Innovative Digital Customer Engagement and Experience in Car Retail using Augmented and Virtual Reality

S.Kalpakha, G.Kalaiselvan, T.Aravindh Krishna
Undergraduate, Department of Computer Science and Engineering, Dr.Mahalingam College of Engineering and Technology, Udumalai Road, Pollachi-642 003. Coimbatore – District, Tamilnadu, India

Abstract

Millennials have forced automakers to see the retail landscape with a new perspective. They are forcing the entire automotive sales ecosystem to introspect deeply on the current buying process. Auto marketers are hoping to align with the changing consumer behaviour and to eliminate the pain in today's buying process with the aid of technology. Virtual Reality (VR) is already enhancing retail,and is rapidly being adapted in automotive industry. Augmented Reality (AR) allows users to experience an enhanced real world, either by bringing vehicles into their own environment or providing additional information on the vehicle in front of them.Reality and Virtuality exist along a spectrum that ranges from adding small cues to real world experiences (AR) to expansive Virtual worlds that allow customers to be fully immersed in an entirely fictional world (VR). Creating an interactive car retail experience, using Virtual models to augment with real-time is far more preferable than showing only paper brochures or static cars in showrooms. The ability to view Virtual/Augmented car models, specifications, interiors, parts and comparisons makes the car buying experience a lot more enjoyable. Initially customers can use Augmented/Virtual Reality tools to visualise content and products. Then they interact with Augmented/Virtual Reality tools on a regular basis and build an emotional connection with the brand. This finally leads to immersion into the product environment. This paper describes the project which aims to implement Augmented Reality and Virtual Reality in car retail experience , and to understand the role of these applications on the perception of actual dimension..

Keywords — *augmented reality, virtual reality, car buying experience, design process, sales tool, showroom.*

I. INTRODUCTION

Car buyers spend nearly 15 hours in the car-buying process, and the majority of that time (59%) is spent researching and viewing cars online. Despite the plethora of information available to buyers, 70% still don't know which car they want until they visit the dealership and sit in different makes and models. This means salespeople spend the bulk of their time lining up cars for buyers to see, only to have them realise they don't like, for example, the way the interior looks. What better way to improve the shopping process than by leveraging technology that transforms an industry? Virtual Reality (VR) is already enhancing retail, architecture, hospitality, and health care. What will it do for the automotive industry, and when? Any discussion of Virtual Reality is also a discussion of VR and AR.

Augmented Reality (AR) allows users to experience an enhanced real world, either by bringing vehicles into their own environment or providing additional information on the vehicle in front of them. VR takes the user into a Virtual world that provides a high level of engagement with and focus on the product presented. AR is already available to millions of people on their smartphones, and forms a stepping stone to the significantly more compelling implementation on wearable AR and VR headsets. These first steps educate the consumer, and allow technology providers to upgrade the operating systems and prepare content developers.

The objective is creating an interactive car retail experience for Maruti-Suzuki combining industrial design, using Virtual models to augment with real-time. The application is meant to reach a broader market segment with the help of Augmented/Virtual Reality proving a location-independent marketing tool. It enables users to view 3D models, Virtual/Augmented car models, specifications, interiors, parts and comparisons

- Allows customers to enjoy a Virtual and Augmented mobile experience with the ease of being anywhere as well as at the showroom.
- Augmented Reality requires the customer to be in the same room with the vehicle while Virtual Reality uses mobile device to enjoy the experience from any place
- Universal and scalable geographically and in real time
- Only uses an app and a smart device

II. METHODOLOGY

Customer centricity is the point appreciated by most of people who want to buy or sell a car. This customer centricity can be reached using various

tools, including IT tools. Taking into consideration the fact that 89% of consumers look for vehicle information online, various integrated mobile apps, including VR app for car dealership, online platforms, pricing and information websites and other digital channels (video marketing, online reviews and so on) can be a source of positive customer experience and can become sales drivers of future car dealership. Even actual showrooms are undergoing the process of transformation into digital market places equipped with automotive VR capabilities.

Car dealers also take the advantage of AR/VR technology Traditionally when customers want to buy a new car they start exploring the market and visiting care dealerships. Very often there are very few models displayed there and the number of colours and additional features is very limited. It would be a lot better if customers got a quality VR headset and can customise any feature or model of the car you want to buy. Otherwise they can get every technical detail you want to know about the future car and also they can even sit at the driver's seat and make a virtual ride.

A. Existing Systems

Audi is the brand which is rolling out this technology to equip its virtual showrooms. Audi virtual showrooms in London display only some actual car models and the relevant buying information is shown on video screens which can be navigated using gestures. The capabilities of virtual reality allow customers to have a 360-degree look inside and outside the car, open doors and even listen to how their potential new car sounds.

BMW also uses VR technology to create virtual reality cars tours allowing customers to get the feel of new cars and to choose a car configuration. The company also uses VR apps to present brand new models.Toyota used Zero Light-powered VR technology as a tool of pre-marketing activity for virtually launching their new C-HR car. In partnership with HTC, the company created the highly detailed, configurable car appears in virtual reality. To showcase the car at 1:1 size the Vive's room-scale capability was used enabling users to walk around and interact with the car to explore its features.

Honda used an AR experience called the Honda Lens to give people an interactive tour of different Honda car features without requiring the user to look under the hood.

Porsche has launched the Mission E Augmented Reality App to make it possible for customers to experience Porsche's first purely electric sports car. The Mission E is still a few years away from actual launch. The app acts as a pre-selling tool by giving customers a peek at what's to come.

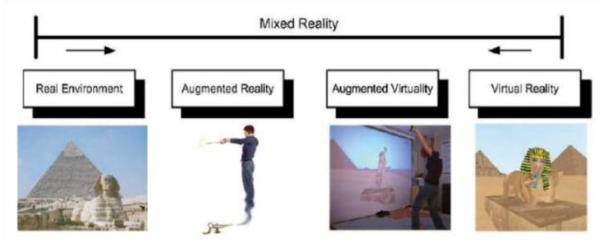

Fig 1 : Existing System

B. Proposed System

- In existing apps, very few apps cover both AR and VR. This project is available with AR and VR experience based on user convenience
- Currently apps provide very limited functionality and are mainly meant to provide experience for a single model but our project extends over all models of the brand
- Modules like manual, customisation, selection, viewing are present as separate applications and here we provide a combined setup
- There is no quick access to database. This app uses a more optimal firebase database and thus provide quick fetching of contents with minimum memory occupation

The proposed system is aimed at providing customers with an AR and VR experience with features like ability to view various car models in Maruti-Suzuki in Luxury segment, Midsize segment, Small segment and Utility segment (currently for models Brezza and Celerio), filter cars according to required criteria specified by the user based on price, features, size, fuel etc., selecting and sorting them based on preference, viewing interior, environment in 360 VR, user manual display (instrument cluster) in AR for dashboard and engine, changing colour, manipulating models of cars in AR, knowing car's anatomy in AR.

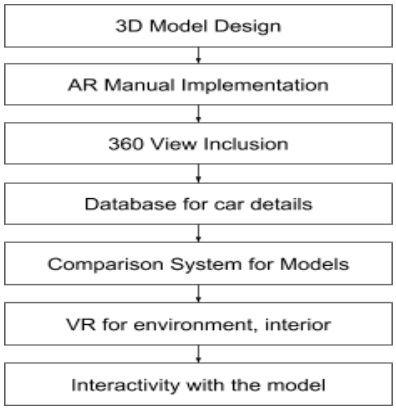

Fig 2 : Flow of activities in Car Retail Experience

III.MATERIALS

The implementation requires the following software and hardware:

- Unity - Unity version 2018.1.6f1
- Firebase - Realtime Database version 16.0.3, Firebase SDK for Unity (v5.3.1)
- Vuforia - Vuforia Engine v7.5.20
- Google Cardboard

Whether it's VR,AR, or MR, Unity's highly optimised rendering pipeline and the rapid iteration capabilities make XR creative vision a reality. Unity is the most widely used VR development platform, and over 91% of HoloLens experiences are made with Unity. Unity supports all the latest and greatest platforms. Its highly-optimised stereoscopic rendering pipeline and the tools to help further optimise your content. It has a rapid iterative development and built-in support for numerous platform-specific features like VR/AR API.

Firebase is a mobile and web application development platform. Firebase now integrates with various other Google services to offer broader products and scale for developers. Firebase Auth is a service that can authenticate users using only client-side code. It supports social login providers Facebook, GitHub, Twitter and Google (and Google Play Games). Additionally, it includes a user management system whereby developers can enable user authentication with email and password login stored with Firebase. Firebase provides a real time database and backend as a service. The service provides application developers an API that allows application data to be synchronised across clients and stored on Firebase's cloud. Developers using the real-time database can secure their data by using the company's server-side-enforced security rules. Cloud Fire store which is Firebase's next generation of the real-time database was released for beta use.

Vuforia is an augmented reality SDK for mobile devices that enables the creation of augmented reality applications. It uses computer vision technology to recognise and track planar images (Image Targets) and simple 3D objects, such as boxes, in real time. This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real world images when they are viewed through the camera of a mobile device. The virtual object then tracks the position and orientation of the image in real time so that the viewer's perspective on the object corresponds with the perspective on the Image Target. It thus appears that the virtual object is a part of the real-world scene.

Google Cardboard is a VR platform developed by Google for use with a head mount for a smartphone. Named for its fold-out cardboard viewer, the platform is intended as a low-cost system to encourage interest and development in VR applications. Users can either build their own viewer from simple, low-cost components using specifications published by Google, or purchase a pre-manufactured one. To use the platform, users run Cardboard-compatible applications on their phone, place the phone into the back of the viewer, and view content through the lenses.

IV. PROCESSES INVOLVED

The proposed application consists of activities that flow in the following order:

- Designing 3D models for various Maruti-Suzuki cars to display in VR headsets
- Implementing Augmented manuals for better understanding of indications and components
- Capturing interior in 360 view to provide real-time viewing experience
- Working on Firebase database to store car details and display them whenever required
- Implementing a comparison system to choose car based on user requirement
- Introducing additional features like changing car colour in AR, viewing components from floor etc
- Virtual reality features for improving car retail experience and knowing interior
- Introducing interactivity in car model like zoom, pinch, drive, operation etc.

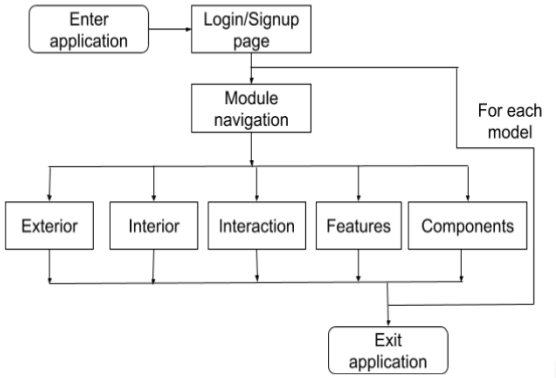

Fig 3 : Features and Processes involved in Proposed System

A. AR Implementation

The Vuforia Engine Library contains technical documentation to help developers be successful with our SDK and create AR applications. Along the left side, you will see that the Vuforia Engine Library is organised by all of the platforms that Vuforia Engine supports. Vuforia Engine supports both the Unity Engine as well as the three major native platforms: iOS, Android and UWP.

The Vuforia Engine Library is also organised by major feature categories.The major feature categories are Images, Objects and Environments.

Lastly, we have links to the Vuforia Engine API documentation which includes C# APIs for

Unity, C++ APIs for iOS and UWP and Java for Android.

Unity integrates the Vuforia Engine, making it even easier to create cutting edge augmented reality experiences for both handheld and head-worn devices.In addition to platform support (iOS, Android, UWP), Vuforia Augmented Reality Support in the Components selection dialog needs to be selected in unity.Vuforia Engine will be visible in the Unity Game Object menu and also in Build Settings and Player Settings.Vuforia Engine must be activated in project before building a Vuforia app, or Vuforia Engine is used in Play Mode. Go to Player Settings to activate Vuforia Engine under the "XR Settings" section and check "Vuforia Augmented Reality".After activating Vuforia Engine in Unity, you can add features of Vuforia Engine to your project from the Unity Game Object Menu.Vuforia Engine-powered Unity apps are built and run in the same way as other Unity apps.

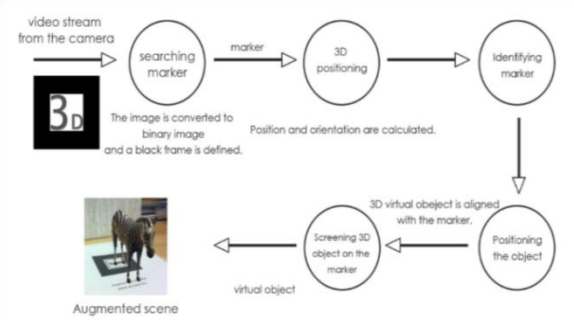

Fig 4 : Internal working AR

B. VR Implementation

Unity VR lets you target virtual reality devices directly from Unity, without any external plug-ins in projects. It provides a base API and feature set with compatibility for multiple devices.To enable native VR support for your game builds and the Editor, open the Player Settings (menu: Edit > Project Settings> Player). Select XR Settings and check the Virtual Reality Supported checkbox. Set this for each build target.Use the Virtual Reality SDKs list displayed below the checkbox to add and remove VR devices for each build target. The order of the list is the order that Unity tries to enable VR devices at runtime.When VR is enabled in Unity, automatic rendering to a head-mounted display isdone.

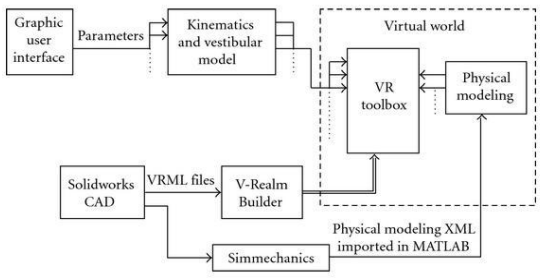

Fig 5: Internal working VR

C. Features Implementation

1. Viewing Exterior

Display of realistic 3D model of car is made in AR.Target image is set to Brezza/Celerio exterior images.Colour change and manipulations like zoom, reveal, translate and rotate to the model are enabled.Operations like car door opening/burst is provided

2. Viewing Interior

360 view of interior is provided with stitching of all the views.Cursor/swipe is used to look throughoutVR is enabled by tap when VR Hardware (Headset) is used

3. Viewing Dashboard

Augmented manual on top of a target image (Car model Dashboard) is displayed.Various indications for user understanding are described

4. Viewing Engine

Augmented specification and model of engine on top of a target image (Brezza Engine) are shown.Details like torque, type, power are given to know about the engine

5. Viewing Features

Feature menus are displayed on top of target image (Car model Features).Navigation to specific feature category is done by clicking onto the menu item.Interior, exterior, safety, comfort and entertainment features are included

6. Comparing Specifications

Variants of car models are compared.Data is fetched based on selection

7. Viewing Showroom

360 image of a car showroom is displayed in a spherical form.VR mode is made available for viewing in VR headset

8. Driving car

Prototypic track is utilised.Car is driven for knowing acceleration and speed

V. RESULTS AND DISCUSSION

The results found during the project work and the discussions made are detailed.

A. 3D models design and usage

Various models of Maruti-Suzuki cars are extracted and displayed for view in Augmented Reality. They include intricate defining of the components with materials and textures. They can be scaled, zoomed in and out, translated so as to improve interaction. There are buttons provided to enable colour changing and burst view. The model can be driven for test to know the acceleration and mileage.

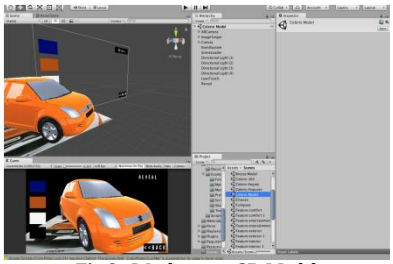

Fig 6 : Work screen 3D Model

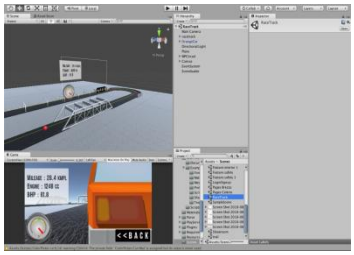

Fig 7 : Work screen Test drive

B. Augmented manual for components and features

Descriptive manuals which specify the components and what they are meant for help users in utility. This is given for dashboard and engine. Engine description includes engine specification with Augmented model of engine while dashboard description points out the names of indicators in dashboard. Comparison system is also implemented to compare features of variants.

C. Interior and Showroom 360 VR

The interiors of the car are shown via 360 image skybox feature and the showroom is provided with 360 view image. This can be viewed better using VR headset. This would improve immersion into application providing users with Virtual Physical Store Experience enhancing online customer shopping experience.

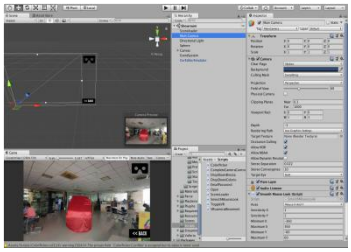

Fig 8 : Work screen VR Showroom

D. Summary of Results

3D model with colour changing, basic interactivity like zoom, select, open up are provided. Other interactions like burst, car operations could be included.

Car models with Augmented modules are included for exterior, interior, features, with comparison and components are present. More details to the augmentation can be included.

VR mode switch for showroom and interior are provided which can be further improved by enhancing interactivity with VR including gaze input etc

Sample drive with acceleration can be extended to real-time driving of the model

Augmentation with car showroom for better experience can be made so that there would be a digital touch to the car buying experience.

VI. CONCLUSIONS

Thus, the application helps user in viewing car model inside out, providing 360 view of interior, enabling interactivity with model, augmented display of manuals, allowing comparison of specification and featuring sample drive. This application proves to be enhanced from existing applications by providing multiple functionalities not present in the other existing systems. However, the working is limited to the current hardware usage. In future the application can be improved by using more realistic 3D models by purchasing and modifying assets; including many models of car for the specified brand; improving interactivity in VR using gaze, controller input providing real-time driving experience and so on.

ACKNOWLEDGMENT

We express our sincere thanks to our honourable Secretary Dr.C.Ramaswamy for providing us with required amenities.

We sincerely thank our director Dr. RangaPalaniswamy, for his moral support and encouragement for our project.

We wish to express our hearty thanks to Dr.A. Rathinavelu, Principal of our college, for his constant motivation and continual encouragement regarding our project work.

We are grateful to Dr. G. Anupriya, Head of the Department, Computer Science and Engineering, for her direction delivered at all times required. We also thank her for her tireless and meticulous efforts in bringing out this project to its logical conclusion.

Our hearty thanks to our guide Ms. A. Brunda, AP(SS) for her constant support and guidance offered to us during the course of our project by being one among us and all the noble hearts that gave us immense encouragement towards the completion of our project.

REFERENCES

[1] Şahin, D. & Togay, A. ," Augmented Reality applications in product design process", 4th World Conference on Design and Arts, (DAE-2015) 26-28 June 2015.

[2] Chen Xi,"Virtual Reality/Augmented Reality",China Academy of Information and Communications Technology (CAICT) Huawei Technologies Co., Ltd December 2017

[3] Mike Campbell, Shawn Kelly, Rocky Jung, Jon Lang, "The State of Industrial Augmented Reality ",PTC,2017

[4] Tobias Höllerer, "Notes on Virtual and Augmented Reality ", IEEE,Los Angeles, CA, USA,18-22 March 2017

[5] Donghao Ren,Tibor Goldschwendt, YunSuk Chang, Tobias Höllerer,"Evaluating wide-field-of-view Augmented Reality with mixed Reality simulation",2016 IEEE Virtual Reality (VR),Greenville, SC, USA,19-23 March 2016
[6] Barath Ashokkumar,Anand Sethuraman,"Redefining the Vehicle buying process",Infosys Limited, Bengaluru, India,2018
[7] H.Chen, Y. Dai, H. Meng, Y. Chen and T. Li, "Understanding the Characteristics of Mobile Augmented Reality Applications," 2018 IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), Belfast, United Kingdom, pp. 128-138.,doi:10.1109/ISPASS.2018.00026 2018
[8] Mathieu Rodrigue,Andrew Waranis,Tim Wood,Tobias Ho ̈llerer,"Mixed Reality Simulation with,IEEE Virtual Reality Conference 2015,Arles, France,23 - 27 March,2015
[9] Mark Billinghurst, Adrian Clark, and Gun Lee ,"A Survey of Augmented Reality",The Human Interface Technology Laboratory New Zealand ,University of Canterbury ,Christchurch, New Zealand ,2015
[10] Mahesh Venkatasubramanian ,"Augmented Reality and Business : Bridging Virtual and Physical gaps", Cognizant Business Consulting ,January 2018
[11] Elin Sjostrom,"Virtual Reality as a Sales tool for Industrial Companies",Interaction Technology and Design journal,Sweden,June 4, 2015
[12] Eduardo González Mendívil, Rocío Esmeralda Naranjo Solís, Horacio Ríos,"Innovative Augmented Reality System for Automotive Assembling Processes and Maintenance", Estudios Superiores de Monterrey Av. Eugenio Garza Sada 2501 Sur, Z.C. 64849 Monterrey, Nuevo León, México,2013
[13] Philipp Hock, Sebastian Benedikter, Jan Gugenheimer, EnricoRukzio",CarVR: Enabling In-Car Virtual Reality Entertainment ", Institute of Media Informatics, Institute of Psychology and Education , Ulm University, Germany,2016
[14] Kaj Helin, Jaakko Karjalainen, TimoKuula, Nicolas Philippon,"Virtual/Mixed/Augmented Reality Laboratory Research for the Study of Augmented Human and Human-Machine Systems", 12th International Conference on Intelligent Environments (IE),Sep 2016
[15] Xiao Li, Bo Xu, Yue Teng, Yi-tian Ren, Zhu-min Hu,"Comparative research of AR and VR technology based on user experience", International Conference on Management Science & Engineering 21th Annual Conference Proceedings,Aug 2014
[16] Using AR and VR to sell cars https://blog.hedgehoglab.com/using-ar-and-vr-to-sell-cars
[17] Industrial applications of AR and VR http://www.zdnet.com/article/ten-industries-using-augmented-reality-and-virtual-reality/
[18] The Automotive Retail Experience Guide: Augmented Reality, Virtual Reality vs Virtual Showroom http://www.whisbi.com/blog/automotive-retail-experience-guide/?submissionGuid=80986af6-1b40-4382-a1b0-920fa2911f63
[19] Cars in the future reality https://www.volkswagenag.com/en/news/stories/2017/03/how-volkswagen-is-developing-the-car-of-the-future-virtually.html
[20] The State of Industrial Augmented Reality https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwj7sKXh4bLaAhWHpI8KHanNAiEQFggoMAA&url=https%3A%2F%2Fwww.ptc.com%2F-%2Fmedia%2FFiles%2FPDFs%2FAugmented-Reality%2FState-of-AR-Whitepaper.pdf&usg=AOvVaw2arV8HvorXFcJJj1B7mxgI
[21] T.Saravanan ,"Innovative Filter Analysis in Image Processing", SSRG International Journal of Computer Science and Engineering (SSRG - IJCSE), V1 (1), 1-5 February 2014. ISSN: 2348 – 8387