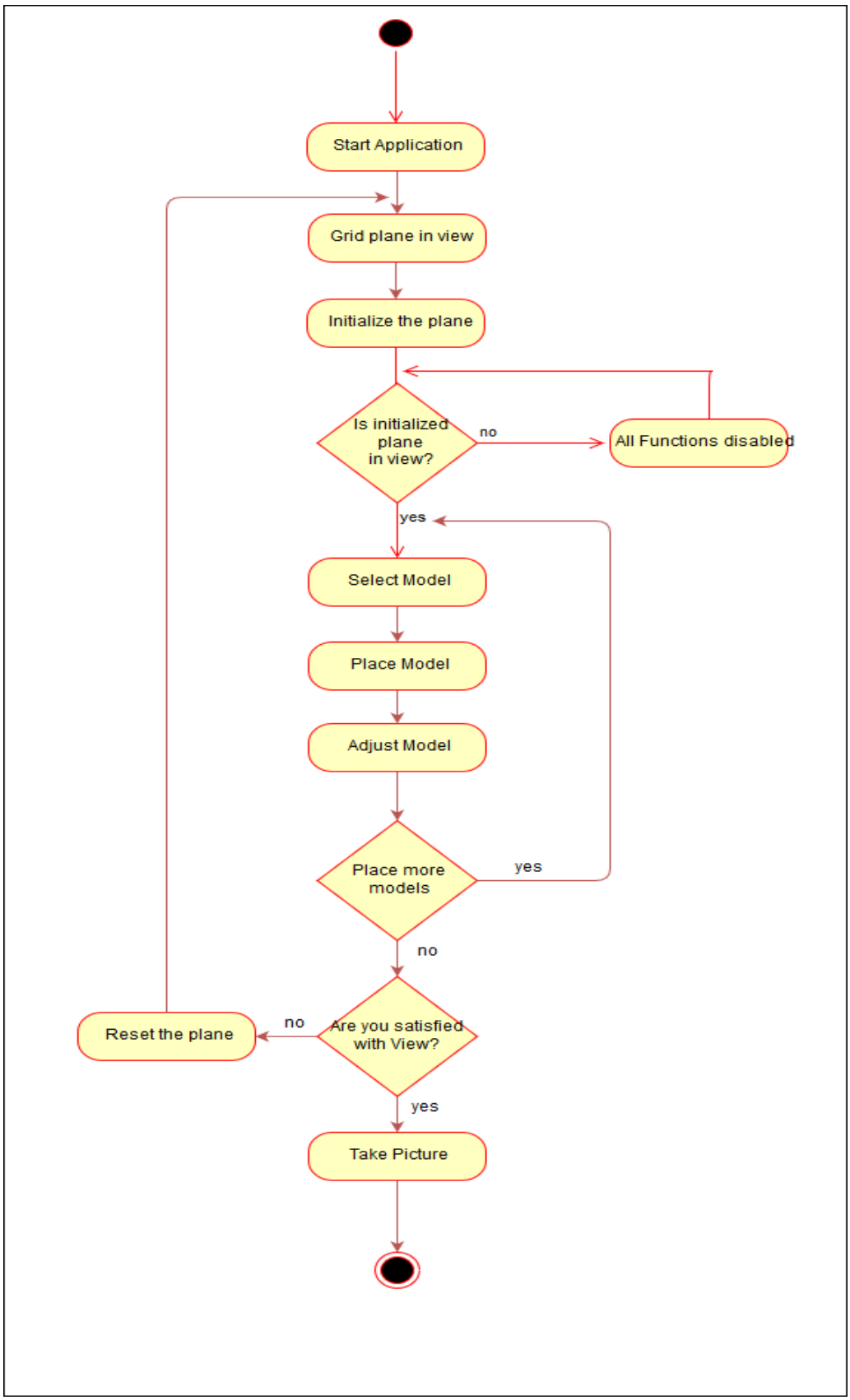

Fig 4.3: Activity Diagram

Client opens the application and a screen comes which tells him to initialize the plane, after the plane is initialized view of the plane is checked. After plane is selected then the models can be selected from the given models and are placed accordingly. Clients are allowed to select multiple objects. If the client is satisfied with the placement of the objects, he can take a picture or can reset the plane.

V. RESULT

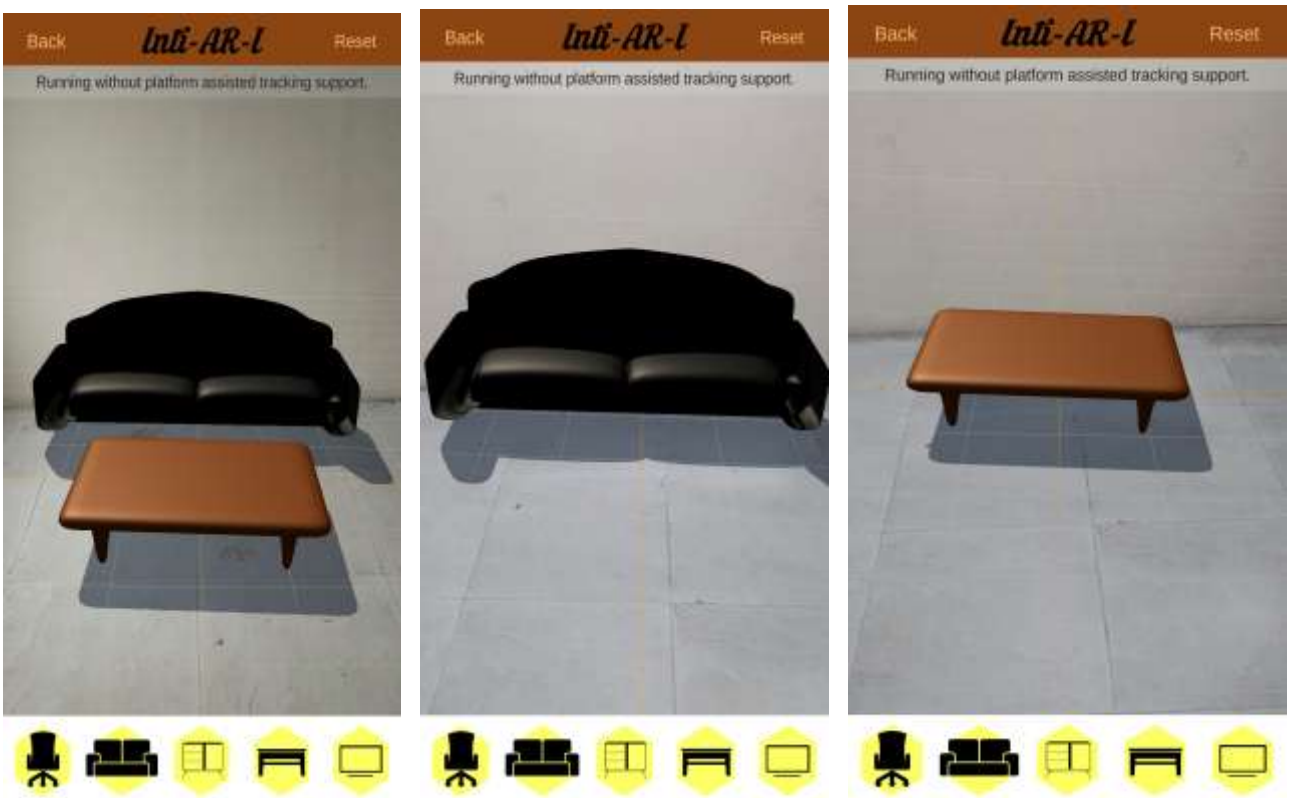

Fig 5.1: Demonstrating prototype of our application

Table 1: Sample Survey of the Application

	Age	Salary in lakhs (per annum)	Room Type	Furniture Type	Are you satisfied with the Objects?	User Friendly	Do this app meet your expectation?	Is this app fast and intuitive or slow and frustrating?	Is the navigation simple?
User 1	22	NIL	Living Room	Sofa	Yes	Yes	Yes	Fast and Intuitive	Yes
User 2	27	4.1	Living Room	Sofa, Chair	Yes	Yes	Yes	Fast and Intuitive	Yes
User 3	30	5.6	Living Room	Cabinet	No	No	No	Slow and frustrating	No
User 4	45	6.3	Living Room	Chair, Cabinet	Yes	Yes	Yes	Fast and Intuitive	Yes
User 5	51	8.6	Living Room	Sofa	No	No	No	Slow and frustrating	No

The survey of the application is done by selecting five random users including one outlier as shown in the Table. The result obtained is as mentioned in the table. There was mix reaction from the users some found it very interesting while some of them were confused. Overall the application made a little impact on the user that they can visualize the furniture without investing any cost in it.

VI. CONCLUSION

Designing Augmented Reality application is challenging task because of evolving nature as well as considering the perspective of the user's satisfaction. We have created a prototype of the application for the living room, which uses the recent augmented reality techniques to enhance existing system. Using this application, the designer has to spend less time in making the presentation.

This AR application minimizes the process of explaining the idea to the designer which in turn saves the time of the customer and the designer. The AR 3D models design can be viewed on the Smartphone without relying on the designer.

The goal of the application is to allow user to experience the various types of interiors at their door steps without any cost included. The use of 3D modelling and Augmented Reality has brought back the life in designing industry.

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