# Shop Augment, Virtual Shopping using Augmented Reality for Retail Industry


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The thesis is to be submitted to the Department of Computer Science, University of Engineering and Technology, Lahore for the partial fulfillment of the requirement for the Bachelor's degree in Computer Science.

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# Declaration

I declare that the work contained in this thesis is my own, except where explicitly stated otherwise. In addition this work has not been submitted to obtain another degree or professional qualification.

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# Acknowledgments

First of all, we wish to thank Almighty Allah for giving us strength in fulfilling this work. It gives us great pleasure to express our deep sense of gratitude and respect to our supervisor, prof. Dr. Usman Ghani, for boasting our confidence and a sense of excitement and inspiring us in our work through his guidance. Our sincere thanks to him for his valuable suggestions and efforts. It is with great pride and pleasure that we submit this dissertation as his students. Lastly we would like to thank our parents for their unconditional love, affection, kind cooperation and encouragement.We are thankful to Mam Zubaira for his continuous help in successful completion of this project. This work was completed in Intelligent Criminology Lab under National Center of Artificial Intelligence.

## *Dedication*

*Dedicated to Almighty Allah for His blessings and benevolence. We would also like to dedicate this thesis and Final Year Project to our supportive families, and friends who stood by us in times of need*

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# Abbreviations

**AR** **A**ugmented **R**eality

**VR** **V**irtual **R**eality

# Abstract

Augmented reality is breakthrough in technology and there is a number of industries that are interested to use augmented reality for their operations. Augmented reality is mixture of virtual and real world environments. Augmented reality enables user to work efficiently in several environments and for several processes. One of the industries that is much interested in augmented reality is apparel. This paper elucidate how augmented reality could dominate the accessories that is a part of clothing industry. Furthermore, this paper discuss several areas for augmented reality and clothing industry, also gaps for future.

# Chapter 1

# Introduction

## 1.1 Overview of the Project

The tremendous growth in the technology has caused the people of every sector of age and the potential buyers of each and every company to switch their shopping experiences to the online shopping. We cannot ignore the importance and interest and interaction factors in the offline person to person shopping, however, with time do the preferences change and hence has the online shopping got a new shape. Nowadays people face lot of difficulty in trying items in different stores due to shortage of time or due to crowd in stores. In present time, stores are not providing try room facility due to contagious Covid-19. So, we'll provide a solution for these kinds of problems. We'll work on system that allow people to try items using augmented reality at any place using our system. People will stand in front of a camera using system and try-on different items of their choice. We can reduce the time taken by both shopkeeper and the customer to try the item manually and then get it back to check. Also it will reduce the threat of getting things contagious by any infected person by touching it as we are still going through this pandemic conditions. This will provide the accessibility and easiness to surf the e-commercial stores with augmented reality system that will give us spectacular online shopping experience. The user can just download the app for that specific brand and browse its products. If he wants to try something just like physical shopping he can open his camera through that app and let AR do the rest. The AR feature will enable user to have 3D models of products to fit on his body so he can try all the sizes available and see if he likes the look of it. In this way physical shopping can be replaceable by much easier and efficient way of shopping. Shop augment, Virtual shopping using augmented reality for retail industry will provide assistance to both the customers and shopkeeper in saving their time. This project

will help people to save them from infectious diseases that came from other people. Using this system people will try different items in minimal time and without any fear of contagious diseases. The main benefit of this system is ability to try the items virtually without having them physically before they place their order.

## 1.2 Background

After the internet users all over the world started adopting online shopping, the main concern of the people was to be able to experience how actually would they look alike and also the experience of being there at the shopping mall. As the time did pass, many solutions to the problem started evolving and hence a few were proposed voluntarily. People go to shopping malls and brands to get the items of their desire and try these products to check if they like it or not. Also in the current situation of pandemic, going out is not easy as there is vulnerability of getting infected by the virus also the shops all round the globe were closed due the lockdown imposed by the government. So, getting things were not that easy due to these mishaps.

## 1.3 Motivation

The motivation of the project is to make the online virtual shopping try on experience so real that the buyers can relate it to the conventional shopping.

- The existing applications addressing this issue don't make any difference than just placing an object in the 3D plane.
- We however will provide a relatively more near-to-practice and relate-able experience through our platform.
- Many brands have their on AR try on apps but they are limited to just one product only.
- There is no such app that can show all the products available in the shop but just only one.

There is an app named as sketchfab that let us to select the model and place it on a plane surface. It contains the list of models that we will select manually. In our system, user will select the product and the item will fit on its body as you are wearing that product using augmented reality. Also many other apps like Glass

On that can let you try different eye glasses on your face but choosing from many that are already available. Nike also have their own shoes app that puts shoes on your feet according to your size and choice. These limited but accurate concept of shopping using augmented reality creates room for our app that can have all the product in the assets of a brand that user can try on using AR. We will fill this gap very efficiently by creating an optimized app that can work under any environment and on both men and women.

## 1.4 Objective

The objectives of the project include making the people able to shop online just as if they were shopping in the traditional real world environments.

### 1.4.1 Industrial Objective

In the older days, it was impossible for people to even imagine the thought of digital fashion where one could experiment wearing fashion articles without actually trying them on themselves. As time went by, technology took a step towards huge progress and the impact of virtual reality (VR) and augmented reality (AR) in the market is found to be transformational. Now, various brands and trademarks can use augmented reality to augment their customer care and services so that unnecessary expenses can be cut down. Almost every brand out there follows the 'try before you buy' concept so as to satisfy the customer. AR is found to be helpful in following this concept and bringing a wonderful merit to the customers as well as the fashion brands. The buyers will be able to foresee their appearance in a particular fashion article before actually wearing them. Also, AR technology will help the users to find their suitable size of the item without repeatedly trying them on. As far as the working of AR is concerned, it simply works i.e. the user takes a picture and the AR augments each and every part of the costume so that the user could see him/her in the particular outfit. This gets easier just because everyone owns a good quality camera in form of smart phone in their hands. In addition, AR friendly smart phones of Apple and different Android brands are supposed to be launched by the end of this year. Industrial objective of our project is very effective because the brands will use it as it will provide flexibility as well as time saving technique to promote their articles.

### 1.4.2 Research Objective

The research objective of our project can be the different ways through which we can implement this project. Although we will use Unity 4 Pro or 3D model detection techniques here but we can implement this by other methods as well

like computer vision or sensors. We can do research about them as well while implementing it one of above techniques. Our research objectives related to this project will be:

- To find different technologies to implement it.
- To conclude the most effective way.
- Places where it can be used other than clothing.
- How to make the existing system more efficient.

### 1.4.3 Academic Objective

The technology which we will use for this project to implement isn't very common or being teach in regular degree courses so we have to learn these technologies to fulfil our academic objectives. These objectives include:

- The technologies we use.
- Technologies we'll learn other than we use.
- To have better understanding of implementation of technology we learn.
- Team Work.

## 1.5 Problem Statement

To provide the highly effective, fast, and efficient system of an AI-enabled, empathetic, text-based conversational mobile mental well-being app that will respond to user queries 24/7, will provide the recommended treatment to them, and make things easy for the users. The problem of the day is to shop augment and try on the jewelry, shoes and garments shopping at the ease of home through online e-commerce platforms. Customer of brand that serves his loyalty on just one specific brand always wants to buy from them but let's suppose if that shop is closed or situation around you is not very optimal to go out and shop just like normal days also this can be very much time consuming so there should be a way to solve this problem. The virtual and augmented reality address this matter in a very straightforward way.

## 1.6 Executive Summary

Nowadays people face lot of difficulty in trying items in different stores due to shortage of time or due to crowd in stores. In present time, stores are not providing try room facility due to contagious Covid-19.So, we'll provide a solution for these kinds of problems. We'll work on system that allow people to try items using augmented reality at any place using our system. People will stand in front of a camera using system and try-on different items of their choice. We can reduce the time taken by both shopkeeper and the customer to try the item manually and then get it back to check. Also it will reduce the threat of getting things contagious by any infected person by touching it as we are still going through this pandemic conditions. This will provide the accessibility and easiness to surf the e-commercial stores with augmented reality system that will give us spectacular online shopping experience.

## 1.7 Scope

The scope of the project is that this system will provide the menu of the store. System will provide the available items in the store. System will detect the body of the customer. System will provide the prices of the items. System will allow the shopkeeper to add different items in the system. System will allow the shopkeeper add quantity, size and color of the items.

## 1.8 Challenges

### 1.8.1 Technology Selection

The technologies used are:

- Unity.
- Blender (for scaling models).
- C Sharp (for back-end).
- AR Core (for building augmented reality experience).
- Vuforia (for surface detection).

### 1.8.2 Lack of 3D models

Any of the 3D models we want to use in our project are either paid or not use-able. We visited many online platforms in search of 3D models that can help us but we face the same problem that ready to use models are paid.

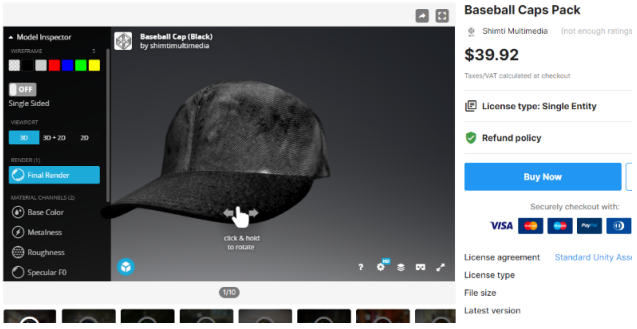


FIGURE 1.1: Pricing of 3D models on asset store

### 1.8.3 Scaling

The models we found were either small or irregular so we worked on these models and re-scaled them to make them use-able for our projects. It's a very time-consuming task.

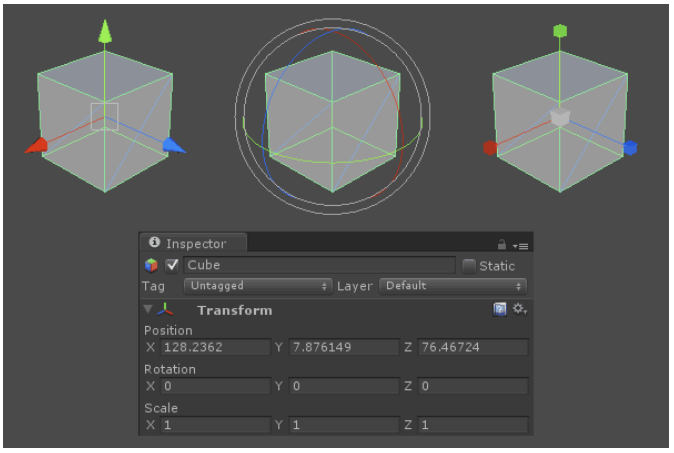


FIGURE 1.2: Scaling of models in Unity

### 1.8.4 UI design

As we know that a successful application has a user-friendly interface and designing such an interface is not an easy task to do. So, it was a challenge for us to create an interactive interface application.

FIGURE 1.3: Scaling of models in Unity

### 1.8.5 Optimization of algorithm

The algorithm we used for the detection of face and other parts of body were not fully optimized according to our need. In order to optimize the algorithm, we provide data set to train the model so that algorithm could perform efficiently.

## 1.9 Applications

### 1.9.1 Remote accessibility to online stores

Using the planned system, a user can access a store product remotely.

### 1.9.2 Try-on

User can try the products by using the camera in real word and can check how it looks on them so they can decide whether they want to buy it or not.

### 1.9.3 Time saving

Going to a mall or any other outlet of a brand takes a lot of time which is a hectic task. By using our application this problem can be solved by trying and buying online without any risk of non- satisfaction of product.

### 1.9.4 Pandemic situation

As we know in current situation of Covid-19 all the physical shops were closed for months and when opened there were still risk of getting infected. Using AR we can resolve this issue by allowing user shop without going out.

### 1.9.5 Opportunity for brands

Using this application brands having variety of products can shift their business from just websites to apps like this so they can expand their business model to expand their business.

### 1.9.6 Increase Business Productivity

This system is helpful for increasing the profit of the business by not just attracting more and more traffic due to this interesting tech but also by inviting their already loyal customers to this new virtual reality store.

# Chapter 2

# Literature Survey

## 2.1 Literature Review

In this chapter we will be discussing the previous works done in the field of shopping in augmented and virtual reality.

## 2.2 Augmented Reality

Augmented Reality cannot be literally defined in general terms. Mostly it is discussed to the "reality-virtuality continuum" of Milgram et al. (1994), which puts forward a continuous changeover between the virtual and real situation (Mehler-Bicher Steiger, 2014) The left area of the continuum describes any situation in-

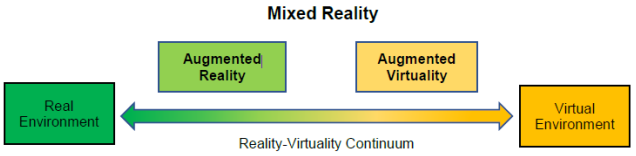


FIGURE 2.1: Realit-Viruality Continuum

volving exclusively real objects and takes account of all the facets of a real-world prospect which can be viewed either directly in person or with the help of a display [12]. However, the environments, which specifically comprise of replicated objects like computer graphic models, have hallmarked the right area. According to this model, Augmented Reality has a connection with an extensive concept of Mixed Reality. Objects of Real and virtual worlds can be integrated and merged in single display. These objects can be arranged anyplace between the extremes of the spectrum. On the other hand, the purpose of AR is to augment the real

world with digital information rather than fetching real world information in virtual worlds [14]. For that reason, Augmented Reality (AR) must be different from Virtual Reality (VR). [8]

## 2.3 Difference between Virtual Reality and Augmented Reality

Talking about the difference between Virtual and Augmented Reality, Virtual Reality (VR) refers to a user's view immersed in a virtual or computer-simulated world [12]. However, Augmented Reality (AR) puts an outward virtual layer to the real world.[16]. In other words, VR totally obscures the actual reality, whereas AR enhances the actual view [15].About the actual reality, VR conceals it whereas AR enhances it. Three degrees of freedom i.e. 3DOF is a characteristic of VR while AR augments the real word with six degrees of freedom i.e. 6DOF. For six degrees of freedom, the camera is required to be positioned and oriented in 3D space combined with varying orientation.[15] According to the graphical point of view, VR and AR differ in allowing the user to witness both the reality plus the computer generated overlay. Also, VR uses any kind of wearable gadget such as a head mounted display but AR is compatible with tablets, smart phones, helmet or glasses.[15] AR has a wider application as compared to VR which proves that only a few numbers of retailers will prefer VR since it has a time-consuming and costly implementation comparatively.[16]. [9] Moreover, the users feel comfort in using their own mobiles to interact with such products instead of buying any sort of head mounted display for this purpose.[4].[8]

## 2.4 Technical Background

In case of the technological demands, AR is needed more than VR and that is why the development of AR took long duration to establish.[17] Anyhow, the key elements such as trackers, displays, software and graphics remained the same. AR puts together the motion, location and orientation sensors and algorithms for the purpose of determining the orientation and camera's position.[15] In the next step, graphics are given so as to augment the computerized images on the top of actual view. Marker-based and GPS-based are the two different types of AR identified till date.[3] In marker-based AR, a mobile camera recognizes an image or a marker to verify the actual position and orientation. Developers can cover the marker by other different content such as images, audio or video. On the other hand, GPS-based AR works by the use of GPS and provides the users extra information of their location. In this way, the users might get directions to reach

the desired destination. On the subject of three mobile application functions, the first type would suit for the information and price function. The second type appears to fit for the navigation purpose. Though, due to the lack of line of sight communication among satellites and GPS receivers, it is not possible to apply GPS in the indoor environments. Even so,[1] shows that there are possibilities with systems like IQEngines to locate the user within the indoor shopping location and give directions based on an underlying coordinate system. Also, there is a possibility that users can adjust themselves in a unknown environment and can plan paths to their preferred destinations. On the account of the display techniques, there are three categories for AR display, hand-held, head-worn and spatial [2]. This project focuses on the hand-held displays which comprises of hand-held optical see-through along with hand-held projectors. Hand-held displays are considered ideal since they are readily available and minimally interfering. Due to ease of use and low production costs, the indication of social acceptance is guaranteed.[18]Here we [17] point out that these demonstrations are suitable to a mass market due to easiness of use and low creation costs. This specified challenge of social acceptance is a fundamental feature of this study.[8]

| Positioning | Head-worn | | | | Hand-held | Spatial | | |
|---|---|---|---|---|---|---|---|---|
| Technology | **Retinal** | **Optical** | **Video** | **Projective** | **All** | **Video** | **Optical** | **Projective** |
| *Mobile* | + | + | + | + | + | – | – | – |
| *Outdoor use* | + | ± | ± | + | ± | – | – | – |
| *Interaction* | + | + | + | + | + | Remote | – | – |
| *Multi-user* | + | + | + | + | + | + | Limited | Limited |
| *Brightness* | + | – | + | + | Limited | + | Limited | Limited |
| *Contrast* | + | – | + | + | Limited | + | Limited | Limited |
| *Resolution* | Growing | Growing | Growing | Growing | Limited | Limited | + | + |
| *Field-of-view* | Growing | Limited | Limited | Growing | Limited | Limited | + | + |
| *Full-colour* | + | + | + | + | + | + | + | + |
| *Stereoscopic* | + | + | + | + | – | – | + | + |
| *Dynamic refocus (eye strain)* | + | – | – | + | – | – | + | + |
| *Occlusion* | ± | ± | + | Limited | ± | + | Limited | Limited |
| *Power economy* | + | – | – | – | – | – | – | – |
| *Opportunities* | Future dominance | Current dominance | | | Realistic, mass-market | Cheap, off-the-shelf | Tuning, ergonomics | |
| *Drawbacks* | | Tuning, tracking | Delays | Retro-reflective material | Processor, Memory limits | No see-through metaphor | Clipping | Clipping, shadows |

FIGURE 2.2: Characteristics of Surveyed Visual AR Displays.

## 2.5 Existing Work

As already discussed that the technology has changed the way of retailers to get in touch with their customers. The most existing applications were made to show a potential in the field of online shopping so that the buyers can be convinced upon shopping. We will discuss here the fields and topics in which the current day augmented reality is being researched. The reason of these is none other than the interest of the customers in the 3D media rather than 2D. The augmented reality has emerged in this field to convince people of its potential and provide unique advantages. For a better shopping experience, we need to add digital elements to the shop environment in the retail industry experience, and the AR has done wonders in this regard. Due to the same reason, the augmented reality has found its success in not only the online but also the offline shopping. Hence and therefore, many retailers like Sephora, IKEA and eBay etc. have adopted the augmented reality. The consumers aren't much happy in this case because of the reason that the products they tried on with the augmented reality based applications don't look like that in the real world environment, even though the applications for the retail are constantly making it clear that the future version will certainly contain the more higher touch of the augmented reality, which in actual should have been the improvement in the AR and addition of the more reality based experience. We can't deny the fact that the AR app makers are also constantly trying to improve the experience as it is their ultimate motive to get it done via app rather than the conventional shopping. As Sephora and L'Oreal have introduced a mirror like application, in which the users can try the make up on, the others like IKEA and eBay have given much attention to increasing the realistic behavior of the AR applications. This makes it more interactive and near to the real world and the ways of human interaction with the physical objects are hence constantly changing. Not only the testing but also the searching of the products will be not as it is now in the near future. Even though the AR has done its part in the retail industry, the customers are not being very much convinced by it. The main reason for that is the retailers are not understanding how to integrate the virtual technology with the retail. The in fact are not understanding the end user perspective and actual needs of the clients. The more pleasing the buyers find the experience, the more will they be able to make an easy decision in this regard. This problem has given rise to the lack of the knowledge of importance of augmented reality in the consumers. The developers are reluctant to make AR applications due to the lack of interest in the apps by the customers and for the same reason that the retailers and developers don't put much effort in this regard, the buyers also are

not adopting these experiences. This has given rise to the fear of failing of the AR retail in the future. So we on early basis should understand and adopt the need of AR in the virtual industry.Since 1960s when the AR was firstly introduced, it has gained its focus in the near past years and hence has drawn the attention of the researchers to admit it as a research field. Since the first survey conducted in this field, the research and development work in this discipline has gained very much popularity and achievement. The early works of the field were focused on the human computer interaction, however, the current work is a result of a recent taking into an account of the retail industry in this regard. This heterogeneous nature has caused the lack of focus in any of the sub disciplines. Even the current focus is on the AR research in retail industry, but there remains a huge space of knowledge and research.

## 2.6 Comparison to the Existing Work

The following table shows the various works done in the field of AR along with the time-frame:

| Year | Author | Research Work |
|---|---|---|
| 100 Years Ago | L. Frank Baum | The AR idea was first put into publishing indicating an electronic display that covered the data with the real life known as 'character marker ' (Johnson, 2012) |
| 1950s- 1962 | Morton Heilig | AR's initial systems were established through cinematography during 1950s; Heiling considered the fact of AR's special cinema characteristics, in which he took the cenima as a pursuit which seeks the viewer's attention on to the senses by using all of his/her senses in an efficient manner(Carmigniani et al in 2011) Declared the Augmented Reality as "Sersorama" in 1955, indicating it as the future's cenima that was proceded digital computing in 1962 (Carmigniani et al in 2011) |
| 1968 | Ivan Sutherland | AR's actual prototype system was established (Carmigniani et al in 2011) |
| 1970s-1980s | NASA, the Aviation Industry | Some of the researchers made an assumption that the Augmented reality has several benefits over VR and one of them was simply found to be the use of less power. (Carmigniani et al in 2011) |
| 1994 | Paul Milgram and Fumio Kishino | Gave the description of a continuam that extended to virtual as well as real environments. It could be named as actualityVirtuality (Carmigniani et al in 2011) |
| 1997 | Ronald Azuma | Published his first review on augmented reality saying that it was the bridge between the virtual and real environment as it is close to reality and is three dimension supportive. |
| 2000 | Bruce Thomas | Azuma et al., 2001; Preece et al., 2015:<br>Made a huge progress in making mobile and computer augmented reality able to be used for the first time |

Table 2.1: Research Paper Comparison Table 1

## 2.7 Research gap

The previous research has not focused on the marketing related variables of the potential buyers. These variables constitute the age, income level and related variables and play an important role in determining what are the interests of the client and why would or would not he buy a specific item from the store. Another thing they lack is the design on the AR shop. They have not kept in mind that the customers want to experience the social interaction as in the everyday shopping. Another related gap is found in the linkage of sales to the AR/VR and the customers' behavior. Many research papers show that the experimental results of the labs very much differ from the actual sales data. The following figure shows the heat map of the focus of research over time.

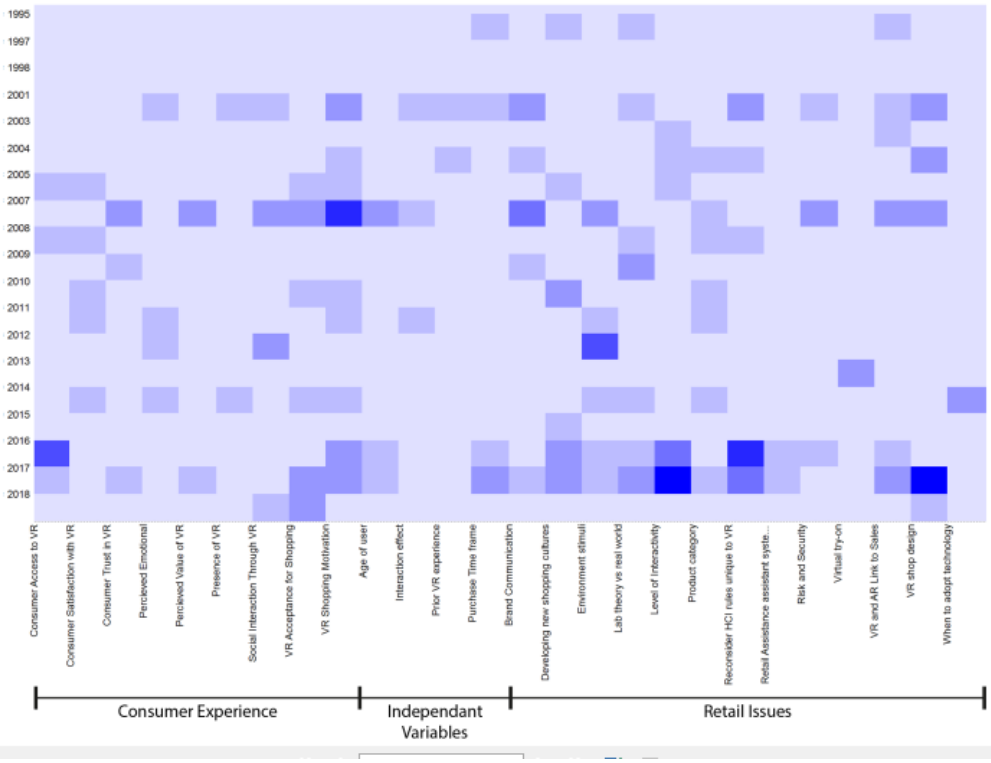


FIGURE 2.3: Reasearch Gap

## 2.8 Current State of Art

The following table shows the various applications of the augmented reality in the retail industry:

| Name | Category | Status | Function |
|---|---|---|---|
| Converse (2010) | Shoe Sampler | Online | Virtually try-on shoes AR application |
| Mr. Spex (2011) | Virtual Mirror | Online | Customers could try-on sunglasses online with the camera of their phones |
| Topshop (2011) | AR Mirror | In-Store | Virtually try-on clothes in-store |
| Uniqlo (2012) | AR Magic Mirror | In-Store | Virtually try-on clothes in-store |
| Yihaodian (2012) | AR Virtual Store | Online | Virtually do shopping in a grocery shop on their phone |
| IKEA (2016) | Catalogue Application | Online | Virtually place furniture on clients' floor and watch how did it really look like |
| Charlotte Tilbury(2018) | Magic Mirror | In-Store | Virtually try-on makeup without actually putting it on |
| American Apparel(2018) | AR application | Online | Check the availability of items in the store |
| Lacoste (2018) | LCST AR application | Online | Virtually try-on shoes |

Table 2.2: Current state of the art

## 2.9 Mixed and Augmented Reality

In terms of commercially and publically available applications, mixed reality (MR) is a relatively new field. It has been around for over two decades as a research topic, with applications in medical purposes, military applications, entertainment and infotainment, technical assistance, and so on industry applications, distance operation, and geographic applications. [1–2]. The goal of AR interfaces is to create a "merging of worlds" by incorporating virtual information into the actual environment. According to Azuma (2001), for a system to be classed as an AR system, it must meet three criteria: it must connect the real and the virtual. They are allegedly real-time interactive, and they are recorded and aligned in 3D citeazuma1997survey, citeazuma2001recent. The virtual continuum proposed by Milgram and Kishino (1994) is frequently used to define the connection between

augmented reality, virtual reality, and the phases in between [10]. Mixed Reality is the umbrella term for all of the phases. To properly integrate new technologies into an organization or workplace, the system must be used by the individuals for whom it was designed. There have been several instances when technology has been put in companies but has not been utilized for a variety of reasons. The usability of the product or system in and of itself is a key contributor to low utilization. To properly integrate new technologies into an organization or workplace, the system must be used by the individuals for whom it was designed. There have been several instances when technology has been put in companies but has not been utilized for a variety of reasons. The usability of the product or system in and of itself is a key contributor to low utilization. However, another issue is how effectively the system interacts with users in a social environment - are the users interested, and do they perceive the same potential in the system as the individuals (management) who opted to implement it in the organization? Davis describes two critical factors that influence the acceptance of new technology, or rather information systems in organizations [5] The perceived utility and simplicity of use of a system both impact user attitudes toward the technique, and hence user behaviour while engaging with the system and actual usage of the system. If a system's perceived utility is high, users are willing to accept a system that is regarded as more difficult to use than if the system is not perceived as helpful. For an AR system, this indicates that even if the system is uncomfortable or large (head-mounted), people will accept it if the applications are acceptable, i.e., practical enough. Similarly, even if the AR system is simple to use, it will not be employed if it is not seen as helpful. MR and AR are relatively new technologies considering commercially available products. Few studies addressing the potential users' attitudes towards this technology have been done. This paper presents a case study where AR instructions have been evaluated for use in the domain of public health care. Public health care, just like many other domains, has an interest in reducing resources spent on training and educating new staff members. In one study, the use of AR for starting up a diathermy apparatus was evaluated, and in a follow-up study, AR was used to assemble a small surgical instrument. Both studies had a qualitative approach where the purpose was to see whether the staff at the hospital would socially accept AR technology.

## 2.10 User acceptance case studies

One long term aim of AR research is for AR systems to be completely useable and user-friendly, and as Livingston [10] and Nilsson Johansson[13] issues point out, human factors in AR systems are being addressed. Quantifiable performance (for

example, work completion time and error rate) and user studies are common in AR research. More qualitative performance indicators are rarely considered. Of course, there are outliers, such as those reported by Billinghurst et al., in which users' effectiveness in collaborative AR is measured not only statistically, but also through gesture analysis and language use. Another example is the analytical technique developed by Livingston et aldomain., which focuses on the work and its requirements uses user profiles.[11] Usability studies in the AR research sector, on the other hand, are primarily based on classic usability methodologies for graphical user interfaces, occasionally in combination with usability for Virtual Reality applications, according to [13]this may or may not be a good alternative because it does not provide us with a result based on own experience. Two user studies in which participants were observed using an AR system were undertaken to examine user acceptance and attitude toward AR technology. The participants in the first research, all medical professionals, were given instructions on how to use a diathermy apparatus. The participants in the second research were given instructions on how to put the puzzle together relatively small surgical instrument, a tracker.

## 2.11 Study 1 – method

The particular point of study 1 was to explore client experience and acknowledgment of AR frameworks in an educational application for clinical gear. A subjective client study was directed nearby at a clinic. Eight members (ages 30 – 60), all utilized at the emergency clinic, taken an interest in the examination. Four of them had past experience with the diathermy mechanical assembly, and four didn't. The entirety of the members had insight with other cutting edge innovation in their day by day work. In the first place, the members were met about their experience and mentalities towards new innovation and directions for use. Then, at that point they were noticed utilizing the AR framework, getting guidelines on the most proficient method to fire up a diathermy mechanical assembly. After the errand was finished, they rounded out a poll about the experience. The meetings, just as the perception, were recorded with an advanced camcorder. In this assignment, the individual is watching it through the video-transparent AR framework was additionally logged with an advanced camcorder.

### 2.11.1 Equipment

The AR framework equipment part incorporated a tablet PC (Fujitsu Siemens Lifebook T with 1GHz Intel®Pentium® M, 0.99GB RAM), a cap mounted showcase (Sony Glasstron) firewire camera joined. A Numpad was utilized for the

cooperation with the client. The AR framework utilizes a cross breed following innovation dependent on marker following; ARToolKit, (accessible for download), ARToolKit Plus, and ARTag [6]). The program comprises of a coordinated assortment of programming apparatuses, for example, programming for camera picture catch, fiducial marker acknowledgment, PC illustrations programming, and programming explicitly intended for AR-application circumstances [7]. Client task is a subsection. The clients were given guidelines on the most proficient method to initiate (and deactivate) the framework set up a careful diathermy contraption (DA), ERBE ICC-350TM with related apparatuses and anodes for use). Diathermy is a kind of actual treatment that utilizes high-recurrence electrical flow to profound warmth tissues. The ERBE ICC 350TM diathermy gadget is used during obtrusive operations for monopolar or bipolar cutting and coagulating strategies. The directions got through the AR framework were created in collaboration with an accomplished working room nurture at the clinic in a pre-study. In the wake of noticing and recording the medical attendant as she gave guidelines on utilizing the DA, the AR directions were developed in a similar way. After a first form of the AR, directions were executed in the framework, and the working room nurture had the chance to give input and amendments. The directions were given as proclamations and questions that had to be affirmed or denied by means of the information gadget, for this situation, a num cushion with just three dynamic catches – 'yes,' 'no,' and 'go to subsequent stage'. Information were gathered both through perception and open-finished reaction polls. The poll got some information about the general impression of the AR framework, issues experienced, great highlights experienced, what they would adjust in the framework, and in the event that it is plausible to contrast getting AR directions with getting exercises from an instructor.

### 2.11.2 Results

It was tracked down that all members yet one (out of eight) could tackle the job that needs to be done with no other assistance than by the guidelines are given in the AR framework. By and large, the met reacted that they favored individual training from an accomplished client (6/8), now and again in mix with short, composed guidelines, and that they liked the target directions given by the AR framework. The issues clients gave an account of related both to the guidelines given by the AR framework and to the AR innovation, like issues with a cumbersome cap, and so on Regardless of the revealed issues, the clients were positive towards AR frameworks as an innovation and as an apparatus for directions in this

setting. The entirety of the respondents work with PCs day by day and are acquainted with customary MS Windows™ based graphical UIs, however they saw no likenesses with the MR framework. Steady with the discoveries in a past report [7], none of the respondents alluded to interfacing with or through a PC when asked what the collaboration felt. All things considered, one respondent even contrasted the involvement in having an individual teacher directing through the means: "It would be in the event that as though somebody was remaining close to me and pointing and... yet it's simpler perhaps, simultaneously it was only each little advance in turn. Not that much on the double." (member 1) Despite the fact that the members expressed that they for the most part wouldn't fret working with various innovative gadgets every day, events that cause issues happen. For instance, when infrequently utilizing gear – it's anything but open to recall how it's anything but quite a while passes in the middle of utilization: "I believe that particularly on this mechanical assembly, there are a ton of subtleties that we get data about, and afterward we fail to remember this is on the grounds that we don't utilize it for some time and afterward you should be refreshed on the off chance that you need to manage something. Else you don't utilize the device to its maximum capacity" (member 3). By and large, the respondents are happy with the directions they have gotten on the most proficient method to utilize innovation in their work. One issue with getting directions from associates and other staff individuals is that the guidelines are not 'objective' however a greater amount of "this is the thing that I typically do." The solitary 'objective' guidelines accessible are the manual or specialized documentation, and perusing this is tedious and frequently not a need. At the point when gotten some information about the overall impression of the AR framework, one respondent replied: "... clear, it wasn't any 'this is the manner by which I ordinarily do it, and it normally turns out great. Clear... " (member 6) A basic component of the individual guidance circumstance is the intuitiveness – it is fundamental to have the option to pose inquiries or get back to guidelines, or change the speed. A greater part of the members expressed that they favor directions from an accomplished client, which permits intuitiveness. The members were likewise gotten some information about in what circumstances or for what reason they figure an AR framework could be useful, if in any. Two of them referenced restoratively intrusive techniques like laparoscopy. A few members reacted that AR frameworks could likely be utilized in any circumstance where directions are required, for example, in training or for directing clients on the most proficient method to utilize specialized gear. The video-based perception delineated that the actual appearance of the AR framework likely influenced the manner in which the members played out the assignment. Since the presentation was mounted on a

head protector, there were a few issues with respect to the position of the display in from of the clients' eyes, so they invested some energy changing it toward the start of the preliminary. Nonetheless, since the framework was head-mounted, it left the without hands for collaboration with the DA and the Numpad utilized for addressing the inquiries during the directions. Because of the examination, the AR framework has been upgraded better to fit the ergonomic requirements of this client bunch. Changes have additionally been carried out in the directions and the manner in which they are introduced. The new plans of the AR framework have been utilized in examination 2 in this paper.

## 2.12 Study 2 - Method

Study 2 is a development of study 1, yet with a somewhat extraordinary application and new members. Twelve experts (ages 35 – 60) working room (OR) medical attendants and specialists at an emergency clinic participated in the investigation. The members all had some information about the object of the get together, albeit not every one of them had collected one preceding this investigation. A larger part of the members expressed that they are keen on new innovation and that they cooperate with PCs consistently; notwithstanding, the greater part of them had insignificant involvement in computer games and 3D illustrations. The members were first acquainted with the AR framework. At the point when the head-mounted presentation (HMD) and headset were appropriately changed, they were told to adhere to the framework's directions to assemble the contraption before them. Subsequent to finishing the task, the members addressed a poll in regards to their experience. At the point when the members built the trocar, they were recorded utilizing an advanced camcorder. The members' perspectives through the video-transparent MR framework were likewise recorded on computerized video during the work. As in Study 1, information was accumulated through both direct perception and surveys.

### 2.12.1 Equipment

The AR system was upgraded and redesigned after study 1 was completed. It includes a Sony Glastron. Head Mounted Display (HMD) and an off-the-shelf headset with earphones and a microphone. The AR system runs on a Dell Inspiron 9400 laptop with a 2.00 GHz Intel®Core™ 2 CPU, 2.00 GB RAM, and an NVIDIA GeForce 7900 graphics card. The AR system uses a hybrid tracking technology based on marker tracking; ARToolKit, (available for download at ), ARToolKit Plus, and ARTag [6]). . The programme contains an integrated collection of software tools such as camera image capture software, fiducial marker

identification software, computer graphics software, and software created particularly for application situations [**?** ]mixed. The use of voice input rather than key pushing is a notable distinction between the revised AR system and the AR system utilised in study 1. The speech input is received via the headset microphone and processed by a basic voice recognition programme based on Microsoft's Speech API (SAPI). OK, Yes, No, Backward, Forward, and Reset are the basic instructions.

### 2.12.2 User task

The item the members were given guidelines on the most proficient method to amass was a standard clinical gadget, a trocar. During negligibly obtrusive medical procedure, a trocar is used as a "gateway" into the patient. The trocar is a small gadget comprised of seven particular pieces that should be fittingly participated to work as a lock that keeps blood and gas from getting away out of the patient's body. The trocar was too minuscule to even consider obliging a few imprints associated with each part. Labels associated with the item (as in examination 1) would likewise be ridiculous given the sort of gadget and its planned use - it should be kept up with sterile and liberated from incidental materials. All things being equal, the marker was put on a minuscule flexible size ring that the members wore on their forefingers. Guidelines on calling together a trocar are generally given out by more experienced OR medical caretakers. To guarantee authenticity in the assignment, the AR application guidelines depended on the directions given by an OR nurture at a medical clinic. The medical attendant was video The film filled in as the establishment for the series of directions and activitys displayed to investigate members. Prior to getting the get together guidelines, the members were given a concise outline of the voice orders accessible to them during the undertaking: "Alright" to continue to the following stage, and "back" or "in reverse" to rehash earlier advances. The perceptions and poll filled in as the establishment for the subjective examination. The survey included ten inquiries to which members may uninhibitedly react about their involvement in the AR framework. Investigations into the general impression of the AR framework experienced difficulties, yet additionally found positive components., What they would modify in the framework, and regardless of whether getting AR guidelines can measure up to getting directions from an educator. The survey answers were accounted for and quantitatively assessed.

### 2.12.3 Results

In this subsequent examination, all clients had the option to complete the task with the assistance of AR directions. The substance of the survey answers changed, however various respondents referenced a couple of issues, and certain topics rose up out of the members' remarks. The examination has zeroed in on issues, concerns, or comments communicated by more than one member. None of the open-finished inquiries were expressly about the arrangement of the marker, however the quality was referenced by half of the members (6/12) as either irksome or not useful in this application: "It would have been decent not to need to consider the marker" (member 7) One respondent referenced the double methodology work in the AR directions (guidelines conveyed both aurally and outwardly) as a great component of the framework. Another member, then again, discovered the media show confounding: "I get somewhat befuddled by the discourse and the visuals." I trust it is surprisingly troublesome.." (member 9) Parallax and profundity discernment issues are usually known issues for any video-transparent framework and are not just utilized in this examination. The issues happen because of the camera's point, which is to some degree contorted from the tip of the clients' eyes, causing a parallax vision, i.e., the client will see their hands at one position. This stance, notwithstanding, doesn't associate to the genuine part of the hand. Just a single individual noticed this issue: "the profundity was missing" (member 7). The bearings and instructive show were adulated by most of members (8/12). Two people referenced the issue of the capacity to pose inquiries. The issue of criticism and the capacity to ask requests is likewise identified with the framework being generally comparable to human educating. Concerning this inquiry, most reactions concerning posing inquiries and the absence of criticism were raised. Getting directions from the AR framework might be contrasted with getting guidelines from a human to acquire a by and large great reaction. 1 4/12 gave a clear yes reaction, while 5/12 gave more vague answers, for example, "It's anything but an applause; for the repeat. Better? At the point when an educator/coach/teacher isn't continually present, it is truly useful when a device is used rarely." (member 1). A few of the Yes class respondents expressed that the AR framework was superior to directions from an educator. The directions were "objective" since everybody will get absolutely a similar data. When gotten some information about their impressions of the AR framework, a larger part of the members gave extremely certain reactions: "Invigorating idea. Straightforward the guidelines. Simple to utilize" (member 3). Others were concerned: "This and that, somewhat troublesome" (member 6). One inquiry expressly tended to members' perspectives on using AR

in their future expert lives, and all members addressed decidedly.

## 2.13 Concluding discussion

While presenting new frameworks, similar to AR, in an action, client acknowledgment is essential. The general outcomes from the two examinations show a framework that the members like as opposed to disdain. Regardless of whether they got guidelines in two modalities or just one, the two examinations demonstrate that the members would need to utilize AR directions in their future expert life.In spite of some actual issues with the AR framework, all clients, however one in the two examinations did the job with no other help. Be that as it may, the impacts of the actual interruption of the framework upon the clients' customary positions ought not be disregarded. Regardless of whether the plan is lightweight and non-meddlesome, it might in any case change the examination and perform it. This may not be an issue over the long haul – if the framework is a positive impact at work, client, and setting, it will with time and experience develop to be a piece of the errand (similar as utilizing PCs have become part of the undertaking of composing a paper). Intelligence is a vital piece of straightforwardly controlling UIs and is by all accounts significant in an AR arrangement of the sort explored in these investigations. A small bunch of the members who addressed "no" to the inquiry regarding the likeness of AR and human guidelines were incited by the way that you may ask and acquire a reaction from a human. In any case, this AR framework couldn't react to clients' irregular requests. Adding this sort of exchange the board and knowledge in the framework would probably build the convenience and the value of the framework and furthermore make it more "humanlike" than "device like." However, this is certainly not a basic errand, yet these reactions from genuine end-clients show and inspire research toward this path. Using information from different fields, for example, normal language preparing, can possibly acknowledge such a dream.

# Chapter 3

# Dataset

The data set we used in this application is consist of a number of face models on which mesh points are created to detect the eyes and forehead of the person that is using virtual shopping application. Similarly, in case of hand a number of pictures of hand are used to detect the wrist to place the watch. Foot pictures are used to detect the foot for placing of shoes models.

## 3.1 Face Data-set

In order to identify the motion of face a mesh of point is created on the face. With the help of these mesh motion of eyes is detected for placing of models. Motion of models is same with the motion of eyes using these mesh points. For detection of forehead mesh points are created on forehead. Using these mesh points model is trained to place the cap models.

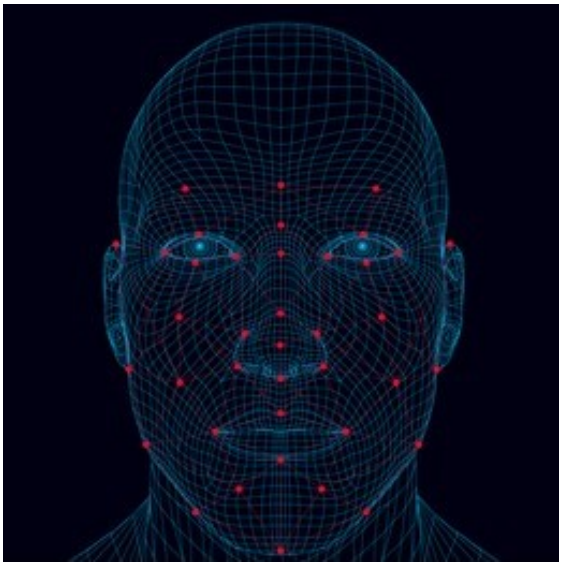

Figure 3.1: Face Mesh Points

The 3D models used for the cap module are given below:

FIGURE 3.2: Model of Cap

The other model in data set for the cap module we used for the system. Similarly

FIGURE 3.3: Model of Cap

for the eyes module same approach is used to create the mesh points on the eyes. Using these mesh points location of the eyes is detected to place the 3D models of glasses. 3D models used for eyes module are:

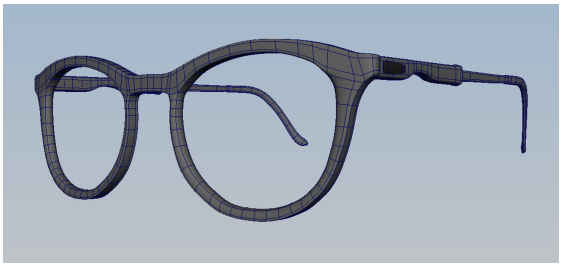

FIGURE 3.4: Model of Glasses

Other model we used in the eyes module for the glasses is

FIGURE 3.5: Model of Glasses

## 3.2 Hand Data-set

The capacity to identify the shape and motion of hands can be a dynamic element in refining the user experience across a range of high-tech domains and platforms. For example, it can be used to form the root for hand gesture control and sign language understanding, and also allow the overlap of digital content on top of the real world in augmented reality. While approaching certainly to people, robust real-time hand view is absolutely challenging computer vision task, as hands often lack high definition patterns and obstruct themselves. In our data set we used models of watches that are to placed on the wrist.

FIGURE 3.6: Model of watch

Another models of watch that is used in application for user.

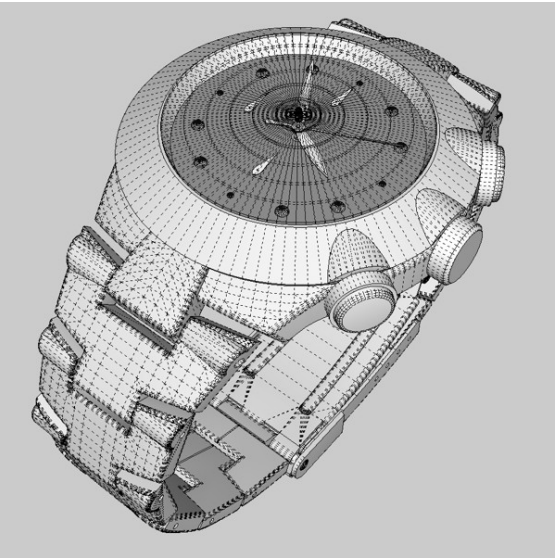

FIGURE 3.7: Model of watch

# Chapter 4

# Proposed Methodology

We proposed a simple and congenital approach to Virtual shopping using augmented reality that comprises of the following steps.

## 4.1 ARCore Integration

In methodology, we start with the integration of Arcore with Unity 3D. Arcore is a Google's platform for creation of augmented reality applications. Arcore works on the interaction of virtual content with the real world objects to create augmented reality scenes. Arcore uses three major points to integrate real world things and virtual objects to create a scene that can be seen through mobile's camera.

### 4.1.1 Motion Tracking

Arcore helps mobile to track the position according to real scene.

### 4.1.2 Environmental Understanding

Arcore allows phone to detect the horizontal, vertical and angled surfaces.

### 4.1.3 Light Estimation

Arcore allows phone to evaluate the current lightning of scene.

## 4.2 Body parts Detection

Arcore algorithm used for the detection of eyes and forehead to place glasses and caps. Arcore create a mesh of points on the face and according to these points detection process works. Its uses three points of face that are ears cheeks and nose to create a mesh of points on face. Using these point on the eyes and forehead we take measure to place the 3D models. Similarly, for the detection of wrist we

have used built in machine learning model that can detect the wrist using vuforia engine database and apply the 3D model that will move accordingly to the wrist.

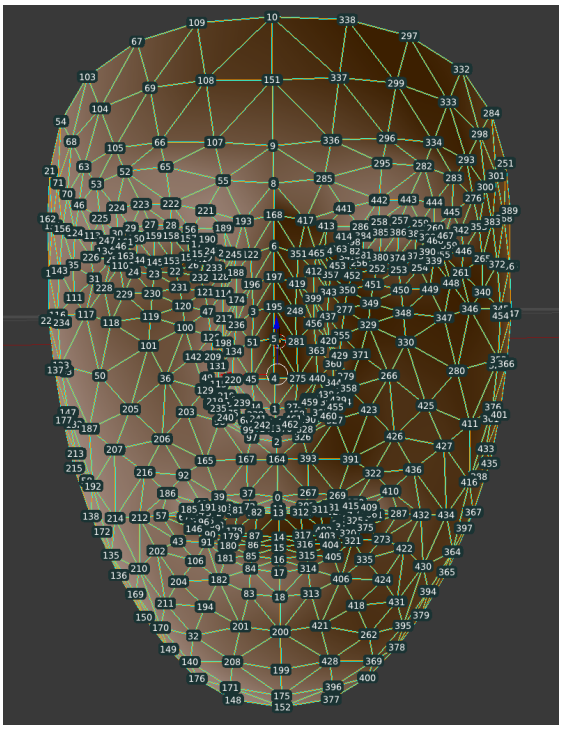

FIGURE 4.1: Mesh points on face

## 4.3 Model Collection

After the detection of body parts next phase was the collection models that are used in our application. Different models of caps, hats, glasses, watches and shoes used in the application. In model collection we face a lot of difficulty, as many models that are aesthetically helpful for our project are highly paid.

## 4.4 Positioning of GameObjects

Mouse is used to handle any Gizmo axis to transform components of gameobjects or we can directly put values in the number field of inspector. We can also select the five transform modes with a hotkey: W for Move, E for rotate, R for scale, T for RectTransform, Y for Transform.

### 4.4.1 Move

Move gizmo has three small squares at the center that can be used to drag gameobjects within a single plane. The Gizmo's center changes to flat square if we hold the shift while clicking and dragging in the center of Move Gizmo. Flat square

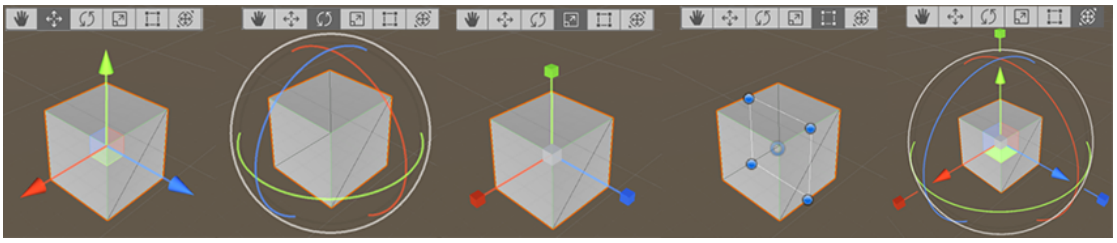

FIGURE 4.2: Move, Rotate, Scale, RectTransform and Transform Gizmos

tells that gameobjects can be move around a plane relative to scene view camera is facing.

### 4.4.2 Rotate

Using the rotate Gizmo, gameobject's change rotation by clicking and dragging the axis of sphere Gizmo that appears around it. With using Move gizmo we can only yellow axes. Outermost circle used to rotate gameobject around z-axis Scene view. This can be used as rotating in screen space.

### 4.4.3 Scale

By clicking and dragging on cube at center of Gizmo, Scale tool can be used to rescale the gameobjects. We can change the axes individually, but we have to take care of child gameobjects because the effect can look strange.

### 4.4.4 RectTransform

This tool is mostly used for positioning of 2D gameobjects, but it can also be useful for 3D elements. This is a combination of moving, rotating and scaling in a single Gizmo:

- Click and drag to move the gameobject within the rectangular Gizmo.
- Click and drag any edge or corner of the rectangular Gizmo for scaling the gameobject.
- Drag an edge along one axis for scaling the gameobject.
- Drag a corner on two axes for scaling the gameobject.
- To rotate the gameobject, position your cursor just beyond a corner of the rectangle. To rotate the gameobject click and drag from this area.

### 4.4.5 Transform

Transform's Gizmo provides handling of movement and rotation. Transform combines the rotate, move and scale. Transform tool can also provide the handles to scale the selected gameobjecs when tool handle rotation is set to local.

#### 4.4.5.1 For Position

To toggle between Center and Pivot click the Pivot/Center button.

- Pivot used for positioning the Gizmo at the actual pivot point.
- Center used for positioning of Gizmo at the center of selected gameobjects.


FIGURE 4.3: Pivot/Center toolbar

#### 4.4.5.2 For Rotation

To toggle between Global and Local click the Global/Local button.

- Local used to keep the Gizmo's rotation according to gameobjects.
- Global braces the Gizmo to world space orientation.


FIGURE 4.4: Local/Global toolbar

## 4.5 Snapping

There are three types of snapping in unity:

### 4.5.1 World Grid Snapping

This is available only when we are using World, Global or handle orientation. It is used to snap gameobject to a grid placed along X, Y, Z axes. It is also used to transform the gameobject in increment along X, Y, Z axes.

### 4.5.2 Surface Snapping

It is used for the snapping of gameobjects to convergence of collider.

### 4.5.3 Vertex Snapping

It is used for snapping of any vertex from the available mesh to the position of another mesh' vertex. We can snap from vertex to vertex, vertex to surface, and vertex to pivot.

## 4.6 Screen Space Transform

Hold the shift key while using transform to enable the screen space mode. This can be used to move rotate and scale gameobjects as they seen on screen, rather than space.

## 4.7 AR Content Creation

Creation of AR content is a visual and instinctive process. In this process, first of all marker is selected from marker id, so the scene can be pictured intuitively as it is being created. Next the camera needed to be activated on the selected marker. After the camera activation, models can be import from dataset. Models can be placed over the marker that are forehead, eyes and wrist. Models can be in following format: FBX, DAE, and OBJ. The texture used in model can be part of 3D file. Finally, the augmented reality scene with all model and marker can be scene using the application.

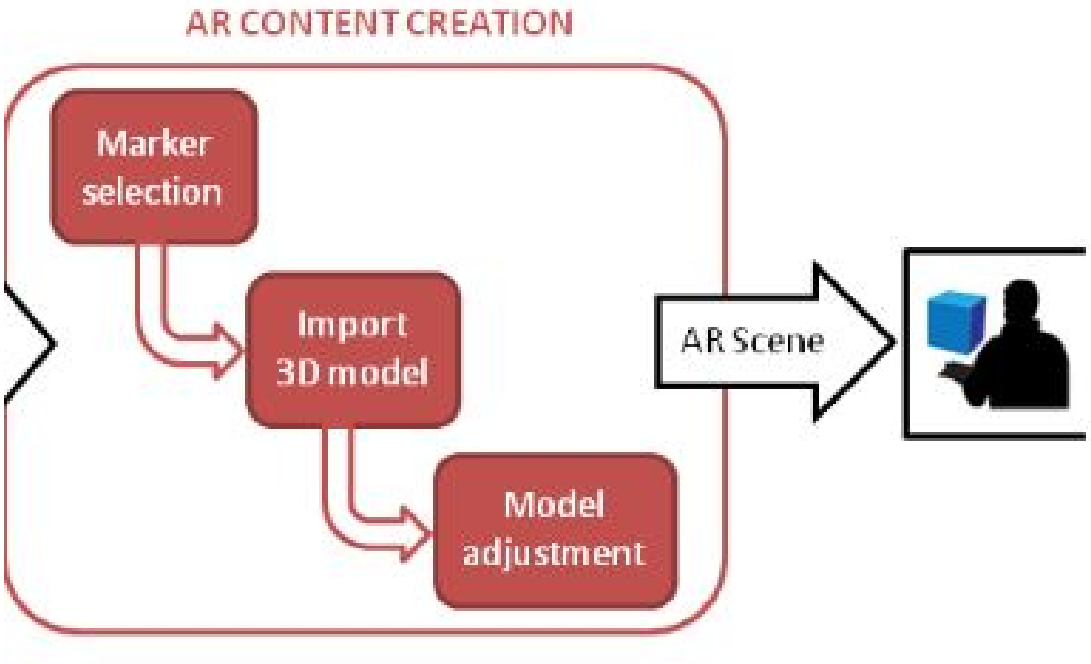


FIGURE 4.5: Augmented Reality content creation.

## 4.8 Methodology

### 4.8.1 Timeline

#### 4.8.1.1 October

This month we started working on idea from scratch. First we found the technologies that are involved in our idea . we divided our modules in 4 parts and assigned to all the members. I was assigned Caps module. It means that I have to work on caps to make them detect human head and place its 3D model in augmented reality. I started learning unity using Vuforia and google AR core. After analysing related technologies I came to conclusion that google AR core will be most suitable for us because of its wide range of features. I worked on AR core and made a sample app that can show a 3D model in real word by using camera. This app was foundation of our idea as it shows us how our ideal app would work under different circumstances This basic app directed my way toward the main goal of creating proper app for cap's 3D model placement. There were some points where I could not even find our required documents, in that case I have to create the 3-dimensional models on my own and implement in my app. That was very challenging task because scaling and modelling a model is not easy and it was out of our scope. This case was applied for all months on-wards for all models because our required models were either paid or not available so we had to do it manually. In the beginning of October, we had submitted the Proposal document and started working on the Unity 3d Basics. Our goal in this month was to get excellence in Unity 3D. In this month we also started research on Literature review of our project. Our project has 4 modules and we divided our modules. Then everyone started research on his module. My module was Cap so I found some projects including Snapchat filters that are related to my module. We presented the literature view to our assigned assistant and started working on the Unity. According to my module I had to switch from Vuforia Engine to ARCore that is more efficient than Vuforia. I completed my Unity d course in this month with daily tasks assigned by the assistant in the lab to get excellence in Unity. It was a great learning experience for me with Unity and ARCore. We had two meeting every week with the supervisor assistant to check our weekly progress and for the further tasks for the next week. Our main focus was to enable ARCore and integrate it with our mobile phone to get the camera access. It took us almost two weeks to accomplish this task but somehow we did it. At the end of the month I was almost experienced with the unity and ARCore. I also learned about placing and importing models in unity that is our basic step for the completion of Final

Year Project. My next goal was face detection using the ARCore. In this month we were directed by the advisor to learn about the technology we will be using in the final year project. We were guided by the advisor that we will work on Unity platform. We choose the software development kit on which we will work. I started to learn about the augmented reality technology. I took the online lecture to learn about the augmented reality that what actually this technology is. So, I watch online tutorial and also started working on augmented reality according to the tutorials. Along with this work on learning of augmented reality we also work on the other things. I were governed by the advisor to look for the existing project related to our final year project. So, I searched for the existing project related to our project. I gave presentation on this topic.

#### 4.8.1.2 November

After creating my first app I started to add more and more features in it. I kept working on the project and keep exploring unity for new and more features. When I made a simple app that can put and object in real word through camera now was the time to allow my app to detect objects. I started working on it and created another app that can scan the flat surface and placed the object on it exactly. It was the google provided AR core that let the camera detect the surface and optimize our 3D model to fit on it perfectly. after testing the app to work on all models I placed the 3D model of watch in our app because it was the module of our FYP idea. The app worked perfectly as it placed the object on the surface and know we can easily see It from any angle by just moving the camera around. Our project Involves image or surface detection because we have to put our model of watch cap on wrist or head respectively so this phase was important to perform so we can clear and pave our way towards the bigger picture that is to implement it on humans. The app I created could do the scanning of surface shows us the highlighted area where we can put our model. Google AR core provides the basic functionality to scan surface by default but I had to modify it so it can be placed other than flat surfaces that Is ground , table etc. In the month of November, our target goal was face detection using ARCore. Face detection is the,main part of my module in our project. It is the first practical step towards the completion of my module. So with the guidance of madam, I selected a udemy course of Face detection Using ARCore and completed the course in fifteen days and at the end with many C scripts my ARCore was able to detect the face with The center pose, located behind the nose, is the physical center point of the user's head (in other words, inside the skull). I used some filters like snapchat filters to test my application with the face parts. It was like an achievement for me and a great

step towards the Completion of project. My next goal was placing the real world models. In this particular month, we were advised to select one accessory item to work on. We divided the accessory item and select one each. I selected the glasses to work in the final year project. In this month, the advisor told us to search for the available model of the objects to be placed in the application. In this month, I worked on the technology to look for the models. I search for the 3d models of the glasses that will be placed in the application. I explore different websites for the available models of the glasses to use in the application.

#### 4.8.1.3 December

Now that I have created my module's app that can detect the surface and place the object in real word. The next step was to add machine learning functionality in it. So, app can detect my hand put the watch on my wrist. That was the ultimate goal of our project. But before doing our final and most important task I implemented this AR functionality on a web site and created a website that has augmented reality feature embedded in it. This web app can be used on both mobile phone and desktop but AR feature will only be use-able on phone. On desktop we can only see the 3D model in 3D form that is from all the angles. This contributes to the core of our project that is E-commerce system. If we have an app of any brand then we must also have its website. We will enable our 3D feature for both website and app. I created this web site using different platforms and different technologies unlike unity it required some frameworks that can be embedded into any we site to provide augmented reality facilities. I created this website using HTML CSS That is from scratch but I did not built its back-end functionality because that was not required at that moment as we wanted to just apply our tech on web apps too. The website was hosted on glitch using google model viewer that basically works on JavaScript libraries. In the month of December, I have achieved the face detection using AR core, Now As my module of this project was Cap so I have to place the cap with proper configuration as it just displays of head if it detects it otherwise it will not place the cap. So I took a simple 3d model of cap because at the end we are going to use the official models of a store. This is just to implement the project. So I took some tutorials for it and after about Twelve to thirteen days, I achieved this goal. Now my project is able to detect the face in front of camera and after face and head detection it can place the cap model on the head to try the cap. In this month we started to work on the how to place models in the real world application. I learned about how the place the 3d of different objects to be placed in the real world application. I worked on this topic in this particular month. I built the first sample application in this month that

place the models on run time in the real world application. In this application I place a 3d model of cube and adjust it according to the camera settings. I also worked on adjusting the models to be placed in the application. This work is done to learn that how to use different models in different applications.

#### 4.8.1.4 January

Now that I have created my module's app that can detect the surface and place the object in real world. The next step was to add machine learning functionality in it. After creating a website (sample furniture website) that can put chairs, tables and sofas on surface in augmented reality I converted it into something our project modules can relate. So,I started to replace those furniture objects with watches, eye glasses and shoes. Placing these objects was a easy task but adding machine learning ability wasn't easy in web based app. For ML facility we used google recognition model that can detect the hand place the watch on it. But for this I had to learn these technologies that can make such an detection intelligently so I began to study machine learning course for detecting real word entities from Udemy and YouTube. I took me almost a month to have a grip on this task. I started to implement this on my project but it was showing some ambiguity and errors that were not easy to resolve because the data I took to train my model was taken from the internet for free so those pictures were not very clear and descriptive. I tried to create my own data set for training the model. But I managed to collect just few samples as classifier needs more images to be more accurate and specific. Somehow I managed to create the classifier that can detect the arm and place the watch. In the month of January, I continued my work On placing the model with right dimensions. As we know the placement of cap is really very important to check how it looks. This is a time consuming process along with all the coursework is going on. I worked on daily basic but not much time because of other course work assignments. Somehow, at the end of the month, my model was looking almost good on placing on head. I also worked on changing the colours of models to increase the functionality of the module. It was quite easy to change the colours as we just have to change the material according to our choice and it will change to it. For the dimensions of head I used some tutorials that were necessary in order to understand the perfect dimensions. Our cap model is being placed on the head as our code detects the face in the picture not the head. So I just placed the model above the face so because of that I had to work that much on it and had to set its perfect dimensions. Along with this, I also completed the imagine cup. In the month of January, I continued my work On placing the model with right dimensions. As we know the placement

of cap is really very important to check how it looks. This is a time consuming process along with all the coursework is going on. I worked on daily basic but not much time because of other course work assignments. Somehow, at the end of the month, my model was looking almost good on placing on head. I also worked on changing the colours of models to increase the functionality of the module. It was quite easy to change the colours as we just have to change the material according to our choice and it will change to it. For the dimensions of head I used some tutorials that were necessary in order to understand the perfect dimensions. Our cap model is being placed on the head as our code detects the face in the picture not the head. So I just placed the model above the face so because of that I had to work that much on it and had to set its perfect dimensions. Along with this, I also completed the imagine cup proposal that was necessarily completed in this month as the final year project committee requirements. So because of the exams starting from the exact start of next month, I had to prepare for my exams and this was the maximum of effort I could have put in the progress of Final year project.oposal that was necessarily completed in this month as the final year project committee requirements. So because of the exams starting from the exact start of next month, I had to prepare for my exams and this was the maximum of effort I could have put in the progress of Final year project. In this month, I started to work on the models to place them in the real world application. As in the previous month, I have created the application that can detect surface and objects. So, in this month I had worked on the models of the glasses to place them in the real world. I worked on the positioning of the models of glasses to place them in the right position. But I face a lot of problem on setting the position of models. I also learned the course along with these task to position the models on YouTube and Udemy. It takes a lot of my time to work on positioning as it is a very difficult. Till now I cannot place the models exactly as they are needed to be place.

#### 4.8.1.5 February

Now that I have created my module's app that can detect the surface and place the object in real word. The next step was to make this step as minimal as possible by reducing the difficulty to track and detect objects. After creating a website (sample furniture website) that can put chairs, tables and sofas on surface in augmented reality I converted it into something our project modules can relate. So,I started to replace those furniture objects with watches, eye glasses and shoes. Placing these objects was a easy task but adding machine learning ability wasn't easy in web based app. For ML facility we used google recognition model that can

detect the hand place the watch on it. But for this I had to learn these technologies that can make such an detection intelligently so I began to study machine learning course for detecting real word entities from Udemy and YouTube. But that was from previous months so I had to make this step replaced by any other step that can do the same task but more efficiently and easily. For this I choose VUFORIA ENGINE and GOOGLE ARCORE. These technologies had the same functionality but it was easy to implement because all the detection algorithms were already implemented and we just had to use this technology. I took me almost a month to have a grip on this task. I started to implement this on my project but it was showing some ambiguity and errors that were not easy to resolve because the data I took to train my model was taken from the internet for free so those pictures were not very clear and descriptive. The data set for this task was not a necessary because these models of google already had in there and these classifiers were already trained so in this way I made it simpler to implement. This is the month of my 7th semester exams. I was working on cap module and learning skills in unity 3d and ar core to get the best out of me. I was recently working on positioning and models of the caps. I searched for textures and collected to make my models look better. Then my mid term exams started and I had to focus on it. My mid exams lasted for a week and then we also started working on the thesis as we knew that it was coming for submission. We almost did the research part of the thesis. Then after a week there were our final exams of 7th semester. We had to pass the exams so we started studying. Exams lasted 2 weeks and the February ended like this. In this particular month, I worked on the models of glasses as I have only one model of glasses to use in my application. I searched out many source on internet for the sake of glasses models. The sources that are available on internet have models that are very expensive to buy. These models have starting price of just $15to20$. We also inform the advisor about the issue of buying models. But he told us to just focus on the working of models and not to worry about models. As we were told by the advisor that our main focus is to show the working of system not the models. The working of system is that it can detect the eyes of the person using the application or not and the placing of the models. I also started the work with other colleagues to combine all the modules that we made separately which are of cap/hats, glasses and shoes.

#### 4.8.1.6 March

Now that I have created my module's app that can detect the surface and place the object in real word. In this month of March we had Final year presentations in which we had to deliver our progress an all about along with 60 percent of

demo video of our working project. I already had created my part so only thing we had to do was to do documentation of the project for which I had to create thesis and demo video along with presentation slides. We divided these tasks among our group mates and created 50 percent of project thesis report consisting of two first chapters that have the introduction and working part along with the methodology and other state of the art mentions. After creating thesis report I created presentation slides that had all of the required parts and their details. For the demo purpose we build our app into our phones and screen recorded the functionality. Our final product will consist of 3 modules that are caps, glasses and shoes. And the core functionality will be performed by google AR core and Vuforia engine not the scratch machine learning algorithms so we were successful in doing that. Then we prepared our slides and understood all the modules for each person for the worst-case scenario. After preparing the presentation we rehearsed our parts and on our presentation day we delivered very well. This month was the submission of our Thesis. In last month we have worked on the basics of thesis as we researched on the modules for our literature review. I was working on the literature review of cap module. My main part of thesis was the scaling and modelling part. I did that part and then started working on the interface of the application. I have to make my interface look nice and user friendly to be used. So I started a course on udemy along with my other courses of unity. I learned about the user friendly interfaces examples and the interaction of the screens. I got familiar with the scene manager in unity and how to load different scenes on button clicks. So also I learned about the image resolution that is a problem for many devices to interact. It took me almost 10 days to make the interface of our project. After that there was the presentation of FYP in that month. I worked on demo video of the project and my presentation part. My part was explain the flow diagrams of the project. So I started working on making the flow diagrams and understanding them according to my project. It was a tough month tough due to work overload. In this month, I work on the errors in the glasses module of our project. As sometimes we face the error that the glasses doesn't show on the face of person. Sometimes the glasses models doesn't move with the moving face. As I didn't realise when the face of a person is moving, the object has a collider on it and that changing the position of model will force the engine to recalculate the whole physical world all over again. So in this case, I seek help from different sources that I have to add some component that can set the model to non-kinematic if I don't want external forces to be exerted on the models. I work on this issue in this month to fix the delay or not showing of the models while using the application. As our application work on the run-time so we have

to make sure that models work properly on been calling upon.

#### 4.8.1.7 April

In this month of April I developed the front end of our app that is the UI of our app. As we know that UI should be very friendly and easy to access and use so user face no problem while using the app and can easily access every feature of app that we are offering. So, for that purpose to fulfil we learned many UX techniques to make our app as useful as possible. We used canvas that is already built-in Unity to create different buttons and images that can interact with each other using transitions that makes the flow of app smooth. We used this technique in every module of app so each product should have its own unique identification. In this month, I work on the errors in the glasses module of our project. As sometimes we face the error that the glasses doesn't show on the face of person. Sometimes the glasses models doesn't move with the moving face. As I didn't realise when the face of a person is moving, the object has a collider on it and that changing the position of model will force the engine to recalculate the whole physical world all over again. So in this case, I seek help from different sources that I have to add some component that can set the model to non-kinematic if I don't want external forces to be exerted on the models. I work on this issue in this month to fix the delay or not showing of the models while using the application. As our application work on the runtime so we have to make sure that models work properly on been calling upon. There were a lot of issue in those modules and because of my understandings due to courses, I helped them in positioning and textures of the models. We worked as a whole in this month and worked on improving the project to make it look better. We also worked on the thesis that where we left it before exams because now we have to submit our thesis a better way. We worked on the research papers to get our thesis more expressive according to the references.

# Chapter 5

# Implementation

## 5.1 Technology Used

Technologies that are used in this system are given below:

- C
- Unity 3D v19.4.13f1
- ARCore v1.24
- Vuforia v9.6

## 5.2 System Requirements

### 5.2.1 Hardware Requirements

- PC with windows
  - Windows: 7 and 10 with 64 bits only.
  - CPU: x64 architecture.
  - Graphics: API DX10, DX11, DX12.
  - RAM: minimum 8GB
  - Hard Disk: atleast 3 gb free
  - Additional: Officialy supported drivers.
- Mobile For Unity 3D we have to meet following requirements:
  - Android: v7.0

- CPU: ARMv7 or ARM 64
- RAM: 1GB+

For Arcore we have to meet following requirements:

-
- Android: v7.0 or later
- Device: Any x86/x86-64
- RAM: 1GB+

# Chapter 6

# Conclusion and Future Work

## 6.1 Conclusion

When we visit shopping brand in any mall and we want to try some items to put on to check their fitting or how they look on us. We have to try many times for different articles and put on every time. Similarly in online shopping we just can't judge if an item looks perfect on us unless we try it physically. The problem with this is that it consumes a lot of time of both customer and the shopkeeper. Moreover, in this time of pandemic it can be dangerous to touch things that may be contaminated by some infectious person. This will solve the Para social presence and product perception issues. Para social problem is the distance between customers and the company and perception is the distanced between the customer and the product. Our system will solve these issues using technologies like Vuforia and unity 3D that are fundamental tools for augmented reality. We will observe the data to so we can make our system enable to learn and detect where to place the model and how to respond if the target is moving. Our system is solving these issues of online shopping very efficiently and will be better observed under optimized conditions.

## 6.2 Future Work

We are planning to enhance our application for wide range of audience by adding payment methods so user can test the article and buy at the spot without going to website for purchase. Furthermore, we can add more products in our app so more audience will be targeted. These products include cloths, jewelwery and makeups.

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