

AR Amenity Perceiver

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Abstract - The major problem in the Furniture industry is choosing the appropriate furniture for the residence or office. The users are feeling difficult to visualize furniture from a catalog and so changing the furniture textures after purchase would be inconvenient. What: Our solution is a powerful mobile application to render 3D Furniture models into augmented reality. This application features AR experience of the Furniture in reality. The inspiration driving this investigation is to consider and develop an android application called 'AR Amenity Perceiver' with the usage of Augmented Reality advancement for structure and improvement that will help users with envisioning how furniture pieces will look and fit in their homes and besides can give nuances of things to help customer decision. How: The application supports plane and object detection to place and track Furniture in real time. Since the application is built with React Native, it is platform independent and supports real time stutter less object rendering. Why: The client can utilize View in Room 3D mode to envision the furnishings or stylistic theme components in the encompassing space with the assistance of AR. This allows users to check out the Furniture with available texture options and thus making the user experience more realistic before buying.

Keywords - Augmented reality, Platform independence, Native mobile application.

I. INTRODUCTION

For a house to be successful, the objects in it must communicate with one another, respond to and balance one another- Andre Putman, a French interior and product designer. Good design is not only about making a room beautiful, but also making the best possible use of the limited space so that people can call it home. Although everyone certainly wants to be surrounded by comfort and beauty that makes their daily experience better, making that dream come true is a challenging task. Nowadays, many people are forced to live in the city, close by their workplace, to reduce their commute time. However, the living space in cities is outrageously expensive.

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Fig 1: Example of bedroom makeover

Since the space is limited, designing the furniture layout is crucial. A well-designed layout not only offers beauty, but also comfort and utility as shown in Fig 1. Unfortunately, good room design requires time and expertise.

Although there are extensive attempts to develop a system to help people to design their own room, e.g., Room Creator, Amikasa, Houzz: view in my room, Home Design 3D, Rooms etc. However, most of the applications are complicated [1] (e.g., camera viewpoint control, light condition control or designing their own furniture color and texture) and also require users to be familiar with technology e.g., users should be comfortable to drag and drop objects on the mobile phone's screen.

To mitigate the difficulties of the existing layout design systems, our work integrates augmented reality technology with 3D modeling technology to develop an easy to understand and easy to use room design system[2]. We believe that anything that we can see and touch is the easiest to understand and to use.

Based on the augmented reality technology, the system provides up to five white QR markers, as shown in Fig2b, to represent the furniture which can be manipulated physically and an additional black QR marker on the room plan, as shown in Fig.2a, to represent the available but limited room space. The users are able to design the layout of the furniture by physically moving the QR Markers or furniture to their preferred location. Then, the system will calculate these QR markers' locations, match them with their corresponding furniture and then display the final room layout on the mobile.



Fig 2: (a) QR markers **(b) Example of the final furniture design**

Fig. 2: Our system includes 1) the QR markers corresponds to unique furniture. other, the example image of the final layout design using the proposed system is shown in the remaining image. phone's screen as shown in Fig. 2c.

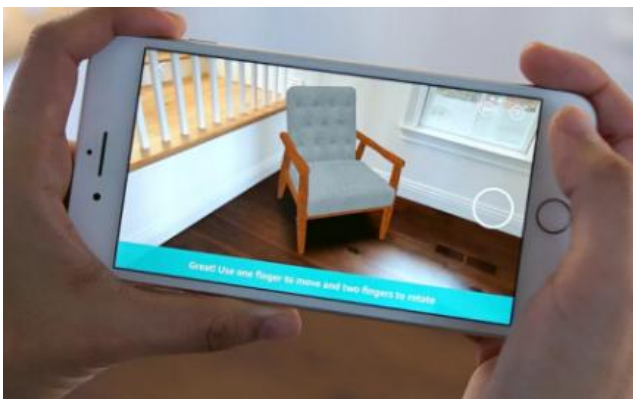


Fig 2: (c) Phone's Screen

To our knowledge this is the first attempt to the augmented reality technology with both room and furniture to mitigate the difficulties of layout design. With the physical user interface tools, the users can easily manipulate their furniture layout as well as camera viewpoints at the same time. Moreover, our system is more flexible for collaborations and enhances the experience of co-design among multiple users. We posit that our system will alleviate the users' difficulties with existing layout design systems, help them to decide what is the best choice for their design and style as well as where to place them.

The rest of the paper is organized as follows. First, we re- view some background and related work. We describe our furniture datasets. Then, we describe the scenario of the proposed AR development for room design and present the design of our system^[3]. Next, the evaluations of our framework compare with one of the top commercial room design application are presented. Finally, we conclude our idea and discuss future works.

II. BACKGROUND AND RELATED WORK

This section will review some background and previous work relevant to augmented reality, quick response code, development tools and existing room layout and design systems.

A. Augmented Reality Technology (AR)

Augmented reality technology is a technology which aims to enhance the real world with virtual elements created by computer programs. These elements can be anything from 3D models to dialog boxes. The AR system consists of the 4 following components:

- Marker to indicate the position of the computer graphic elements in the real world
- Optical Sensing Device the component, such as a smart-phones camera or a webcam, that detects the real-world environment and the markers' position, then sends the collected data to the core program.
- AR Engine a computing component that receives data from the optical sensing device, then computes the position and angle of markers and generates a result accordingly.
- Display this component receives data from the core AR program and then displays the result on a screen.

The following 3 steps show how Augmented Reality works:

- **Image analysis** - The first step is to detect the marker from the camera collected data. Markers, also called image targets, are the images that the AR application will use as the points of reference to display the 3D objects in the real world.
- **Pose Estimation** - This step is about calculating the position of the marker relative to the position of the camera.
- **3D Rendering** - The final step is to render 3D models and to display them according to the data received from the previous steps.

B. Quick Response Code (QR code)

QR code is a two-dimensional barcode first designed to be used in the automotive industry in Japan. QR code is very accurate and can pack a considerable amount of data. For this reason many other industries have adopted QR code for various aspects e.g., proposes the notion of contextual QR codes that merge a public QR code and private information, in order to provide data related to a particular context^[4].

Moreover, due to its clear and distinctive look, QR code has been demonstrated as a potential marker of AR application by reducing the chances of the application matching it with a wrong marker in the database. Inspired by , we handpicked the QR code as our marker in this work.

C. Development Tools

Several software that has been used during the development will be discussed in as following:

- Atom is an Integrated Development Environment used to develop the native mobile application in React Native.
- Expo is a tool used for emulating and developing the React Native application for debugging.
- QR Code Generator This project uses QR codes as markers for the application; for this reason, a QR code generator is very important. We use ReactNative libraries to generate the QR Code required.

- ARCore is a software development kit developed by Google that allows for augmented reality applications to be built.

- ARKit is a software development kit developed by Apple for developing augmented reality applications.

I. Dataset

In this work, we collect the 3D furniture dataset from a variety of assets available from the Unity asset store including the Big Furniture Pack, Chairs and Sofas Pack, Chalet Style Furniture, Chest of Drawers and Wooden table and chair^[5].

The Big Furniture Pack is a free furniture asset which includes a variety of low-polygon furniture models e.g., beds, sets of sofas, chairs and coffee tables, office tables and chairs, TV cabinets, lamps, mirrors, cabinets and etc. Chairs and Sofas Pack is a free collection of chair and sofa models with multiple colors and textures.

II. Application Scenario

There are two different QR marker colors in our system: white and black. While the white QR marker represents the 3D furniture models, the black one represents the room model.

In order to design their room layout, users will follow 2 steps:

Furniture selection: Users are required to pair up the 3D furniture model of their choice with the QR marker. There are 4 categories with 8 different models of furniture available in our system. Additional colors or textures might be available

3D rendering: When furniture is selected, the system will scan these QR marker locations, pair them with their corresponding furniture and finally display the 3D furniture layout on the mobile phone's screen.

III. RESULTS

Steps to Pursue:

- ✓ Open the application on an android gadget.
- ✓ Select the ideal furniture from the rundown see.
- ✓ Point the camera to the objective picture to see the furnishings.
- ✓ Squeeze-in, squeeze out, slide, and so forth to move the furniture according to the necessity.

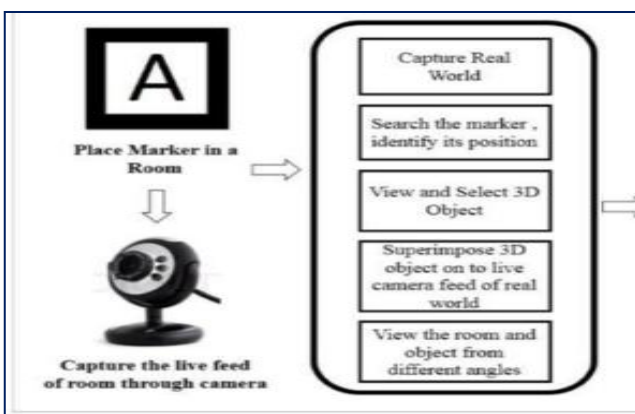


Fig 3: (a) Mobile App

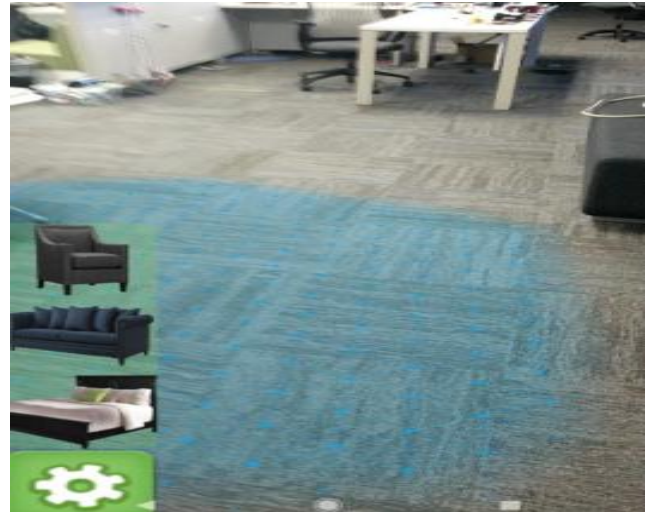


Fig 3: (b) App with setup

IV. CONCLUSION AND FUTURE WORK

In this work, we present an AR development for room design that aims to help users visualize furniture layout before purchasing the furniture. Based on the AR technology, the proposed system detects and recognizes the marker or QR code position and pose from the live camera feed. Users are required to map QR markers to their selected furniture model and then specify their location. Unlike existing systems, when the corresponding furniture models and room model are rendered on the furniture marker, the users can physically rearrange the markers inside the room plan without any obstacle from using the touch screen. The final design will be captured with a screenshot in the last step. We demonstrated that by utilizing the AR technology, the proposed system will mitigate the complication of the existing systems and encourage the collaboration of simultaneous multiple users^[6].

There are several future directions to extend our work:

- 1) Allow users to customize the furniture models or add new categories. Then, an image of the new model can be passed through the image search engine to find the most similar existing model from a furniture store which will facilitate the users experience to access their desired product in the real world.
- 2) Optimize the system performance to support even more markers simultaneously which would allow users to put more furniture into their room.
- 3) Allow users to capture an image of their actual room and use it as a virtual room in the application. With this function, the users will be able to assess the compatibility of the new furniture in the context of their actual room.
- 4) Make the application to render the 3D furniture without any markers. This marker-less approach will require a plane surface or floor to place the 3D objects.
- 5) Support users with built-in purchase system and make their purchase easier.

- 6) Collaborate with multiple furniture companies and create a centralized portal to test all furniture.
- 7) Add Machine learning to match user's preferences and suggest them with various alternative.

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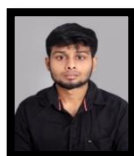
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