AN AUGMENTED REALITY APPLICATION TO ENHANCE THE SHOPPING EXPERIENCE OF ELECTRONIC APPLIANCES

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***Abstract*—As a consequence of the Covid-19 pandemic, retail industry has altered customer behaviour and conventional wisdom. People in India still prefer buying products offline due to their 'try before you buy' way of thinking. This scenario can be changed through a tech-based solution. Augmented Reality(AR) can bridge the gap between online and offline shopping. Users can superimpose the desired electronic product sitting at home. They can also ensure how the product looks at their house. Users can also adjust the size and rotate the object to get a sense of assurance. This paper will explain marker-based and markerless techniques used in our system to place the realistic 3D model and to give a virtual try-on experience. This system will help businesses grow despite challenges caused by Covid-19. As a result, people will be in a position to maintain social distance, but using AR technologies they will also be virtually close.**

***Index Terms*—Augmented Reality, Markerless, Marker-based, Photogrammetry, Retail.**

I. INTRODUCTION

AR got its recognition through the success of the game Pokemon Go [21]. Use of marker based AR technique was first seen in 2008 through a commercial ad of BMW Mini [22]. Later in the early 20's the 'virtual try on' phase came into picture to interact with live movements in the real world [3]. Apart from this, AR can be immensely applied in the cultural, historical and geographic side of environs. Looking at the ongoing Covid-19 situation, AR needs different approach in India i.e. It's just a slight boost and that's where it stands [1]. AR helps customers in better decision making not only in the pandemic but also in contemporary age. Wheelchair users or physically disabled people found it difficult to shop independently [18], interacting with the products on sale is also hard for them. Keeping that in mind AR can give these individuals a new way to forget their deficiencies and shop like abled people. Taking into consideration, the aspects of the shopping/retail industry if this is taken to a professional level this could be step to milestone [2].

Purpose for opting this idea was to make the real world come home helping us to overcome the isolation of Covid-19. The idea is to make the shopping experience better and more realistic for users, where users can shop using AR technology. By making online products tangible brands upgrade buyer confidence and chances of customers to add product to the cart will also improve. To bring shopping to the fingertips of users and experience them as a virtual platform. It should be a financial win-win for companies, as well as a win for their customer satisfaction. The objectives set are as follows

- To create realistic 3d models of electronic devices.
- Detection of different planes in user's environment through scanning.
- To position anchor points and trigger 3d models.
- To impart flexible rendering of object in augmented view.
- Attaching interactive product details or information along with 3d model.
- To achieve immersive wrist watch occlusion.

Consumers can have real time experience of placing electronic appliances at their home. B2B companies [23] can even use our system to bring all the features of the product to life. Providing AR-enabled experiences can give online retailers the differentiated image they need in an overcrowded market.

The next section summarizes the state-of-the-art literature. Section III proposes the methodology used in the paper. Section IV discusses the technology used. Section V explains proposed system working. Section VI mentions proposed outcomes. Conclusion and the future work is presented in section V.

II. LITERATURE SURVEY

It is the need of the hour to look at the things around us in a different way–using modern technology and gadgets. They help in all possible ways giving a real feel. On that note AR is aimed at improving the way we grasp our surroundings by combining technologies such as computing, sensing and display technologies [8]. By analysing features, functionalities, applications and restrictions of AR, this technology can be used for reducing the negative impact in the retail sector caused due to Covid-19 and ultimately maintaining the balance between economy and safety [9].

A. State Of Art

Talking about innovation, for every innovation there is a preexisted model for which one has to innovate. Majority of the AR applications used by retailers were online web based, in-store and mobile apps [6]. Based on extensive review of current applications of AR, the broad use cases of AR are to entertain and educate customers, help them evaluate product

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TABLE I
DIFFERENT BRANDS USING AR IN RETAIL

Uses of AR	Brand	Short Description
Entertain customers	• Walmart	•Collaborated with Marvel to bring AR experience.
	• Starbucks	•Used AR to offer Customer a digital tour of roasting facility.
Educate customers	• Walgreen, Lowe's	•Made apps using AR to guide users to product location and notify them.
	•Toyota, Hyundai	•Used AR to demonstrate key features in their car models.
Help customers ***Evaluate*** product fit	• BMW	•Provided preview of cars based on interior aesthetics
	• L'Oreal	•Provided virtual try-on feature for cosmetic products
Enhance customers' post-purchase consumption experience	• Lego	•Made Hidden side sets to be played with companion AR app
	• McDonald	•Used AR to discover the origin of ingredients in food for customers

fit, and enhance the postpurchase consumption experience [5]. Table I gives summary of the big-players in the retail industry that are using AR for sales improvement. Some of them use AR at entrance to engage customers in sportswear retail stores [14] ,the main benchmarked company IKEA [15] uses AR in furniture and home decoration retail business, Amazon [17] has recently been granted a patent for clothes shopping through AR smart mirror.

B. Identified Gaps

Doing an industry survey, helped in identifying some gaps like the virtual products have still not reached realism, low performance level of the web portals, high demand of resources and therefore the less stability of the market [7]. Along with this, there were other gaps too that are listed below with the possible solutions to overcome the existing system level challenges.

1) Users identify the application as complicated (comprehensibility) [11]
2) Users find the application as slow (efficiency) [11]
3) Equipment and setup is not cheap (low affordability) [12]
4) Users may get injured or damage their surroundings [12]
5) Requirement of powerful hardwares [13]

To overcome the above mentioned problems, systems can be optimized in the following way respectively. For clarity additional explanations (text or video) can be added like user instructions. Application processes can be simplified by reducing the size of 3d objects and simplifying functions. Making use of minimum resources and devices at affordable cost. Providing digital contents in exact mapping with the real world to reduce side effects of virtual reality. Use of markerless systems [16] that complement visual pattern recognition with embedded sensor measurements.

III. METHODOLOGY

By analysing the different AR algorithms and referring to the literature survey, a methodology is built to achieve the proposed objectives [10]. In below fig.1 there are three different modules with their key techniques to be implemented. For implementation of each module there are steps to be followed in respective software and integrating all of them together to create a full working system.

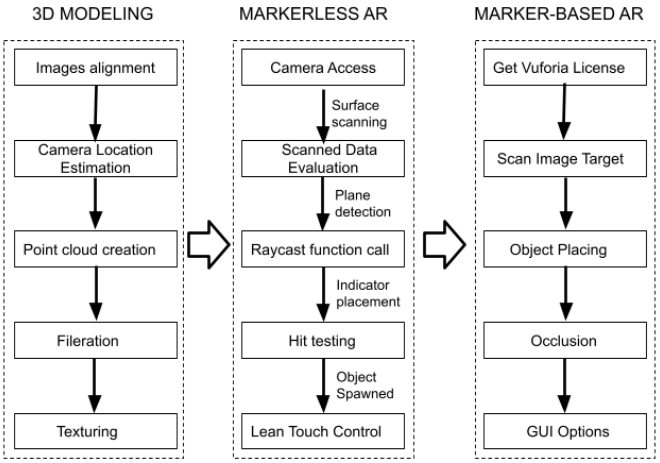

Fig. 1. Module Integration.

A. 3D Modeling

Fig. 2. Phases of 3d modelling.

Fig. 2 indicates a visual representation of separate 3d modelling phases like point cloud estimation, mesh generation and texturing which are explained in following steps.

1) Capturing plenty of images. Minimum two from each angle. Higher resolution of the camera more is accurate are the models. Photogrammetry fails on shiny and transparent surfaces.
2) The image must be aligned in order to match the images together. Estimation of camera location recovers 3d structure from 2d images.
3) The point cloud created helps get idea about how a model will look like and can adjust camera angle accordingly.
4) Creation of mesh and to ensure whether there is any need to get more pictures so that we get a sharper model.
5) Last part is texturing of models to make them look more realistic.

B. Markerless AR

1) Installing the libraries like AR Foundation, AR core, XR plugin for the purpose of android compatibility.
2) Adding AR Session and AR Session origin needed for accessing AR cameras and manipulating AR scenes.

3) Plane detection through camera view using AR Plane Manager.
4) Dragging Placement indicator over detected plane.
5) Function call to Raycast

   Physics.Raycast(Vector3 Origin, Vector3 Direction, Raycasthit Info, float distance, int LayerMask);

   Vector3 means x,y,z position, second parameter to store our direction, third parameter stores info on colliders hit. Finally, there are two optional argument, distance that defines length of ray omitted, next is LayerMask which is number of Layer in unity Layer system.
6) Fetching an object from 3D model per hit detection.
7) Adding component i.e. box collider to allow scaling and rotating.

C. Marker Based AR

1) Image target is created and added to vuforia database.
2) Accessing database through vuforia license key.
3) Placing objects on the image target plane.
4) Adding default hand mesh to create occlusion on the wrist.
5) GUI canvas creation for catalogue browser.

IV. Technologies used

A. Unity 3D

Unity is a real-time rendering game engine developed by Unity technologies. It provides an environment for the development of 2D and 3D content along with a rendering engine, scripting interface and exporter to different platforms such as Android, Mac and PC [4].
To build our system we have used unity version 2019.4.20f1. This version has XR Plugin Framework. This allows software and hardware providers to develop and maintain their own unity integration. It has an interface that allows separating controls binding from the code logic.

B. Reality Capture

Reality Capture is a software used to create 3d models using photogrammetry [20]. It requires a minimum hardware requirement for processing n number of triangles. It is able to mix plenty of images and laser scan. Its features include alignment, coloring, texturing, scaling, filtration, projection and coordinate system.

C. AR core

It is a SDK provided by Google to build AR apps [19]. It uses motion tracking which is used to identify the position. Environmental understanding helps to recognize the size and location of the surface. Light estimation helps understand the current lighting condition.

D. AR subsystem

It is free from any ties to the platform. All related subsystems come under this package. They include session origin, raycasting, camera, plane detection. As a prerequisite one needs to install ARKit XR plugin, ARCore XR plugin. These are called subsystem ”providers”.

E. Android

Developers can build apps in Android through unity. Need to add Android SDK and NDK modules in unity. Android 7.0 and above are compatible with AR. Higher the resolution of the camera better the result .

F. Firebase

Firebase helps to create quality web and mobile applications. It is a Backend-as-a-Service (Baas). Firebase is classified as a NoSQL database program and stores data in JSON-like files. To connect unity to firebase, need to download firebase sdk generated. Then import FirebaseDatabase.unitypackage from the firebase_unity_sdk/dotnet3.

V. Proposed System Working

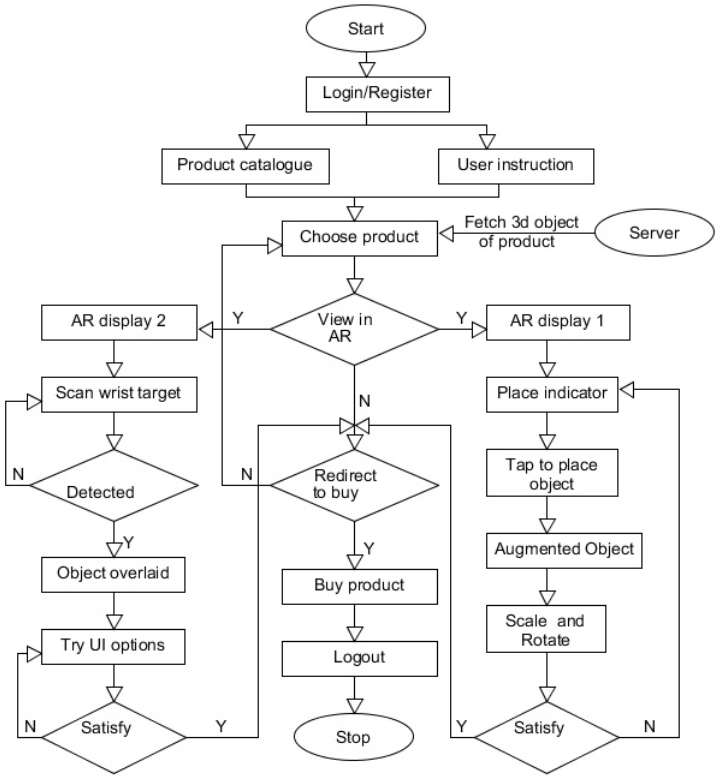

Fig. 3. Proposed system flow

The proposed system should have the features shown in fig.3. In this system, users will be buying electronic gadgets online using our AR app RESURE. For ease of user experience there will be starting instructions in the app to handle the AR scene. After browsing the desired product there should be a 3D model of it displayed in AR view without taking much

time to load. Out of these ten electronic models included in the app, nine models are displayed through markerless view i.e AR display 1 and tenth model is a watch model which is displayed through markerbased view i.e AR display 2.

Because of applied methodologies we expect that our system should be working efficiently in uncertain conditions too, like low light intensity and pure internet connection.

VI. Proposed outcomes

1) Making AR feature capable of understanding user's environment to show or display electronic objects in exact mapping with user's real world. In simple terms - providing minimum difference between computer generated products and existing physical things in real view.
2) Second is related to user experience, usability and convenience meaning the proposed system will be convenient enough so that any type of user can use it regardless of their age, motor disabilities and prior technical knowledge.
3) Third considers the ethical perspective, buyer will be confident and assure about the product through virtual try on without getting tricked by any online threats.
4) Last is a quantitative outcome which states that once our product reached among masses we will achieve both economical and social benefits like being socially distant and improved AR market growth.

VII. RESULT

Fig. 4. Catalog page

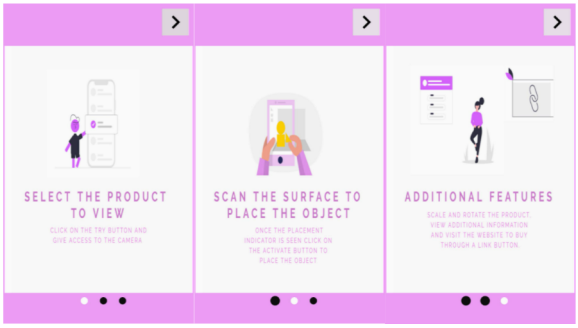

Fig. 5. Instruction page

Fig. 6. Augmented watch model

Fig. 7. AR view of 3D TV model

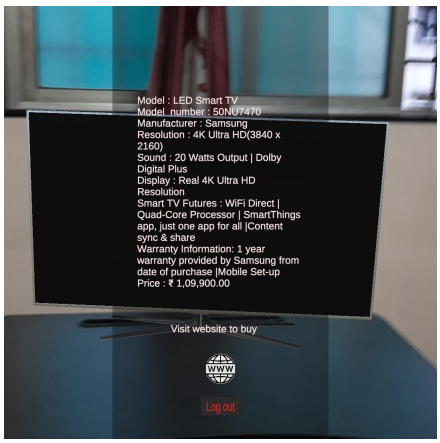

Fig. 8. Product details

VIII. CONCLUSION

The main aim of the application is to use AR to render the electronic device on the desired surface. Due to this, customers will get a clear understanding of how the product will look in their house structure. A 3d model gives a realistic look to the product and helps users gain confidence. Users can also rotate and scale the product at their fingertips without physically visiting the store which is needed by society today. The system will also be beneficial to the retailer as users can navigate to the website to buy the product.

The future scope includes the use of AR portal to navigate through the shop and then click on the product to render it.

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