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Product Visualization Using Augmented Reality

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Abstract - *In today's world with technology taking over everything and making our life easy, we should be able to perform our tasks in easier way. It is hard to visualize how the furniture item would look in our own premises and complement the already existing items in the room. This can be easily solved using Augmented Reality. Augmented reality is a field of Image Processing which deals with the combination of real-world and virtual environment. It will allow users to experience in real time, how the item will look in their room. To help customers who buy interior products online, an Application for smartphones is proposed to help them virtually see how their room will look like after purchasing the product. It uses Google ARCore for augmented reality. ARCore will take in as input, the image from the device camera. It will identify planes and then virtually overlay the 3D models of the product onto the image, and then display it in real time to the user. This will give an almost realistic experience of placing that product in users home. Products like wall paintings, furniture, accessories and electrical appliances can be placed and viewed. Intelligence within the application will make relevant suggestions to the user to help buy related items. This will help a person to decorate even an empty room from scratch. For association mining, Apriori algorithm was used to recommend products to the user. This algorithm will find the most frequently bought sets products, so that it can provide suggestions.*

Key Words: **Augmented Reality, Android Application, E-commerce, Shopping, Recommendation System**

1.INTRODUCTION

Augmented Reality (AR) is defined as a direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input. Simply put, AR is digital content onto a live camera feed which makes it a part of the physical world.

AR is divided into two main types and six subtypes:

1.Trigger based: They are stimuli that initiate the augmentation. They can be papers, object markers as well as GPS locations.
2.View based: These digitized objects do not require a reference field to be overlaid, where their location can be manipulated dynamically.

Types of Augmented Reality

1.1 Marker-Based Augmented Reality

The other name for Marker-Based AR is also called Image Recognition or Recognition based AR. This type of AR provides us more information about the object after it focuses on the recognition of objects. Marker-based AR technology has diverse uses according to market purposes. It detects the object in front of the camera and provides information about the object on the screen. The recognition of the object is based on the marker where it replaces the marker on the screen with a 3D version of the corresponding object. Therefore, the user can view the object in more detail and from various angles. Apart from that while rotating the marker user can also rotate the 3D imagery as well. This acts as a reference for the AR app running on the system.

1.2 Marker-less Augmented Reality

Marker-less augmented reality is one of the most widely implemented applications in the industry. It is also known as Location-based AR for the reason for the easy availability of the features in the smartphones that provide location detection. This type of app is mostly used to help travellers. Apart from that, it helps users to discover interesting places within their current location. This method works by reading data from the mobile's GPS, digital compass and accelerometer while predicting where the user is focusing. This AR is all about adding location information on screen about the objects that can be seen from the user's camera.

1.3 Projection Augmented Reality

This is one of the simplest types of AR which is the projection of light on a surface. Projection-based AR is appealing and interactive where light is blown onto a surface and the interaction is done by touching the projected surface with hand. The widespread uses of projection-based AR techniques can be used to create deception about the position, orientation, and depth of an object. In such a case this allows the user to take different objects into consideration and its structure in order to study in-depth. This technology offers a whole lot more in every sense. This piece of tech is used for creating a virtual object for much larger deployments for experiencing Augmented Reality.

1.4 Superimposition Based Augmented Reality

As the word itself explains the superimposition of the objects. This AR provides a replacement view of the object in focus. This is done by replacing the entire or partial view with an augmented view of the object. Here object recognition plays a vital role where replacing a view of an object with an augmented view is done.
Among the above four types application used marker-less AR due to the fact that it suits the requirements of the project.

1.5 What we are trying to build:

In the era of technology, augmented reality is used in almost every field. Prominently in entertainment and medical surgery, we aim to incorporate this technology into our project and use it for the benefit of e-commerce.
We are making an app which will be used for home décor and interior designing.
AR will help us to do so by augmenting the real life 3d objects into 3D models and portraying them onto the screen of the user, this technology will benefit the users by giving them a detailed idea of how the product will look in the real life. And how it will suit the dimensions of the room.

2. LITERATURE SURVEY

2.1 Furnishing Using Augmented Reality

Mrs. Ruchita Tatiya, Vikas Pakhe, Sourabh Khaire, Lalit Metkar, Nikhil Lale proposed an AR application through which we can view furniture items from our mobile phones rather than going in a shop and purchasing it. The paper states problems with existing systems, the main being most of the application were marked-based, that means a user has to carry a marker everywhere they want to project Augmented Content which was inconvenient. It degrades o user experience and user faces problems, user has to wait for the image to process properly and also the graphics of the objects used for furniture are lower in resolution.

The proposed application will be marker-less, and they will be using Google's AR core to build augmented reality experience. AR core has many features which make the application more immersive. To make environment understanding work well, AR Core constantly keeps looking for clusters of distinct feature points that are present on common vertical and horizontal surfaces like for example, walls, tables, floor, etc. We can use this information to place virtual objects resting on flat surfaces.
The paper also talks about how the objects are augmented. It is achieved by using ar core features such anchors, feature points, light estimation etc.

The proposed design specifies how the objects will be imported and which sensors from mobile device the application would be used by the application.

2.2 Interior Design with Augmented Reality

Ananda Poudel and Omar Al-Azzam proposed a paper for an augmented reality for interior design. Different types of AR are explained and where they are been used.

The paper mainly talks about an application which allows user to visualize and interact with furniture using their smartphone in augmented reality environment. AR allows an application to use the phone's camera and sensors to directly place a virtual object in the space seen by the camera. This is done by identifying a marker in the AR space and using that as a reference for the rest of the room. The application utilizes marker-less AR technology to place objects in a 3d space without the need of a marker. Using this technology, it is possible to develop an interior design application for previewing furniture virtually in your own house.

The main goals of this research was to build an app that is able to render different furniture models and be able to interact with them using different gestures. They determined that the system will perform the following tasks:

- Select furniture from a menu
- Place furniture by tapping on the screen
- Remove rendered furniture
- Change material of rendered furniture
- Move the location of furniture
- Take a picture of the current environment and store in the local storage
- Load 3D models from local storage

The project uses model view control architecture. The development environment include unity game engine, c# programming language, visual studio IDE.

2.3 Comparative Study of Augmented Reality SDKs

Dhiraj Amin and Sharvari Govilkar presents a detail survey of various augmented reality SDK's. It specifies the basic difference between augmented reality and virtual reality. The paper mentioned how AR works. According to the study there are three simple steps for AR to work: recognition, tracking and mix. Description of all the steps is provide in the paper in detail. It also mentions two main type of AR systems, marker-less and marker-based.

There are 4 types of AR tracking mentioned in the paper: Hybrid based tracking, marker based tracking, natural feature tracking.

Augmented reality SDKs facilitates many components within the AR application like AR tracking, AR recognition, AR content rendering. The recognition component works as the brain of the AR app.

The SDKs studied in the paper are Metaio, Vuforia, Wikitude, D'Fusion, ARtoolkit, ARmedia. Various benefits and limitations of each of the SDK's are given in detail.

2.4 Capabilities of ARCore and ARKit Platforms for AR/VR Applications

In the paper mentioned proposed by Paweł Nowacki and Marek Woda, ARCore and ARKit capabilities were scrutinized and compared.

To be able to compare capabilities of both frameworks there were developed two applications (iOS and Android) that were taking advantage of given features. Both apps provided following functionalities: detection flat surfaces, imaging of detected flat surfaces/special points, positioning any number of 3D objects on stage, choosing scene lighting based on the actual lighting conditions, support for shadows cast generation by virtual objects, measure the distance between 2 points, saving information about detected planes (and special points) to a file, measurement and display of frames per second during operation, measurement and save information on app startup time.

Various mobiles phones were used in the tests, such as iPhone X, iPhone 8, Google pixel 2XL, Google pixel, Samsung galaxy s9 and their results for various tests are given in the paper.

The tests performed are accuracy of plane detection, percentage of incorrectly detected planes, time to detect the first plane, time to map the surface, influence of surface type on mapping quality, work in low light conditions and work in motion for both ARKit and ARCore.
Both platforms differ in the approach to delivering the required library to devices on which AR applications run. In the case of ARCore it is necessary to install an additional library, which can be downloaded from the Google Play store, while ARKit is delivered together with the iOS version 11 or higher.

Both platforms have their strengths and weaknesses, but it is difficult to find technology that would be objectively better. Both platforms are better suited to the situation. In the final analysis, the choice of technology should be conditioned by the current state of the market and your own preferences.

2.5 Association Rule Mining Using Apriori Algorithm: A Survey

Charanjeet Kaur in the paper presents a survey of recent research work carried out by different researchers. Association rule mining is the most important technique in the field of data mining. Association rules are one of the major techniques of data mining. The volume of data is increasing dramatically as the association rules from massive amount of data in the database is interested for many industries which help in making business decision based on the transaction.

In association rule mining find rules that will predict the occurrence of an item based on the occurrence of the other items in the transaction.

Apriori algorithm is the most classical and important for mining frequent item sets, proposed by frequent item sets in a given database. The basic step in generate and test, join step, prune step.

It is no doubt that Apriori algorithm successfully finds the frequent elements from the database. But as the dimensionality of the database increase with the number of items then:
More search space is needed and I/O cost will increase. Number of database scan is increased thus candidate generation will increase results in increase in computational cost.

3. EXISTING SYSTEM

The existing systems are online furniture websites which only let us view the pictures of the product and their dimension. These details about the product are not sufficient enough to make a decision whether to buy the product or not.

Even if the user purchases the product the user might not like it in person or it might not look good when it is places in real environment. There are fewer chances that the user might like the product in person if he/she orders the product by given details. To return the product takes a lot of time as some items are heavy such as sofas, beds and so on.

The most commonly used ones are as follows:

3.1. IKEA Place

IKEA is leading the furniture industry. IKEA's furniture categories within the App have not expanded to its full lists, meaning you can only view a few items if you want to purchase from IKEA. On the other hand, the app user experience is the best so far, in terms of UI and quality of their 3D models.

Advantages:

- High fidelity 3D models, great UX experience

Disadvantages:

- Limited product selection

3.2 Homestyler

If you take a photo of your room, the app has the ability to convert it into a 3D scene where you can place 3D models into your picture offline. Homestyler product selections are very limited and usually from non-popular brands. Homestyler is more like a fun product for designers, since shoppers won't want to buy furniture from the platform.

Advantages:

- Products are 3D models therefore making design easier from any angle.

Disadvantages:

- Bad User Interface.

3.3 DecorMatters

The app has a few 3D models for users who want to try furniture in 3D, but their main focus is still on 2D. It can upload your own furniture and decorations, and place it on a template or a picture of your room. This app has few 3d models, and it does not always satisfies the user.

Advantages:

- It is best for users who design their room by themselves.

Disadvantages:

- Few 3D models to shop.

4. PROPOSED SYSTEM

The basic idea behind the app is that the user can visualize the product by placing it in an open space; this is achieved by Augmented Reality, a technology which is very rapidly growing in the market. Industries like gaming, movies, entertainment are booming rapidly by incorporating Augmented Reality in their products. It will help the customer choose the product which they want to buy and then place it in the given room of an unknown dimension.

The application aims to augment products of a large variety such as Dining Table, Sofa Set, Chairs, Flower Vase, Small Coffee Table and so on. The 3D models then could be placed in the room by tapping on the screen of the phone and see where it would suit the best according to the customer's choice.
The main motive behind this app is the comfort of the user and increasing the ease of online shopping by the use of Augmented Reality. The user will easily be able to browse through different products based on generic classification and then choose the desired option and check it in augmented reality. The User Interface is a simple app and very user friendly by just tapping and dropping the product and also moving it around the room.

4.1 App Overview

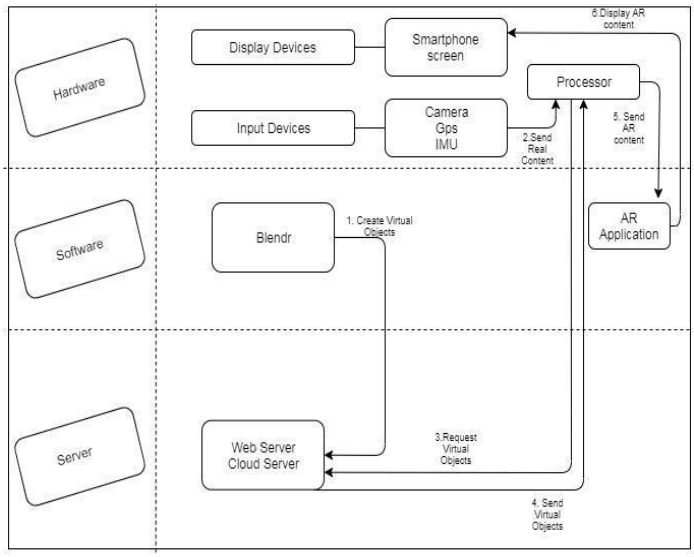

Fig -1: Working of the application

Blender creates 3D models of the virtual object. The format for the 3D models is .OBJ format. Once created, these models are can we used in the application. ARCore takes in as input, the digital signals from the phone's primary camera and the sensors. The camera supplies the image feed to ARCore. From the set of images, the ARCore Engine creates a virtual representation of the world. Various sensors from the smart phone like accelerometer, gyroscope, Ambient Light Sensor and GPS are used to calibrate ARCore and help understand how the camera is placed and being moved, in the virtual environment. The user has the choice to selects a furniture item from the catalog or suggestions list. After selecting, he needs to tap on the image to place it on the virtual environment. The 3D model of that item needs to be fetched from the application, in order to be overlaid.

The 3D model is received by the application. Then ARCore identifies possible surfaces by performing the hit test. When a surface is identified, the 3D model is appropriately rendered onto the surface. This gives a Pose to the object and it is successfully anchored to that plane.

The rendered model of the 3D furniture is combined with the camera feed to create a realistic scene view. The AR Content based on the orientation of the user, is overlaid on the camera feed. This is sent to the application to be displayed on the window.

4.2 App Flowchart

4.2.1 Seller Model

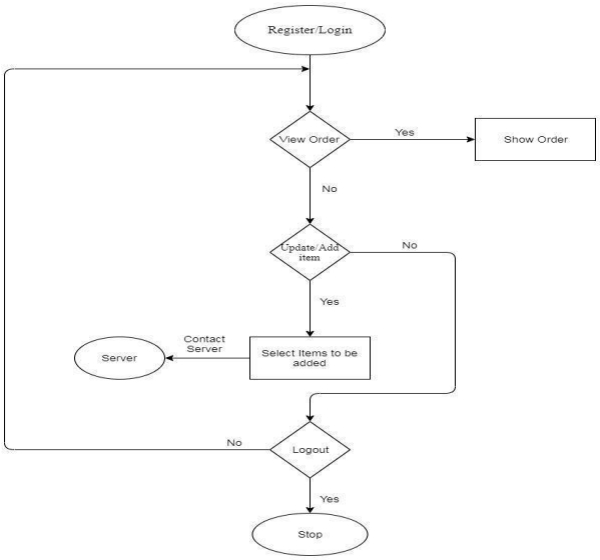

Fig -2 : Flowchart of seller model.

4.2.2 Customer Model

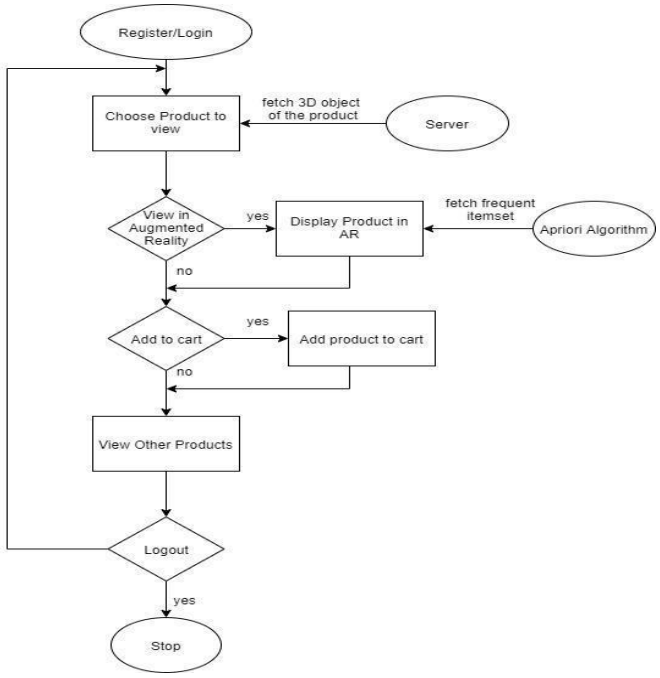

Fig -3 : Flowchart of Customer Model

4.2.3 Apriori Flowchart

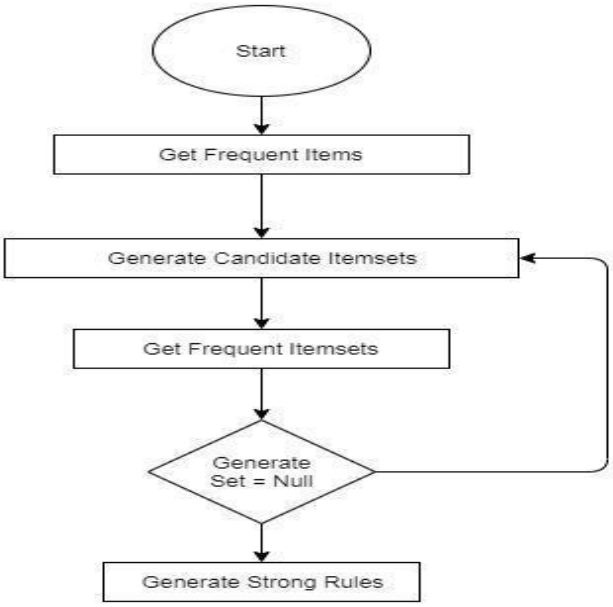

Fig -4 : Flowchart of Customer Model

4.2.3.1 Get Frequent Items

From the list of transactions, we generate a frequent item set. Frequent item set includes items whose occurrence in database is greater than or equal to the minimum support threshold.

4.2.3.2 Generate Candidate Itemset

A candidate itemset is potentially frequent itemset. This operation generates new candidate k-itemsets based on the frequent (k-1)-itemsets found in the previous iteration.

4.2.3.3 Get Frequent Itemsets

It will find the frequent items from the candidate set and if candidate set does not contain any frequent items i.e. Generate set = Null, then it will stop the process and finally finds the association rules. Otherwise if there are frequent items then it will generate candidate set for next iteration till there are no new frequent itemsets generated.

To generate candidate itemsets, following are the requirements:

- It should avoid generating too many unnecessary candidates.
- It must ensure that the candidate set is complete.
- It should not generate duplicates candidate set.

4.2.3.4 Generate Strong Rules

Generate strong rules from frequent itemset .Strong Rules are rules which satisfy the minimum support and minimum confidence threshold.

4.4 Database

For the backend technology, we will use a NoSQL database. This database will hold the information about furniture item and its various attributes. When the application basic information about some item. It will also store user data.

5. IMPLEMENTTION AND RESULTS

The images below are the screenshots from the beta android application of the project.

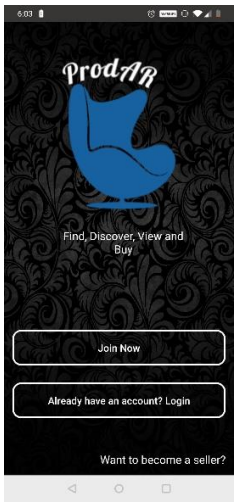

Fig -5 : Main screen of the Application.

Fig -6 : Home screen of the user view.

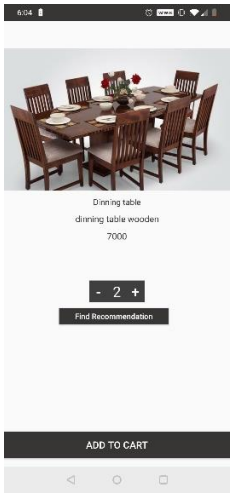

Fig -7 : Product display screen for single product.

Fig -8 : Objects placed using Augmented Reality

6. CONCLUSION

The primary motive for developing this project is to enable furniture shoppers to experience how the products will look in their room, and to enable better purchases.

Our project made it possible to visualize the product which a user wants to buy in real world using Augmented Reality. User was be able to place multiple products and design the entire room. Using association mining user are able to check suggested products which go well with other products selected by them.

The basic features for a shopping app which are signup, login, cart, placing an order and so on were included in the application.

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