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Augmented Reality Implementation for Interior Designing and Virtual Furniture

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Abstract: ***The Real environment is supplemented or augmented with the computer-generated 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 implementing a methodology that builds preview of the interior designs of the room which contains the virtual object alongside the real environment. Using this application user can place the selected objects such as furniture, lamps, vase etc in their personal space. This eventually reduces the challenging task of purchasing and adjusting non suitable objects to his or her room as user gets the preview before purchasing the actual item. This application is more suitable for this busy and digitalizing world.***
Keyword: Augmented Reality, Furniture, Interior Design, Virtual Objects, Real Environment.

I. 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 to the real environment. One of the finest tools 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 a methodology for purchasing Furniture using Augmented Reality. 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, increase the availability of the furniture try-on. In this paper we are proposing a methodology that uses location based Augmented Reality.

The figure 1 shows the System architecture of the application developed.

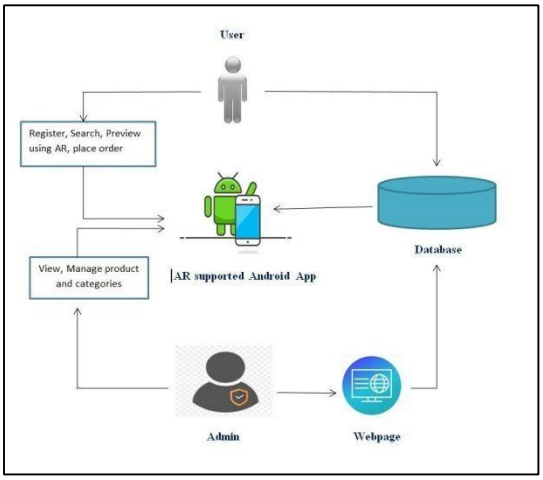

Figure 1.System Architecture.

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II. LITERATURE SURVEY

Paper entitled "Furniture Layout Application Based on Marker Detection and Using Augmented Reality" was proposed by Khushal Khairnar [1] et al. The Unity Engine was used to develop a windows application, the same application could be extended to smartphone 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 disadvantage of the application was that the translocation and rotation of the furniture object are not supported. 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.

Deepak Uplaonkar [2] et al in "Virtual Furniture Application based on Augmented Reality", have proposed a new model for trying virtual furniture. This technique utilizes marker identification methodology which is to discover the diagrams of possible markers and afterward to derive areas of marker's corners in the picture. This includes procedure like RGB to GRAY scale, thresholding, marker detection, superimposed 3D objects and 2D and 3D transformation. This technique does exclude client's feedback assessment of the framework which is a significant issue, since the developer can't have a clue about the issue looked by the client. The primary detriment was that it was helpful for single item.

Paper entitled "Furniture Layout AR Application Using Floor Plans Based on Planar" was published by Vaibhav Raut [3] 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 disadvantage of the system was that user has to take the picture of the furniture and interior object which was then converted to 3D image by the application. This methodology of converting 2d to 3d was already present at that time. Hence there was no need of the application to alter the image of furniture.

Raviraj Patkar [4] in "Marker Based Augmented Reality Using Android OS", proposed a marker based augmented reality application using Android 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 its working. There were such a large number of computations that might have been diminished if SDKs were utilized, along these lines improving the effectiveness of the framework.

Mai Lee [5] 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.

III. METHODOLOGY

With the methodology of augmented reality application, this can be handily accomplished. Interior planning is a field where increased reality has not had the option to get its grasp to its fullest. Individuals today are knowledgeable with the innovation and are working cell phones which support AR. In this manner, the idea of making a furniture format-based application brings the fashioner step nearer to being innovatively exceptional. With the new development of better cameras and more precise sensors in prospective standard gadgets. In our present executions of use, we use Google AR Core to precisely identify this present reality climate, like the locations of walls and points of intersection, permitting clients to put virtual items into a genuine setting. This project consists of two modules:

1) Admin module
2) User module

A. Admin Module

In this module the admin of this system can login to the system. After login to the system admin get various options, such as manage categories, manage product, view orders, accept or reject orders, dispatch, view history. We designed admin module as web application. To design this module, we utilized spring MVC design since spring gives a perfect division between controllers, JavaBean models, and view and spring gives interceptors just as controllers, making it simple to factor out behaviour common to the handling of many requests. We designed backend using java and front end using JSP. Database used is MYSQL.

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1) *Spring MVC Architecture:* Here in this methodology, we use Spring MVC to build the admin module. The language used to build the View part is JSP and for controller is Java. The database used is MySQL. Spring MVC is a Model View Controller architecture. Here each module is separated from each other. It provides the user the flexibility that user can change anything anytime. Using the Spring MVC people can create websites in an effective manner. When client requests the server for something the request is sent to the dispatcher servlet through web.xml file. The dispatcher servlet directs the client request to the respective controller. The controller returns the name of the requested view and data to the dispatcher servlet. Dispatcher servlet calls the requested view. The View technology fetches the data from the controller. The requested page is rendered to the client. Here in the spring MVC the client only interacts with the dispatcher servlet. Example: When user clicks on login button the request is sent to the web.xml file. The web.xml files direct the client request to the dispatcher servlet. The dispatcher servlet directs the request to the login controller. Login controller responds to the dispatcher servlet with the data and name of the view. The dispatcher servlet calls the requested view page. The view technology that is JSP page fetches the data. And the requested view page is sent to the client as the response for his request.

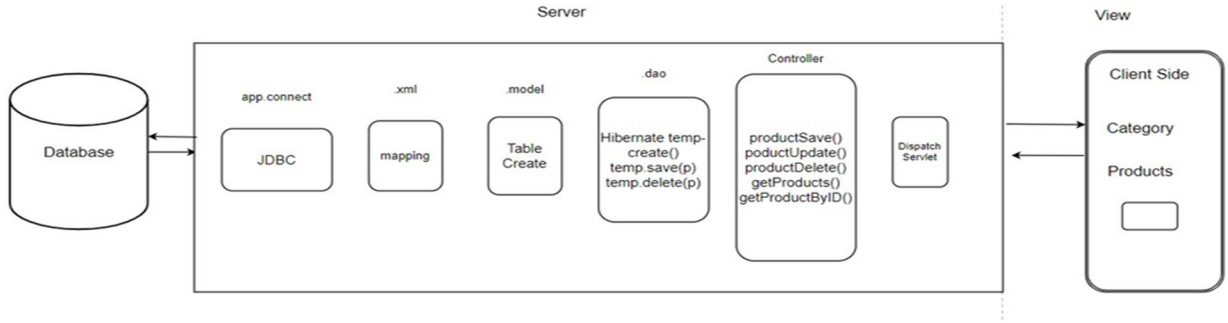

Figure 2 Spring MVC Architecture

The above figure shows the representation of how spring MVC is incorporated in admin module.

2) *AR Module Implementation using Google AR Core SDK:* To build the User module that is an android application we use Android Studio. The language used to develop this is Java. The Google AR Core is imported to Android Studio to implement the Augmented Reality part. The Google AR core is supported in the phones with Android Version 7 or more that covers 73% of the total Android phones. AR Core uses three key competences to integrate virtual content with the physical world as seen through phone's camera:

a) *Motion Tracking:* Motion tracking consents the phone to recognize and track its position relative to the real environment. Concurrent Odometry and Mapping (COM) algorithm is used to understand where the phone is relative to the real environment around it.

b) *Environmental Understanding:* It lets the phone to detect the location and size of all type of surfaces. AR Core searches for clusters or feature points that seem to lie on surfaces such as desks, chairs, etc. and makes these surfaces available to your device as ground planes.

c) *Light Estimation:* It helps the phone to estimate the location's present lighting conditions and lets to light the virtual items under the equivalent lighting condition.

B. User Module

For user module we are building an android application which gives us an augmented reality preview for each product available in the application. User gets to see the different categories of product where he can add that to the cart and buy that product. Before buying the product, he can preview the product in his personal space. If the product is suitable for the real environment user can go ahead with the product. When user place the order, the request is sent to the admin where he can approve or reject the request based on the availability. The admins choice is reflected on user side. To build the User module that is an android application we use Android Studio. The language used to develop this is Java. The Google AR Core is imported to Android Studio to implement the Augmented Reality part. The Google AR core is supported in the phones with Android Version 7 or more that covers 73% of the total Android phones. The application asks the user for permission to use microphone, camera and Google AR services. Google AR core is used capture live stream of place where the 3D image needs to be placed and it is key platform where Augmented reality works. Unity 3D is used to design 3D images of the furniture and interior objects.

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The below figure shows the flow of how AR works in user module. In this first the application captures the live stream from the user space where he desires to place the object with AR supported Android Phone. The 3D image from the database is combined with the live stream to render the combined video to the user. The 3D visuals of the object is displayed on the user's screen.

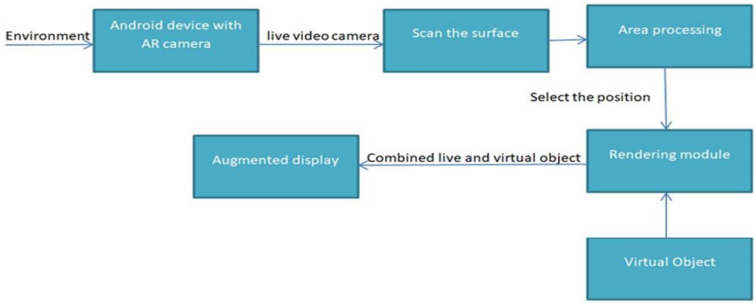

Figure 3 Dataflow diagram of AR module.

1) *Rest API:* Admin module website is linked to user module Android app using Rest API. Rest stands for representational state transfer. It is set of rules that engineer follows when they make their API, using this we can access resources like text content, images, videos and so on. Rest API is architecture to create restful services. Client requests the server for required information, the server response to client which is either in the form of JSON format or in the form of XML format. Rest basically works on HTTP web layer and use the Key verbs to work with resources on the server. It consists of 5 methods namely GET, POST, PUT, PATCH, and DELETE. On the server we can write POST requests to create a resource on the server, GET requests to retrieve the resources from the server, PUT requests to change or update the resources, DELETE to remove or delete resources from the server.

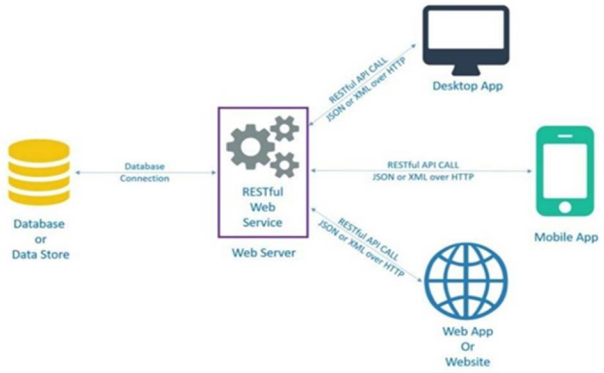

Figure 4 Flow of REST API

IV. RESULT

We have developed an android application to implement AR. This application allows the user to preview the 3D furniture before purchasing the product.

A. Initially when the user opens the application user need to register or log in to the application.
B. After the effective login client will be redirected to the home page.
C. Then the user needs to click on the view furniture button.
D. Then he will be redirected to category page where user needs to select the required category.
E. Furniture in that particular category will be displayed with description and amount of the product.
F. When user clicks on view in AR button, the phone camera detects the surface of the real environment.
G. After detecting the surface user can view the 3D image of the selected object.

Then user can add the item to the cart and he can place the order with single or multiple items.

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V. CONCLUSION

This augmented reality methodology will guide the user to view the furniture and other interior objects virtually on their cell phone alongside the genuine space prior to purchasing the article. 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 is that multimedia augmentation of excessive brilliant simulations for person in actual time. In addition, it lets in the client to apprehend the idea of the assignment and hence allow them to acquire the custom designed necessities and higher layout affection.

VI. ACKNOWLEDGEMENT

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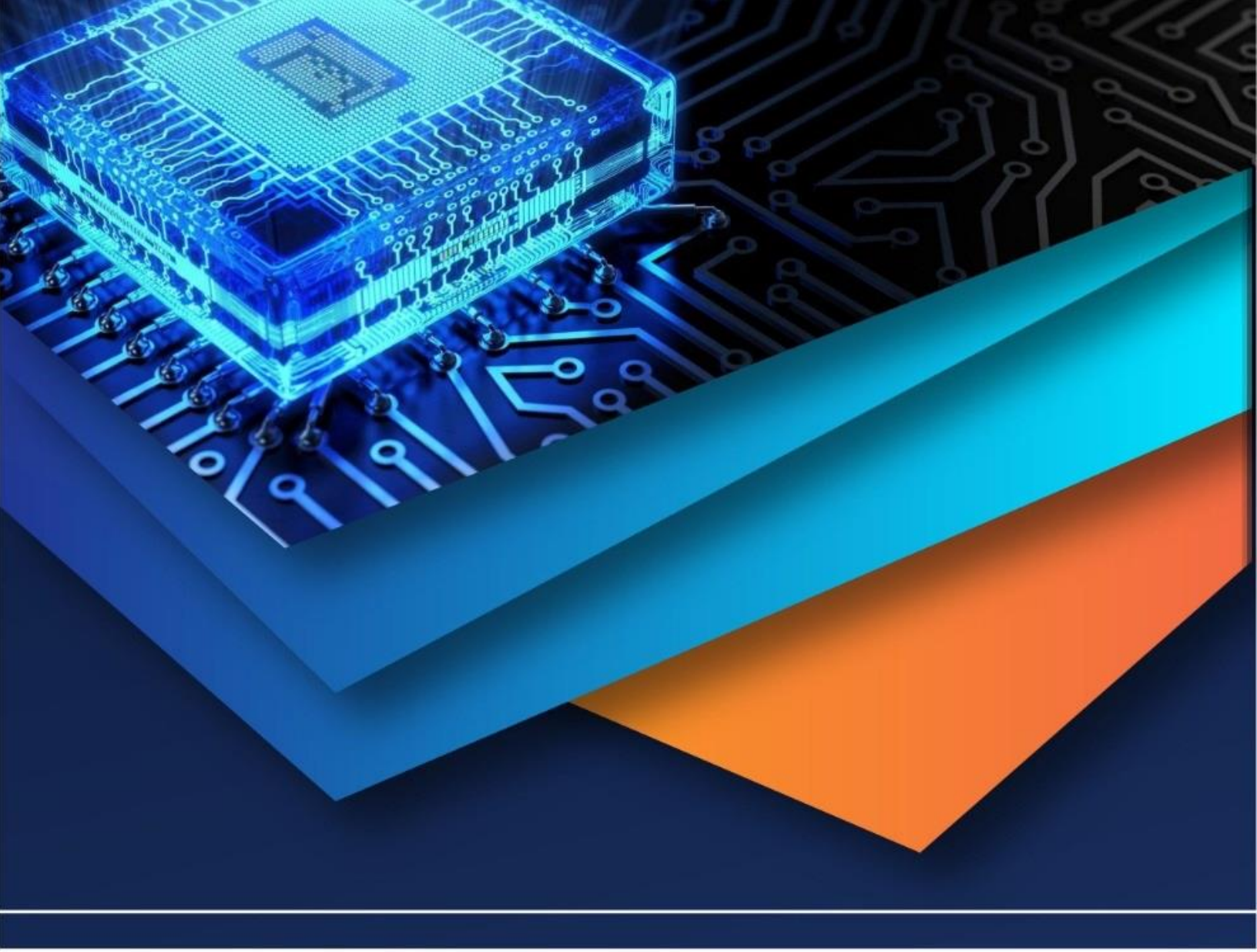

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