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BSc (Hons) in Software Engineering

Sadees Kumar Krishan Shanuka

Smart Watch Store

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## Contents

List of Figures .....	4
List of Tables .....	4
1. Abstract .....	5
2. Introduction .....	6
3. Background and motivation .....	7
3.1    What is Augmented Reality (AR) ? .....	8
4. Initial Scope .....	8
5. Business Case .....	9
5.1    Business Need .....	9
5.1.1    Underlaying Problem.....	9
5.2    Business Objectives.....	10
6. Project Objectives .....	10
7. Legal Licenses .....	11
8. Literature Review .....	12
8.1    Augmented Reality.....	12
8.2    Augmented Reality with E-commerce .....	12
8.3    What is AR based E-commerce?.....	12
8.4    What is E-commerce AR Try On Watches ?.....	13
8.5    Different Types of AR Out Available .....	13
8.6    Types of E-commerce Stores Based on AR .....	13
8.7    Working of AR Watches .....	14
8.8    The present run with AR technologies.....	15
9. Use Case and Functional Requirements .....	16
9.1    Functional Requirements .....	16
9.2    Non - Functional Requirements .....	17
10. Design .....	19
10.1    Activity Diagram (User) .....	19
10.2    Activity Diagram (Admin).....	20
10.3    Entity Relation Diagram .....	21
10.4    Context Diagram .....	22
10.5    Level 1 Diagram .....	23
10.6    Use Case Diagram.....	24
10.7    Use Case Description .....	25
10.8    Software Design Principles .....	34
11. Development Technologies.....	34
11.1    Web Application .....	34
11.1.1    React .....	34
11.2    Mobile Application .....	35
11.2.1    Flutter .....	35

11.2.2	Unity .....	36
11.2.3	AR Core / Vuforia .....	36
11.2.4	Firebase .....	36
11.2.5	Tools.....	37
12.	Method of Approach.....	37
12.1	Agile .....	37
12.2	Test Driven Development.....	38
13.	Project Plan .....	39
14.	Risk Management .....	40
15.	Testing.....	40
15.1	Unit Test.....	40
15.2	. Functional Testing.....	40
15.3	Functional Testing.....	41
15.4	Usability Testing .....	41
16.	End Project Report.....	42
16.1	End project summary .....	42
16.2	Analysis of user requirements for mobile application .....	42
16.3	Analysis of technologies to be used.....	42
16.4	Analysis of user interface .....	42
16.5	Designing of the mobile and web application architecture.....	42
16.6	Development process .....	43
16.7	Technology change review .....	43
17.	Project Post-Mortem .....	43
17.1	Evaluation of objectives .....	43
17.2	Evaluation of development process .....	43
17.3	Evaluation of technologies .....	43
17.4	Developer performance.....	44
18.	Future Plans .....	44
19.	Conclusion.....	45
20.	References .....	46
21.	Appendices.....	48
21.1	User Guide .....	48
21.2	Test Cases .....	51
21.2.1	Manual Testing.....	51
21.2.2	AR augmentation test cases .....	70
21.2.3	A.I voice command test cases .....	73
21.2.4	Web application.....	76
21.3	Project Proposal .....	85
21.4	Project Initiation Document (PID).....	88
21.5	Interim I .....	96
21.6	Interim II .....	110
21.7	Meeting Minutes .....	126

## List of Figures

Figure 2.1: Project Overview Diagram .....	7
Figure 8.1: AR Working .....	14
Figure 8.2 : Kinect AR fitting room in Moscow .....	15
Figure 10.1 : Activity Diagram (User) .....	19
Figure 10.2 : Activity Diagram (Admin) .....	20
Figure 10.3 : Entity Relationship Diagram .....	21
Figure 10.4 : Context Diagram .....	22
Figure 10.5 : Level 1 Diagram .....	23
Figure 10.6 : Updated Use Case .....	24
Figure 12.1 : Agile Development.....	37
Figure 12.2 : Test Driven Development .....	38

## List of Tables

Table 13.1 : Project Management & Schedule .....	39
Table 14.1 : Risk Management .....	40

## 1. Abstract

Smart e-commerce watch store is a prototype made for the sole purpose of converting an online store into an Augmented Reality Store. The store will give the option for users to try on the product virtually before buying it. The present issue of the watch store is the inability to allow users to try on their products or have any interactive experience with the consumers, which causes the customer to second-guess their decision-making. As a result, the product is more likely to be returned because the consumer does not like how the watch fits on their wrist. This results in losses for the company and prevents it from gaining loyal clients. The solution to increasing revenue and increasing customer satisfaction is allowing the customer to try on the product before checking out. Because of covid, interest in Augmented Reality has grown. People are more aware of AR than ever before and integrating AR into a business boosts its power to sell more and lower losses. That is how a company grows.

Furthermore, for a firm to thrive, it must attract customers. As a result, artificial voice recognition has been incorporated into the smartwatch shop. Changing the way an e-commerce business operates requires public permission. A survey was conducted on a few students, which resulted in a good response regarding the e-commerce revolution. The primary purpose of implementing AR and AI in a store is to improve business income while decreasing business losses. Not only that, but the AR function enables customers to make better judgments from home, which is helpful during times of lockdown and mirrors the core purpose by allowing the firm to stay afloat during pandemics.

**Keywords:** augmented Reality, artificial intelligence voice recognition, ecommerce smart store, 3D model object, communication.

## 2. Introduction

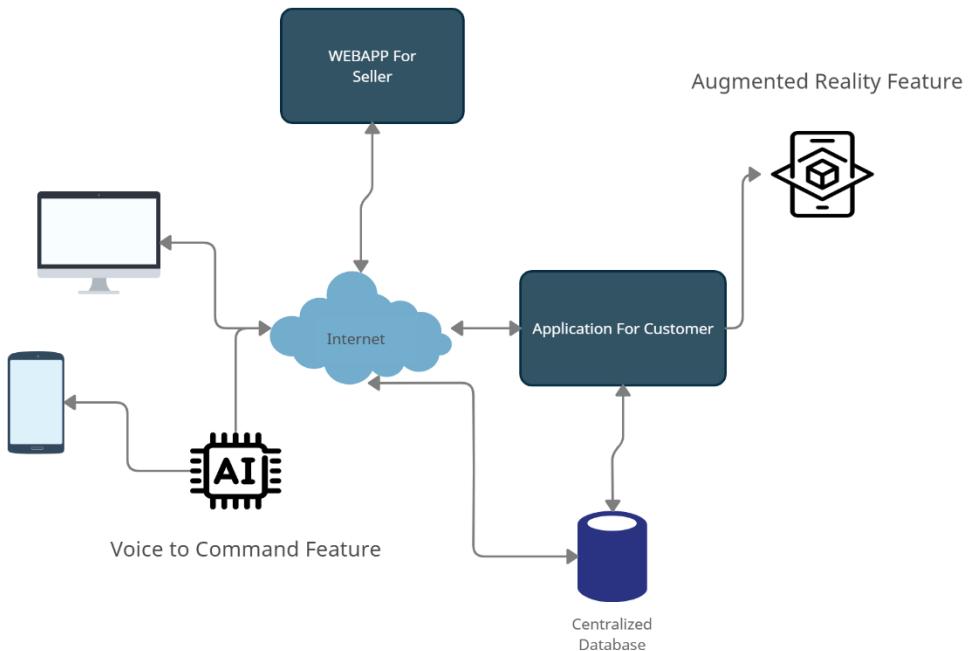
Currently- diving into the minor details, Sri Lanka is continuing to gain common ground to keep up with the global digital era's requirements. Closely examining Augmented Reality (AR) is still in its infancy, slowly but steadily making its way into today's governing sectors. Whether it is about internet e-commerce or face-to-face interactions, AR has successfully constructed a name for itself worldwide, such as AR-based Snapchat filters and AR-based learning. As an undergraduate, the project I proposed is to comprehensively acute with the AR technology and merge it with an online watch e-commerce store (Mileva, 2020)

In the modern world, as we observe closely, we notice that many people go to the mall to try on watches and purchase them, but why do they do this? One reason is that they prefer to have direct contact before buying the watch they desire. Hence to briefly explain, they like to see how the watch looks on their wrist beforehand. When e-commerce shopping bloomed, many started to buy products online, but the major downfall was that users could not try on a product they liked. Users solely depended on the product reviews and the static picture that the business owner uploaded. An e-commerce store is said to be successful when it has a 2% conversion rate for every 5000 visits. However, many Apps and websites fail to reach such high demand and standardized base goals because there is no dynamic interaction with the customer (Shlomo Trachtenberg, 2021)Shopify revealed new data showing a 94 per cent greater conversation rate using Augmented Reality than interaction with a non-AR-enabled store (Papagiannis Helen, 2020)When the covid-19 pandemic started, the visits to e-commerce Apps and websites exploded. But many e-commerce stores especially watch store has static images of different watches. These arise various issues like the following enlisted below –

1. Return of the product increases.
2. Low conversion rates.
3. The “try before you buy ” mindset.

As a person, I would visit a store or mall to purchase a watch because I would first want to see how the watch suits my hand and rarely would I return if it works for me. But when it comes to e-commerce watch stores, we can argue that it's not the same as going to the mall and trying it on. A plain static image of a watch isn't going to justify how the watch will look on the wrists of the customer. There's a 40 per cent decrease in return of products reported by Shopify when applications used 3D visualization instead of a plain image. The reason behind this is that the general population has a “try before you buy ” mindset (Mike Boland, 2021) (Matt Anderson, 2018).

‘Kuwait Smart Watch Store’ is a mobile application that would eliminate two critical issues an online e-commerce store faces by implementing Augmented Reality. AR allows the customer to virtually try on the watch before purchasing the product, thus reducing returns up to 40 per cent. The proposed project also helps in customer satisfaction because a dynamic 3D model will be used instead of a static image. The customer can either try on the watch or view the 3D model. This helps to reduce the “try before you buy ” mindset.



*Figure 2.1: Project Overview Diagram*

### 3. Background and motivation

The market is filling up with great AR applications. There is a massive growth in 2020 because of Tech giants like Microsoft, Google, and Apple. Moreover, covid-19 has helped push more Augmented Reality applications into the market. AR has made a massive impact. In 2020, 32% of consumers used Augmented Reality for shopping online. AR market is looking at about 68.5% growth by 2027. Studying and implementing Augmented reality on my application would help me to understand how to implement AR and VR on much more complex apps in the future. When AR and VR become the future and being a part of AR since the time of my higher education would help me in my future career. (Andrew Makarov, 2021) (Sergei Vardomatski, 2021).

One of the main reasons I would like to take on the proposed project is to learn and become familiar with the current Augmented Reality trend. Apart from the significant education institutes that study the principles of augmented reality, ANIMAX is the only known company in Sri Lanka that specializes in this field. Others are made up of AR and are still in their infancy, but they will undoubtedly become widespread with time. Some more reasons would be

1. Other reasons I want to pursue the proposed project is because of how interesting the project is and the amount of new knowledge that I'll come across in the software development life cycle.
2. The proposed project is supposed to be a final year-based project but for me I want to fully develop the application, launch it in the market, and start a small-scale ecommerce business.

### 3.1 What is Augmented Reality (AR) ?

Augmented Reality (AR) is a technologically enhanced version of the real world that is achieved by the use of digital visual components, audio, or other physical enhancements. It is a growing trend among businesses related to adaptable processing and, more especially, business applications.

## 4. Initial Scope

The initial scope of this online e-commerce watch store is to learn and monitor the watch industry and have a good knowledge of the online eCommerce business. I have developed how to make an online watch business much more successful than a static online business with these two components.

I will approach my project according to the System Development Life Cycle flow. And for external parties to understand the project, all the business processes and I will document the procedures using UML diagrams, Jira, and GitHub. This helps others understand the scope of the project and help me maintain the application.

The application will use Vuforia and unity to track a marker on the customer's wrist, and with object tracking, The application will augment a virtual watch on the customer's wrist. A centralised database will be used for the project to keep track of the watch data and user's data so that Vuforia can access the watch's data. The initial application has excellent features that the consumer and the seller can access. Some of these features are

1. Customers can use the Augmented reality feature to try on the watch they would like to buy
2. Customers are provided with a secure ecommerce store.
3. A 360-degree model is uploaded instead of a static image so users can view the watch from every corner.
4. Allow customers to personalize and modify the watch to some extent .
5. Provide stripe service and google map for easier checkouts.
6. Implementation of A.I voice to command help special needs and consumers.
7. Sellers have a Web application and a dashboard to add and maintain their stores and also provide them with various kinds of business analytics.
8. A chat service to have better customer-seller relationship.

There are many competitions in the online ecommerce world, Augmented reality try on feature and Voice to command, and the other small, detailed features can make the proposed project stand out in the current market.

## 5. Business Case

### 5.1 Business Need

If we take an ecommerce watch store the ultimate goal is to become a successful business. And what does it take to become a successful online watch store business? A high conversion rate defines an ecommerce store. But to achieve this goal we need to dive into a bit of human psychology. The buying impulse of humans is broken down into Desire, Trust, and Ease (Emily Usher, n.d.). And this is an issue with an online watch ecommerce business ad there is none of these pillars exist in a new consumer. A typical online watch store has a plain image along with some texts and reviews. A static image of a watch on a screen is not going to persuade a consumer to buy the product because the customer does not have any dynamic interaction with the product. A huge trust issue plays a role as the customer does not know how the watch is going to look In their wrists.

In 2019 covid-19 turned the entire world online and it became a hassle to shop physically at a store. Retailers started to implement online ecommerce stores with images of their watches, but this causes a major uncertainty for the customers as they do not know if the watch will look good in their wrist. This discourages the customer to check out and thus the store will have a low conversion rate. Shopify data released data revealing stores with Augmented Reality had a 96% more conversion rate than a store with no AR (Papagiannis Helen, 2020). And what makes an online watch store worse is the return of products. But when there is an AR implementation there was a 40% decrease in return products according to Shopify and 25% decrease In AR-guided purchases reported by SeekXR (Mike Boland, 2021). With the AR implementation customers can try on every watch the store has to offer on their wrist just with their phone and see what fit them the best this solidifies the “try before you buy” mindset.

#### 5.1.1 Underlaying Problem

E-commerce watch businesses have challenges in today's market since clients are unfamiliar with the watch's appearance on their wrist. To be successful as an e-commerce business, the consumer must check out the store, and the merchandise must have a low return rate. However, many companies feature basic photos of timepieces on their website, which leaves the client perplexed as to which watch would look best on their wrist. If customers check out and are dissatisfied with the purchase, they frequently request a refund. The return issue arises for two reasons: first, clients purchase things without knowing the exact fit of their wrists. Thus, when the product is delivered, they can inspect it and make an informed decision; the other reason is that the product's description falls short of the consumer's expectations. In other words, the percentage of returns due to items that did not meet the customer's expectations is 64.2 per cent (GRAHAM CHARLTON, 2020). Additional difficulties encountered by the watch ecommerce store include the following:

- Difficulty navigating the store.
- Lack of touch and feel of the products.
- A lack of participation in the shopping process.

- Lack of close examination.

## 5.2 Business Objectives

Using Augmented Reality Mobile based application with A.I where customers can try the watch on their wrists helps solve the following problems

- Reduces returns up to 30%
- Customer can try their favorite watch virtually just with a smart phone.
- Customer expectation on how the product looks increases by 64.2%
- Conversion rate on AR store increases by 40% according to Shopify
- Provides future trust on the store
- Implementation of A.I voice command increases attraction to the application.
- Improves efficiency of the store's return policy by 33%
- Buying a customer intended watch increases.
- The psychological factor that impulses one to buy a product.
- The active trend of AR implementation would increase downloads of the app, especially during covid as customers cannot visit stores and physically try on the watch.

(GRAHAM CHARLTON, 2020) (Emily Usher, n.d.) (Mike Boland, 2021)

## 6. Project Objectives

1. User-friendly Application - A user-friendly app is critical since difficult navigation is a sure way to lose a long-term consumer base. I'll need to create the simplest feasible layout so that users can use the program independently and without encountering any unexpected problems. Analyze AR technology and implement them so the customers can try on the product before buying.
2. Augmented Reality - As this is a critical component of the project, ongoing study will be required to ensure that users do not struggle to figure out how to utilize the application's augmented reality capabilities when this feature is implemented. Additionally, I'll need to keep track of the most appropriate augmented reality software development kit to employ, the system requirements for running the AR features, and design the application around these needs.
3. 3D models – Integration of 3D watch models rather than static photos enables consumers to examine the watch from a variety of angles.
4. A.I – Artificial intelligence may increase sales by up to 67 percent in an internet business. The addition of an A.I voice bot simplifies the application's usability for consumers.
5. Updated UI – By integrating human-computer interaction (HCI) concepts, businesses may provide clients with a trendy UI appearance and feel.
6. Chat Service – It's important for users to be able to communicate with a business. Around 73% of customers stated that the most essential aspect of a

business is providing superior customer service. It's not always about free shipping or free returns (Kaleigh Moore, n.d.).

7. Check out - Provide stripe service for consumers
8. Analyze more on consumer requirements.
9. Owner dashboard – Provide the business owner with statistics of the store data to make business decisions and manage the store in one place.
10. Owner to manage products
11. Owner to add admins
12. Owner to manage orders

## 7. Legal Licenses

- Firebase - As this is a free plan for Firebase Database, Functions, and Storage, the developer must agree to Firebase's terms of service (Firebase, 2018).
- Unity - To access all functionalities, the Unity Asset Store, and Storage, a free registration under Unity Personal must conform to the terms and restrictions specified by Unity Hub (Unity, n.d.).
- Vuforia - The License Manager enables you to establish and manage licenses by providing you with the necessary tools and information. Regardless of whether you are creating or deploying an application, you will require a license key. The only exception to this rule is for Unity developers who do not require the ability to deal with targets. However, in order to access its database, Vuforia Developers' terms and conditions must be obeyed (Vuforia, n.d.).
- Stream chat – Stream offers developers free access to its service if their monthly income is less than \$10,000 and their team size is fewer than five (Streamchat, n.d.).

## 8. Literature Review

### 8.1 Augmented Reality.

*"Innovative digital technologies enable the superimposition of perceptual data (auditory, visual, tactile, or olfactory) onto our reality, for example, in retail contexts. These technologies aimed at augmenting reality are commonly referred to as Augmented Reality (AR) technology" (Marc Riar, 2021).*

### 8.2 Augmented Reality with E-commerce

*"The phrase augmented reality was coined in the car industry for promotional purposes. A significant progression is feasible inside e-commerce by using augmented reality. 77% of buyers prefer to use augmented reality capabilities to preview types of products based such as colour, size, style, and difference" (Navneet Garg, Ankita Pareek, 2021).*

Augmented reality (AR) is a technological advancement that "embeds" tangible items into our current experience. AR aims to integrate this current reality with the real world in such a way that both physical and conceptual objects are visible to the client in the same location. R. Azuma defines augmented reality as frameworks that "connect real and virtual data, maintain a consistent interface, and are registered in three dimensions."

### 8.3 What is AR based E-commerce?

To begin, let us define E-commerce. Ecommerce – often known as electronic commerce, internet commerce, or online commerce – is a business model that involves online purchasing. The term "e-commerce retailer" refers to enterprises that sell their products online. Frequently, company owners would give basic static photographs of their products online. A consumer is not given the feature to examine the watch in further detail. However, emerging technologies such as Augmented Reality are about to revolutionize all of that.

Customers may interact with things in real time when AR e-commerce is integrated into an online company, all while remaining in the comfort of their own home or workplace.

Augmented reality (AR) helps customers bridge the divide between in-store and online buying experiences. A chasm that has grown even larger as a result of the Covid-19 outbreak, which has forced retailers to close their doors, preventing people from entering stores and directly handling items (reydar, 2022).

## 8.4 What is E-commerce AR Try On Watches ?

When purchasing a watch online, one of the critical considerations is, "How will it appear on my wrist?"

While online retailers can provide extensive size and colour information, there is no replacement for physically seeing a timepiece on your wrist. As technology evolves and continues to evolve, buyer behaviour will also evolve. Buyers now can interact, choose, identify, and purchase in new ways.

The age of static e-commerce has passed us by. Augmented Reality technology is making a name for itself in different fields and especially a major impact in E-commerce stores. AR is only now beginning to influence the extremely competitive era of internet buying, but they have already spawned concepts like virtual trying on. AR Try On watches are a ground-breaking Technology that combines the power of Augmented Reality with the joy of acquiring a new watch.

## 8.5 Different Types of AR Out Available

1. Marker-Based AR - Marker-based augmented reality apps place things in a given location by utilizing target pictures (markers). These markers specify the position of the application's 3D digital content inside the user's field of vision. Earlier versions of augmented reality systems relied on markers. Simply put, the virtual item is associated with a physical visual pattern. The 3D item is materialized into the actual world using this approach (Softtek, 2021).
2. Marker less AR – This technique uses machine learning and artificial intelligence in conjunction with smart phone sensors to indicate the location of 3D objects (Softtek, 2021). Marker less AR is broken down to
  - Location-based AR
  - Project-based AR
  - Overlay AR
  - Contour-based AR

## 8.6 Types of E-commerce Stores Based on AR

1. IKEA Furniture - Project-based augmented reality is a subset of augmented reality that enables the user to materialize an item in a stationary setting. The IKEA app leverages the potential of project-based augmented reality to allow users to virtually arrange furniture in their homes using their phone. The software begins by scanning the space and then displays the furnishings with 98 percent accuracy (SVETLA PAVLOVA, 2020).
2. Michael Kors – Michael Kors, who is well-known for its prescription eyewear, utilizes Overlay AR, which enables clients to digitally try on the spectacles (Aleksandra Kwiecien, 2018).

3. Dulux Paint – Another firm utilizes overlay augmented reality to allow customers to examine over 1,200 paint hues on their walls. Dulux Augmented Reality feature enables clients to realistically see which colour matches their wall, rather than blindly comparing a colour pallet to the wall (SVETLA PAVLOVA, 2020).

## 8.7 Working of AR Watches

AR indoor navigation technology is quite complex as it consists of 3 modules, which have to be factored in; and these include: Processing, Rendering, Marker, Positioning.

**Processing** involves comparing the image target against a known database.

**Marker** Image targets are pictures that the Vuforia Engine is capable of detecting and tracking.

**Rendering** modules are responsible for bringing 3D objects into the actual world. Currently, there are a variety of platforms that enable the use of augmented reality. However, there are complications when it comes to dealing with mark less augmented reality.

However, when it comes to **Positioning**, the situation becomes fairly daunting. There is no clear way to determine the actual size of the consumers wrists, including the depth level of the wrist. Determining the appropriate accuracy levels is also a test.

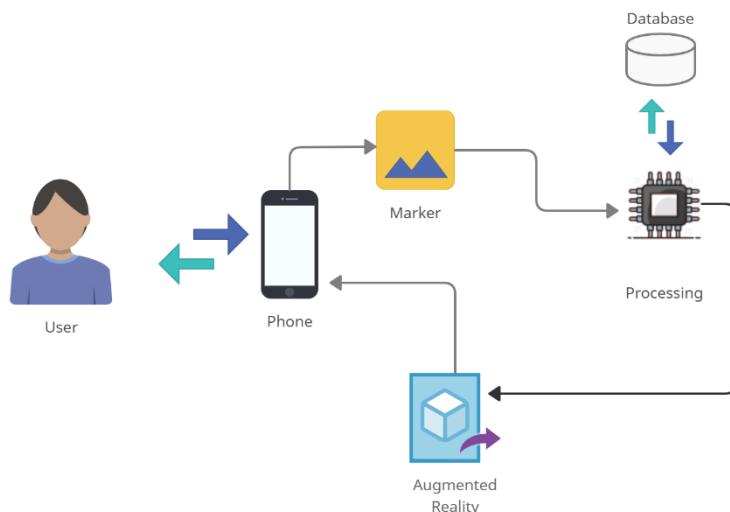


Figure 8.1: AR Working

The introduction of Apple's AR Kit and Google's AR Core enhanced the capabilities of augmented reality applications by providing a standard and easy-to-use AR experience. All things considered, there is one more obstacle to survival in the field

of spatial orientation – true reference. To establish a permanent, facilitate framework, the program must first determine the location of the virtual area inside the current reality environment.

While using image markers or QR codes might aid in providing a long-lasting guidance framework, they are not the most popular options. SLAM (Simultaneous Localization and Mapping) technology now available does not function in larger zones. Google VPS does this function admirably. however, it is not available as an SDK.

## 8.8 The present run with AR technologies.

Augmented Reality is a technology that enables users to interact with digitally made items in the real world using their cell phones. What differentiates Augmented Reality (AR) from Virtual Reality (VR) is that AR does not remove the user from their current environment as VR does. As a result of this advantage, mobile developers have been able to maximize the benefits of Augmented Reality, as they can include AR into mobile applications that people use daily.

Numerous global retail organizations are currently utilizing augmented reality (AR). According to Media Post, 38% of internet buyers now shop using augmented reality app . Numerous countries now offer virtual fitting rooms. Consumers may approach a screen equipped with an integrated sensor (typically a Microsoft Kinect sensor) and try on items while switching between different costumes using hand gestures (Martin, 2019).

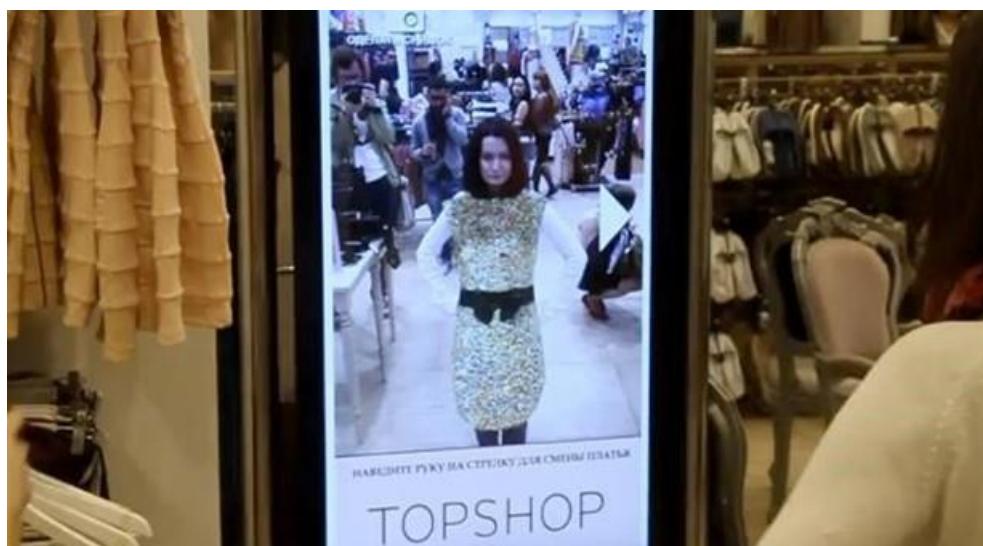


Figure 8.2 : Kinect AR fitting room in Moscow

*"While some individuals find the process of selecting clothing from a rack, putting them on, discarding those that don't fit or flatter them, and repeating the process enjoyable, I am one of those people who find the entire procedure tiresome"*  
*(Delony, 2011).*

Another company called Coolhobo, has developed a mobile application for shopping that incorporates a variety of entertaining and useful augmented reality features, including the following:

- Augmented reality in-store navigation
- Augmented reality 3D shopping assistance
- Shortened route based on users' shopping list

This has been a popular app with 5-star reviews on the Apple App Store. Additionally, the renowned Nike corporation has included augmented reality elements into its Nike app. Now, consumers can just aim their smartphone at their foot to determine their shoe size and then purchase shoes in that size. There are mock up AR stores without any business goals in mind and several draw backs.

## 9. Use Case and Functional Requirements

### 9.1 Functional Requirements

Functional Requirements are often characterized as the statement of requirements essential for a system to accomplish its objective (Jafari, 2020). The System's duties. The functional requirements are divided into two categories: Core and Optional. The fundamental functions are the most critical and must be present. Without them, the system would cease to function, and the project would fall short of meeting its requirements and deadlines. The Desirable Requirements would include functionality that provides extra options to the user, but the System would still work without them. Optional needs are functional aspects that are more likely to be absent from the final project owing to constraints (time, cost, resources etc.). They are the requirements that define the project's future enhancements.

#### CORE:

##### 1. Admin (Seller)

- The main administrative account can login with the provided credentials.
- When a new member of the administration requests access to the system, someone who is currently logged in should generate a password for the new member using the system's password generator and transmit it to the new member.
- All products information should be accessible to the administration team.
- The administrator should have the ability to see the specifics of particular product.
- The team can update any product that's in the system.
- Admins can add several photos of a single product to create a 3D model.
- The administration should be able to register new product details.
- Admins can make any product feature in the store.
- Admins can view all orders made from the customer with the customer details.
- Admins can filter orders by order status.
- Admins can change status of order respective to product status.
- Admin can filter orders based on dates.
- Admin can search any product based on the customer ID.
- Admin can add or update watch categories to be displayed in the store.
- Admins can delete categories or brands.
- Admin can view all the users registered to the store.

- Admins can chat with every user that is registered to the store.
- Admins are provided with various analytic charts to improve the store business.
- Admins can manage their profiles.
- Web application should be responsive.

## 2. Consumer (Buyer)

- Customers can view all products in the store.
- Customer is provided with a search option to filter our products based on their names.
- Customer can check any product details.
- Customer can view the product in a 360-degree view.
- Customer can try the watch on using AR feature.
- Customer can add the product to cart.
- Customer can use in built voice command to control the apps navigation and certain functions.
- Customer can add or edit address. Customer is also given the option to save the address for future use.
- Customer is provided with stripe payment gateway.
- Customer can register and login.
- Customer can update profile.

## OPTIONAL

### 1. Admins

- To notify admin through email for every new order made

### 2. Customer

- Send push notifications with delivery status changes
- Save credit card information.
- Add gift voucher
- Change languages.
- Reward system.
- Categories based on genders.

## 9.2 Non - Functional Requirements

### 1. Usability

Irrespective of the organisation's size, the application should be simple to use for even the most inexperienced user. Did you know that the average user takes only 0.05 seconds to decide if an application is worth their time? Thus, you must pay close attention to the development of the homepage, CTAs, and checkout process to avoid those dooming moments (Shvetsova, 2021). Additionally, the usability of a mobile application is determined by the following:

- The ease with which a person may accomplish their objective in a single page visit
- Their ability to do things rapidly in the store
- The design's memorability and intuitiveness
- The number and kind of mistakes made by users

## 2. Security

When it comes to financial transactions and sensitive data, security is critical. A straightforward SSL certificate and data privacy policy will build trust in the application and convert users into brand evangelists. Additionally, it is about distinct administrator responsibilities handling user data.

## 3. Performance

The primary goal here is to launch the e-commerce shop as quickly as possible, regardless of the number of integrations or visitors to your website. Consider employing a third-party system for distribution, as not all third-party API requests can be regulated by the system.

## 4. Maintainability

By including application maintenance into the original development phase, may save time and money in the future when determining and resolving system errors.

## 10. Design

### 10.1 Activity Diagram (User)

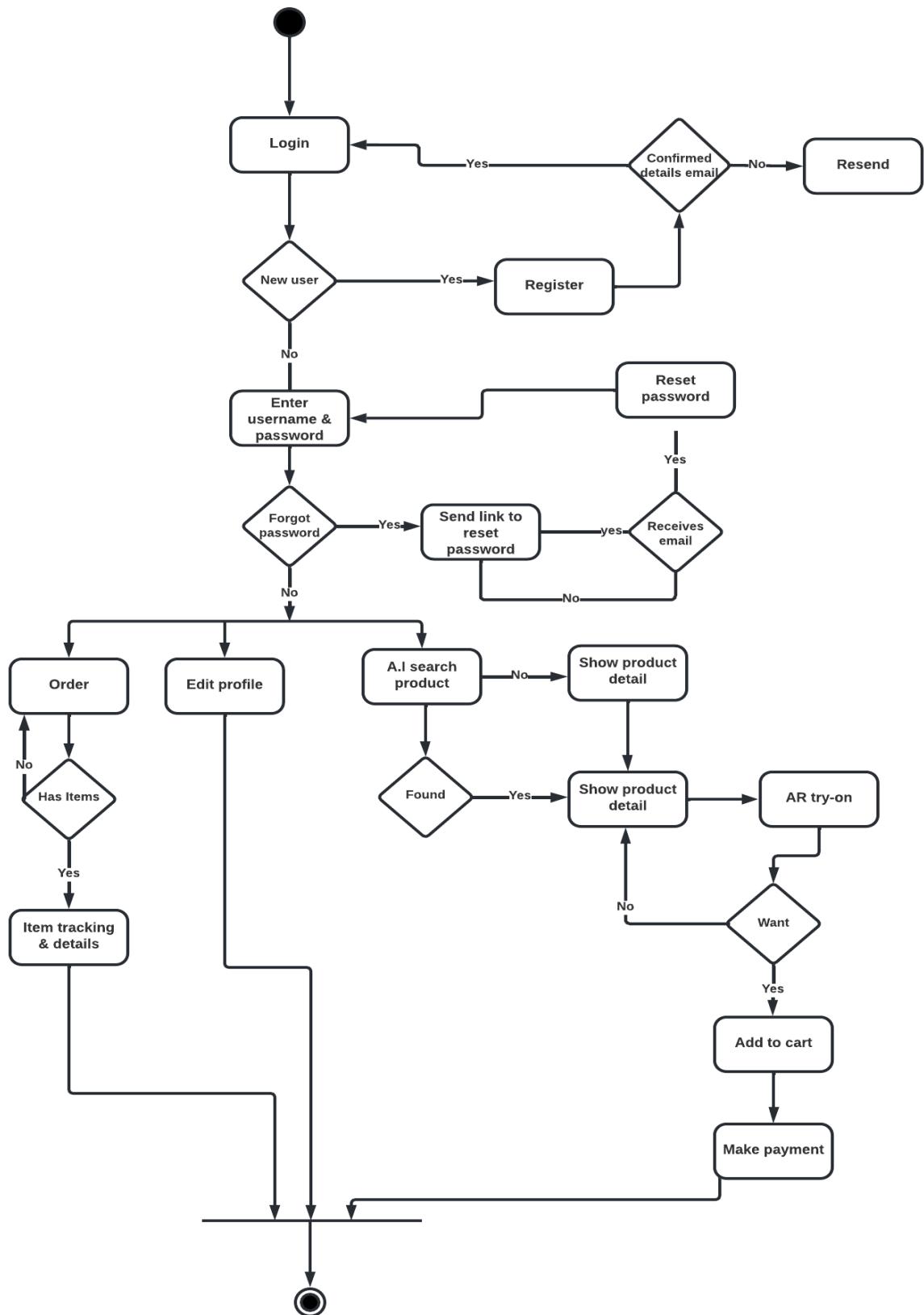


Figure 10.1 : Activity Diagram (User)

## 10.2 Activity Diagram (Admin)

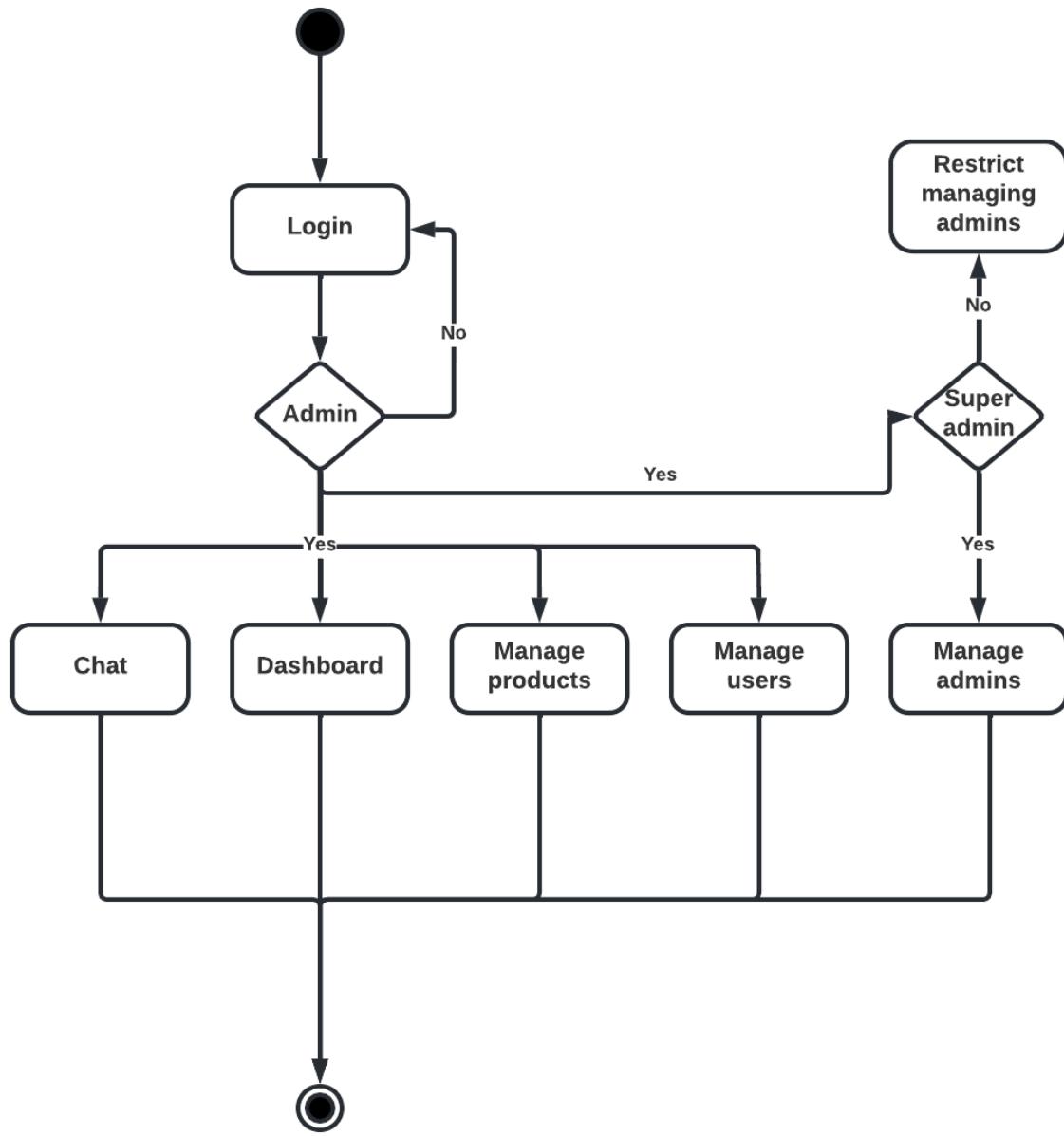


Figure 10.2 : Activity Diagram (Admin)

### 10.3 Entity Relation Diagram

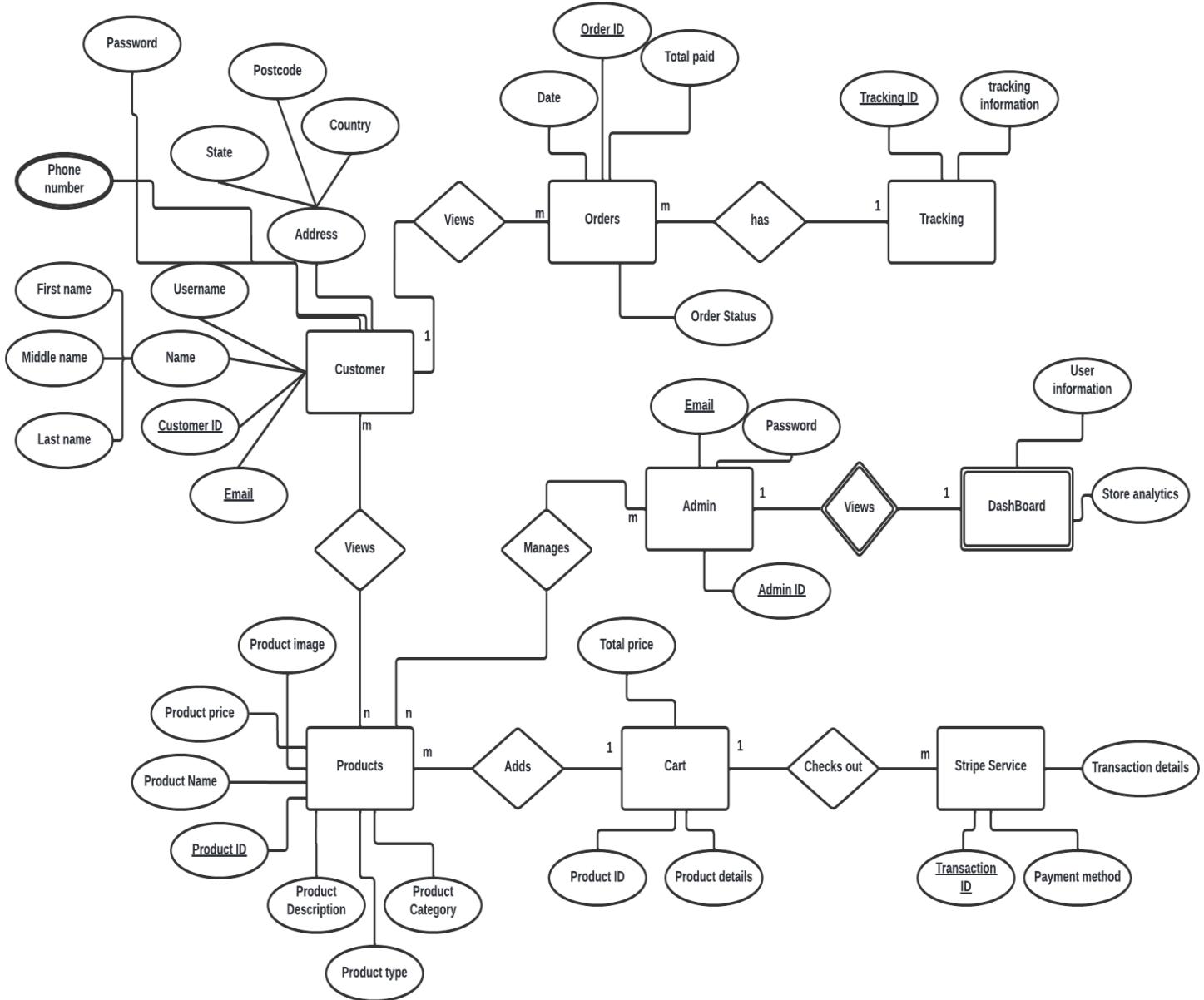


Figure 10.3 : Entity Relationship Diagram

## 10.4 Context Diagram

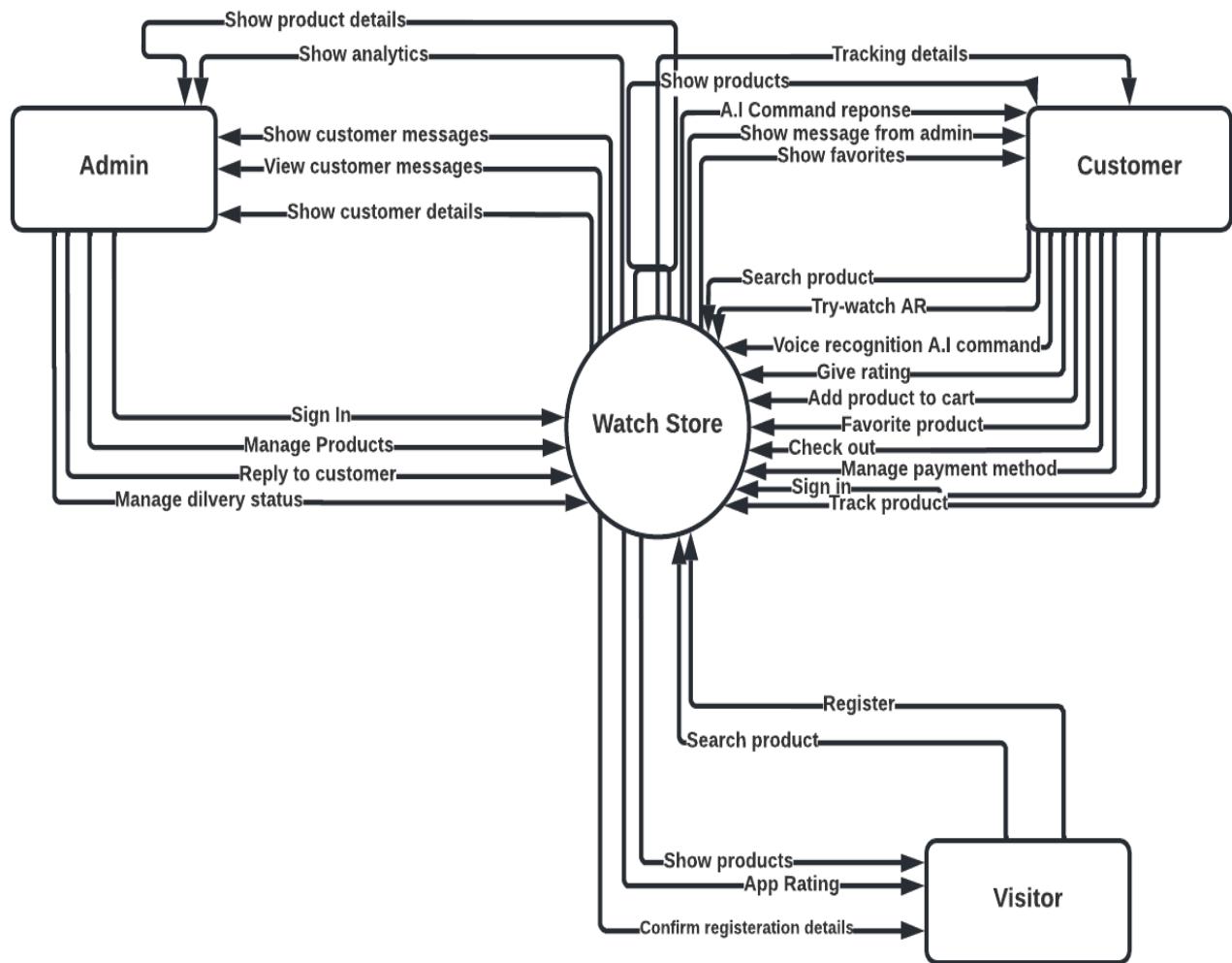


Figure 10.4 : Context Diagram

## 10.5 Level 1 Diagram

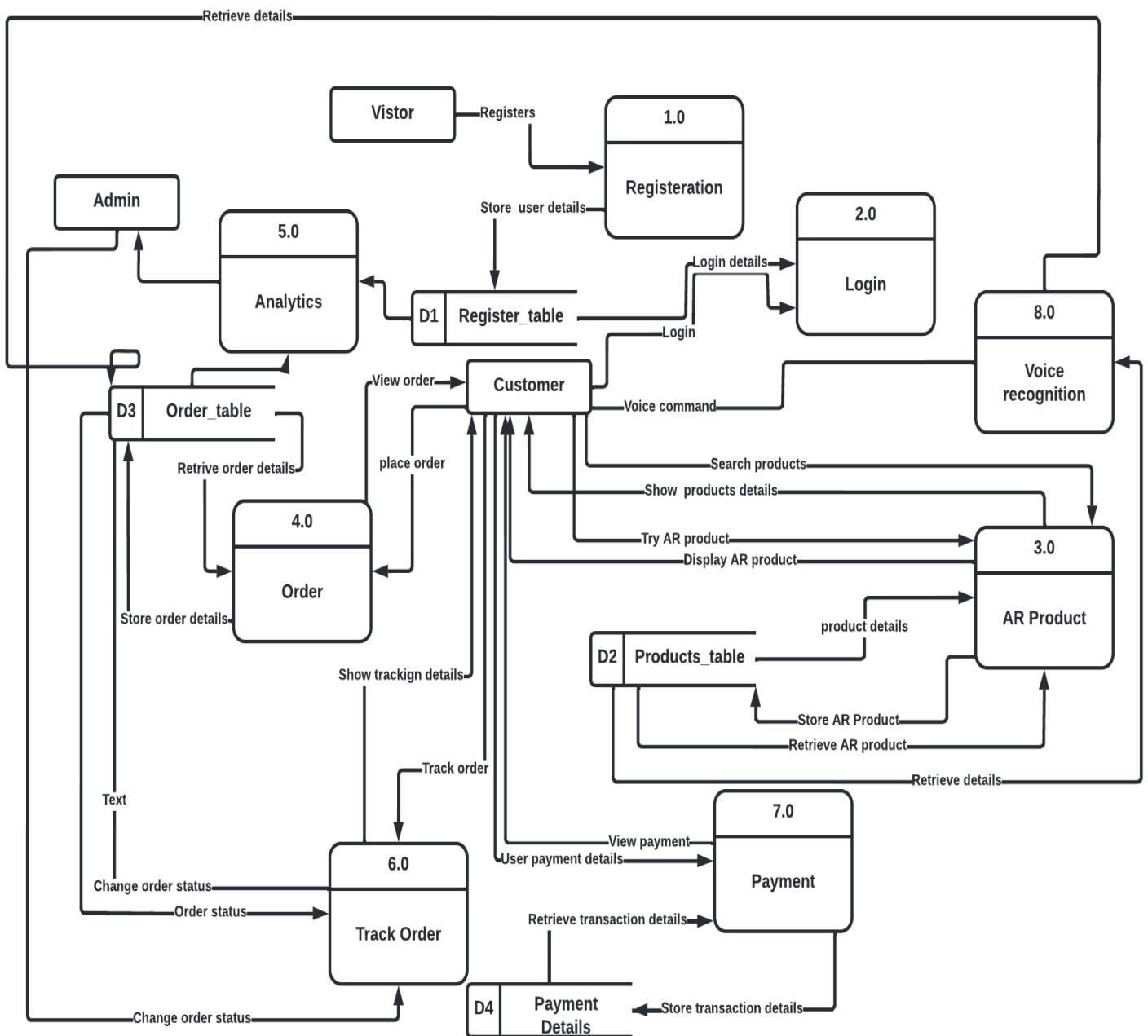


Figure 10.5 : Level 1 Diagram

## 10.6 Use Case Diagram

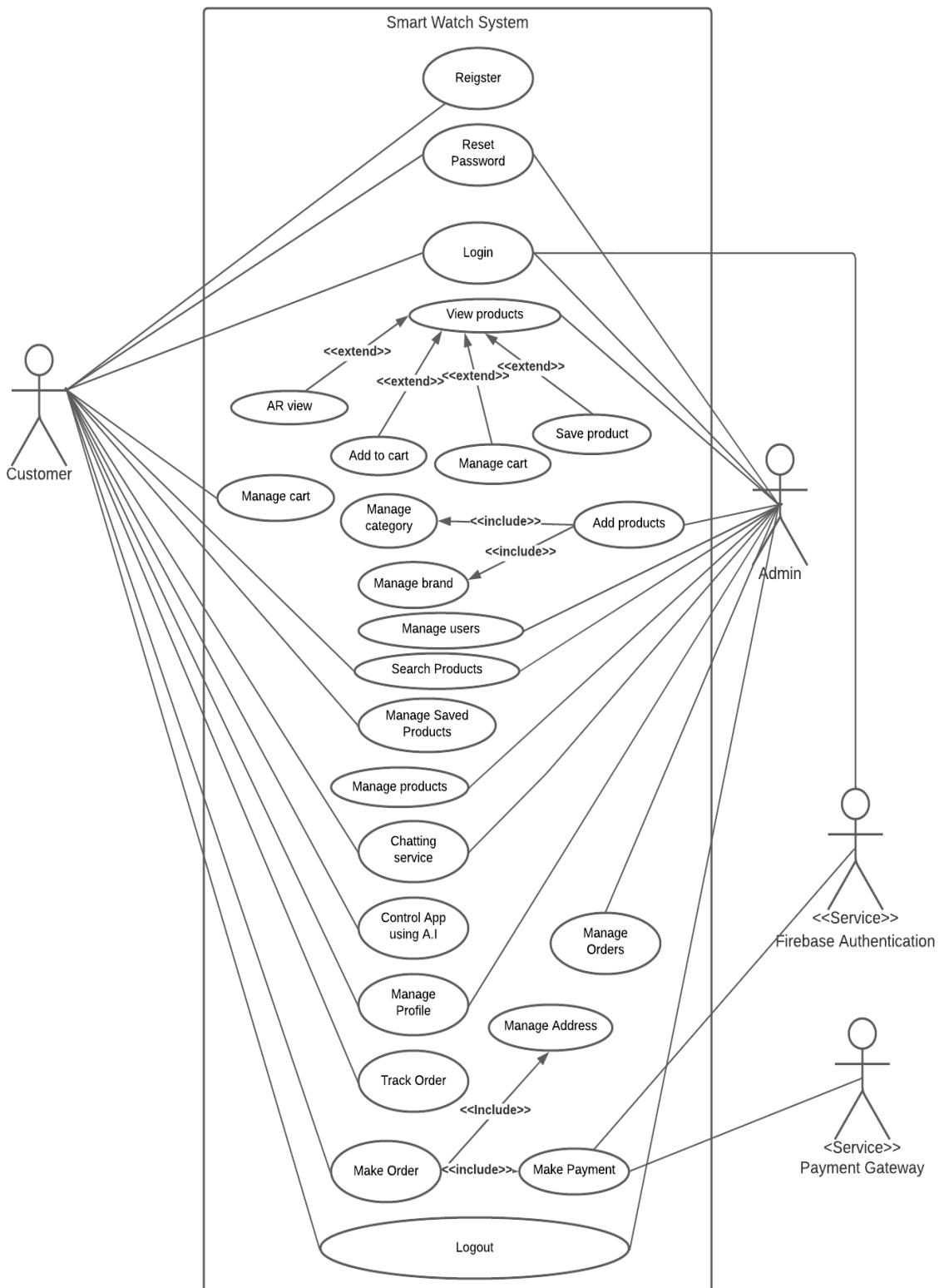


Figure 10.6 : Updated Use Case

## 10.7 Use Case Description

Use Case No.	UC - 01	
Use Case Name	Register	
Priority	High	
Actor	Customer, Store Admin	
Description	Allows customer and admin to create an account to access the system.	
Pre-condition	All information required by the system must be provided to successfully register.	
Post condition	Access to the system	
Course of action	User Action	System Response
	1. User enters necessary information and clicks save.	Sends an email to the entered email.
	2. User clicks on the sent email to confirm authentication.	System automatically logins in user.
Alternative course of action	1.1 If user enters invalid details, the authentication fails and shows error message  2.1 If user doesn't confirm email, The email expires and thus needs to be resent.	
Use Case No.	UC - 02	

Use Case No.	UC-02	
Use Case Name	Login	
Priority	High	
Actor	Customer, Store Admin.	
Description	If the authentication if successful admin and customer can access the system.	
Pre-condition	Customer and admin must be registered to the system.	
Post condition	Access the system.	
Course of action	User Action	System Response
	1. Clicks on the login button	System checks if the user is registered to the system and give access to the system if authenticated.

Alternative course of action	1.1. If user credentials are invalid or empty, an error message is displayed to the user.
------------------------------	---

Use Case No.	UC - 03	
Use Case Name	Reset Password	
Priority	High	
Actor	Admin, Customer	
Description	Allows user to reset password that is forgotten by the user.	
Pre-condition	1. Need to be registered to the system.	
Post condition	Access the system with new password.	
Course of action	User Action 1. User enters the email that's registered to the system 2. User clicks on the link that's sent by the system. 3. Enters new password	System Response System sends an email that's registered to the account. Redirected to a webpage where password can be changed. System changes the old password to the new password in the database
Alternative course of action		

Use Case No.	UC - 04
Use Case Name	View Products
Priority	High
Actor	Customers
Description	Shows all the products to customers that's available in the store.
Pre-condition	Customer must be logged in.
Post condition	Customer is given the option to view the product in AR view, add the product to cart or save the product to view later.

Course of action	User Action	System Response
	1. User wants to see details of product.	System fetches information about the product from database
	2. User wants to see the product in AR view	System opens unity package to show the watch in AR view.
	3. Customer adds to cart	System adds the product to cart which can later be used to check out
	4. Customer saves product	The specific product gets saved under the user, which later used in UC-07
Alternative course of action	After product is added to cart user is given option to move into UC-05	

Use Case No.	UC - 05	
Use Case Name	Manage Cart	
Priority	Medium	
Actor	Customer	
Description	Users can view all products that's added to cart and also remove any item they would later dislike.	
Pre-condition	To remove an item from cart, an item must first be added. Customer needs to be logged in.	
Post condition	All the items user added during virtual shopping is displayed along with the product details.	
Course of action	User Action	System Response
	1. Customer deletes product.	Removes product from cart and shows success message.
Alternative course of action	Customer can continue shopping or move to UC-16	

Use Case No.	UC-06	
Use Case Name	Search Products	
Priority	Medium	
Actor	Customer, Admin	
Description	Allows admin and customer to search products in the system.	
Pre-condition	Products should be available in the store. User must be logged in.	
Post condition	Display the product the user searched for with the product details.	
Course of action	User Action	System Response
	1. User uses the search option and searches a product by name	System checks If that specific product exists in the system.
	2. User clicks on the searched product	System shows the details of the specific product
Alternative course of action	2.1 User is redirected to stage 4	

Use Case No.	UC-07	
Use Case Name	Manage Saved Products	
Priority	Medium	
Actor	Customer	
Description	Allows customer to view all the saved products in one place and also remove the item from saved products.	
Pre-condition	Customer must have a saved item. Customer needs to be logged in.	
Post condition	Display saved items so user can easily access the products of preference in one place.	
Course of action	User Action	System Response
	1. View saved products	Fetches ID of the saved product from database and run through the fetched products and display it to user.
Alternative course of action	From UC-07 user can go to UC-04	

Use Case No.	UC-08	
Use Case Name	Control App Using A.I	
Priority	High	
Actor	Customer	
Description	Allows user to navigate through the app and also carry out certain commands made by the user.	
Pre-condition	Internet connection, User command. Customer needs to be logged in.	
Post condition	Carry out the command that's given by the user.	
Course of action	User Action	System Response
	1. Command A.I	System recognizes if the command is valid and then successfully carry out the task that's given by the user and upon success the mobile speaker is used to notify the user.
	2. Invalid Command	System uses mobile speakers to give information on why the command is invalid.
Alternative course of action	None	

Use Case No.	UC-09	
Use Case Name	Add Products	
Priority	High	
Actor	Admin	
Description	Allows admin to add products to the store.	
Pre-condition	Need to have a category added and a brand. Admin needs to be logged in	
Post condition	Admin can add products to the store with all the relevant information for the product.	
Course of action	User Action	System Response
	1. Add product	Adds product to the database which is reflected in the store only if a category and brand exists.
	2. Add category and brand	Adds category and brand where the product will fall under.

Alternative course of action	1.1. An Error message will be shown to the user if category and brand is not added first.
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Use Case No.	UC-10	
Use Case Name	Manage Users	
Priority	High	
Actor	Admin	
Description	Allows admin to delete, view and add a user to the system.	
Pre-condition	Admin needs to be authenticated.	
Post condition	Display all the users registered to system and give administration to manage them.	
Course of action	User Action	System Response
		1. View Users System fetches all the registered users from the database
		2. Delete User Removes user from system
		3. Search User by ID Display user information related to the user.
Alternative course of action	3.1. If invalid user ID is entered, an error message will be displayed.	

Use Case No.	UC-11	
Use Case Name	Manage Products	
Priority	High	
Actor	Admin	
Description	Allows admin to update product details or detail a product from the store.	
Pre-condition	Admin must be authenticated.	
Post condition	Display updated details in the store.	
Course of action	User Action	System Response
		1. Edit product System updates the product details in the database.
		2. Remove product System removes the product from the database.
Alternative course of action	None.	

Use Case No.	UC-12	
Use Case Name	Chatting Service	
Priority	High	
Actor	Admin, Customer	
Description	Allows Customer to communicate with admin	
Pre-condition	User must be authenticated.	
Post condition	Send and receive messages from admin.	
Course of action	User Action	System Response
	1. Send message to user	System sends message to admin via API
	2. View Messages	View all the messages by the respective user
	3. Delete message	Delete the message.
Alternative course of action	Cancel will redirect to UC – 4	

Use Case No.	UC-13	
Use Case Name	Manage Orders	
Priority	High	
Actor	Admin	
Description	Manage all incoming orders	
Pre-condition	Admin must be authenticated. An Order must be made by user.	
Post condition	Check Order details.	
Course of action	User Action	System Response
	1. View all orders	Fetch all orders made by customer
	2. View order details of a customer	Fetch the product that's requested by the user and the delivery address
Alternative course of action	None.	

Use Case No.	UC-14	
Use Case Name	Manage Profile	
Priority	Medium	

Actor	Customer, Admin	
Description	Allows customer and admin to update their profile information	
Pre-condition	User must be authenticated. Old password is needed to update password.	
Post condition	Change profile information of the user.	
Course of action	User Action	System Action
	1. Update profile	System updates user information in the database.
Alternative course of action	1.1. Invalid old password shows error message to the user.	

Use Case No.	UC-15	
Use Case Name	Track Order	
Priority	Medium	
Actor	Admin, Customer	
Description	Allows customer to view order status.	
Pre-condition	Customer needs to make an order. User needs to be authenticated.	
Post condition	The changed order status by admin can be viewed by the customer.	
Course of action	User Action	System Response
	1. View order status	System fetches the order status relevant to the order.
	2. Change order status	Admin changes order status based on the situation.
Alternative course of action	Admin can cancel the order.	

Use Case No.	UC-16	
Use Case Name	Make Order	
Priority	High	
Actor	Customer, Firebase authentication, payment gateway, Admin	
Description	Customer can make an order of the selected products.	
Pre-condition	Customer needs to be authenticated. Payment should be successful.	

Post condition	Order is sent to the admin after authenticated by firebase and payment is done.	
Course of action	User action	System Response
	1. Customer makes order	System checks if user is authenticated and then requests payment gateway to provide its service. When payment is successful order is sent to admin,

Alternative course of action

1.1. If entered card details is invalid, error is displayed.
--

Use Case No.	UC-17	
Use Case Name	Logout	
Priority	High	
Actor	Customer, Admin	
Description	Allows user to logout from the system	
Pre-condition	User needs to be logged in	
Post condition	User successfully logged out of the system	
Course of action	User action	System Response
	1. User wants to logout	System logs out user and destroy authentication token

Alternative course of action

None
------

## 10.8 Software Design Principles

These concepts give the means to manage complexity while minimizing the likelihood of mistakes. Software should be open to extension but closed to alteration, as the phrase goes. The goal of the statement is to ensure that the code is as easy to comprehend as possible without sacrificing performance comprehension.

S - Single Responsibility Principle Here, classes are constructed so that each class serves a specific function.

O - Open/Closed Principle — as previously said, open to expansion but closed to alteration.

L - Liskov Substitution Principle – Functions that rely on pointers or references to base classes can utilize objects of derived classes.

I - Interface Segregation Principle - Users may observe the features they should be utilizing.

D - Dependency Inversion Principle (DIP) — High Level Modules do not depend on Low Level Modules; nevertheless, they both depend on abstractions (Chauhan, 2019).

## 11. Development Technologies

Prior to the commencement of the project development phase, an inquiry was conducted to choose appropriate technologies. The chosen technologies were the finest but, the web application technology lacked maturity and a solid release.

### 11.1 Web Application

#### 11.1.1 React

Initially the web application was supposed to be developed using flutter web. But when it came to the time of implementation the technology lacked maturity and presented several other complications. Therefore, it was decided to transition to a well-known and established technology known as React.

React was first launched in the year 2013 by Jordan Walke at Facebook. React is a JavaScript based library that can be used to create beautiful and complex interfaces. Forty percent of developers cite React as their preferred language, giving it a sizable user base (Baranowski, 2021).

#### Pros

- React Component – React is component-based. This implies that if an application requires a custom button, the button may be created as a component and utilized throughout the code. This makes it simple to change the button from a single location and adhere to the rules of clean code.

- High Performance – React component-based design is useful for maintaining high application performance. React enables dynamic page loading in reaction to the user.
- Large Community – React has been tagged over 130,000 on GitHub. React is used every corner of the world and has accumulated a large community since the release. This makes it easy to solve arising issues and learn new techniques (Krivopust, Mar 24, 2021).
- Easy to Learn - Another advantage of working with React is that any developer with knowledge of HTML and JavaScript may begin studying it. React makes extensive use of what is currently available. This makes it really simple to get started with, which is another reason why it has become the most used JS library (Kumar, 24th Mar, 2021).

## **Cons**

- Hard to keep up with development – This is React JS's major weakness. React is continually expanding, with new features being introduced on a regular basis, resulting in the deprecation of existing functionality and the inability to utilize deprecated packages in development. Developers and the company must continually update the program to maintain the most recent version.

## 11.2 Mobile Application

### 11.2.1 Flutter

Flutter a language developed by Google has a bright future in the programming word. A lot of companies are migrating to cross-platform development. And moreover, is slowly gaining demand in the industry. So, decided to take a course on flutter and develop the mobile application using flutter (ANTHONIA, 2022).

## **Pros**

- Hot Reload : One of the most popular features of flutter is hot reload. The hot reload feature allows to reflect the change made to the application instantly. This helps to reduce time taken to develop or debug.
- Dart : Dart is a programming language created by Google. Its mainly created for mobile apps, web application and backend. The language is optimized for clients, so they perform the task fast and clean.
- Flexible UI : Flutter can be used for creating beautiful graphical user interface. Flutter allows the developer to control every pixel that's in the screen. It uses a widget in a tree system which makes it much easier to develop a GUI compared to native frameworks.

### **Cons**

- Community – Even though flutter is popular, Flutter still isn't mature enough. So, a lot of code has to be written from scratch and Still the native frameworks are the go-to option for developers (Berka, 2020).
- Flutter produces weighty applications.

#### 11.2.2 Unity

Unity is a great platform used for dealing with 3D models. 3D modelling is the process of digitalizing a real word or fictional object.

The watches are 3D objects rather than static and unity comes to the rescue to work on the 3D objects that imported.

#### 11.2.3 AR Core / Vuforia

Vuforia is a platform used for creating augmented reality application for mobiles. I used image tracking for creating 3D objects in the real world.

Using of 2D images has become old school. And it's not very interactive with the users. But however, using Vuforia we can create 3D objects in the real world. This increases the user experience and thus increasing business and traffic to the business.

#### 11.2.4 Firebase

Google launched Firebase in April 2012, which is a NoSQL online and mobile backend it created. Backend as a service (BaaS) is the category that Firebase belongs to. From The highly optimized features of Firebase distinguish it from all other databases (Firebase, 2018).

Firebase supports IOS, Android, C++, Unity, simple JavaScript, and more Web technologies such Angular, React, Ember, etc. Data are stored in JSON format in Firebase Database. Firebase Fire store is being used to power both the web and mobile application in this project.

### **Pros**

- The budget significantly reduces because firebase is free. There's additional cost only if the limits exceed.
- There's no need of SQL knowledge as firebase is a no SQL database. And because there's no SQL the data load and read is faster.
- Firebase Manages its database in real time. This makes the exchange of data fast.

## Cons

One of the main drawbacks of Firebase is it's not made for complex queries. This means it has limited capability of filtering user data. But during my use of Firebase, I have haven't still come to any complications yet.

### 11.2.5 Tools

- Android Studio - Android studio is the official IDE of android. Its purpose is to build fully functional commercial applications for free. Since my project is a mobile application based on android the best IDE to go for is Android Studio. The mobile application was fully developed by using Android Studio.
- Visual Studio Code – Visual studio is an IDE build by Microsoft. It provides all the function to build web applications with ease. The web application was developed in Visual Studio Code.

## 12. Method of Approach

### 12.1 Agile

In the project's planning, design, and development phases, an agile methodology was adopted and utilized. This methodology has the capacity to address a circumstance in a process that is adaptable and flexible. Instead of the lengthy, drawn-out release cycles of the once-popular Waterfall Model, the agile methodology features regular, short sprint release cycles (Stefancic, 2021).

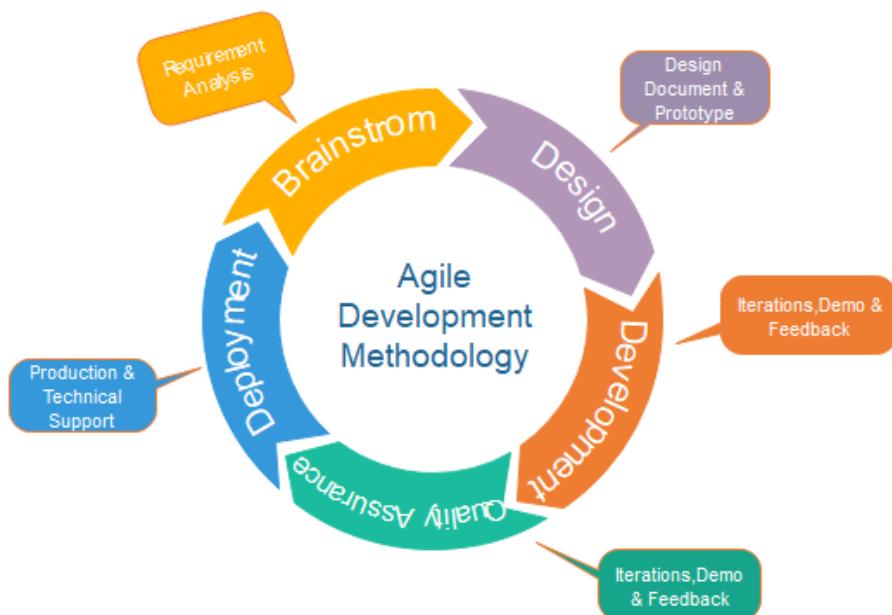


Figure 12.1 : Agile Development

(javapoint, n.d.).

Agile was superior to Waterfall for this project since it also facilitates development in small iterative increments. In contrast to the Waterfall Model, a complete stage is not handled as a single event, making it simple to alter the scope, add new features, and dare to improve. In agile, development is ongoing, as seen in Figure 12. It was essential to have such an approach because I had to work with new technologies and execute several prototypes and integrations.

## 12.2 Test Driven Development

Test-driven development (TDD) is a method for making software in which test cases for each feature are made and tested first. If a test fails, new code is written to pass the test, making the code simple and free of bugs. This enables the development of high-quality, maintainable code, and the TDD methodology offers long-term advantages that outweigh its disadvantages(Beck, n.d.). This method

enabled me to create an idea of what the code needed to accomplish while testing each capability before moving on to the next

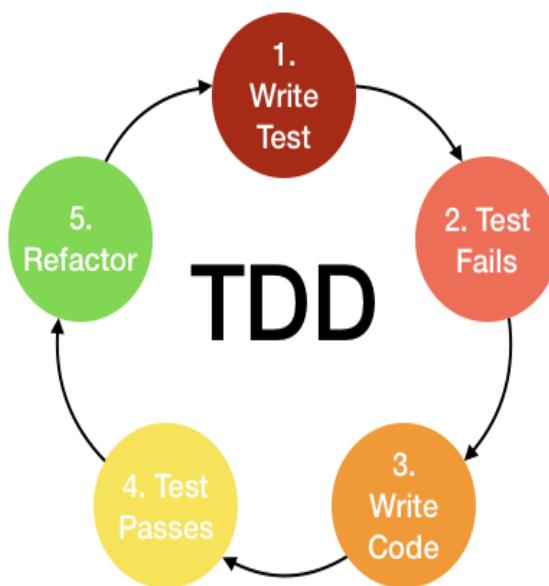


Figure 12.2 : Test Driven Development

## 13. Project Plan

The importance of a schedule in 6.1.1 shows the importance of a schedule. This is the current plan undertaken to accustomed to time management of project completion. The improvised schedule because of overlapping projects is

Stage	Deadline	Deliverables
Problem Identification	1/11/2021	Project Proposal
Initiation	17/11/2021	Project Initiation document (PID)
Further research and unit testing of functions.  Debugging and Maintenance.	15/2/2022	Requirement Progression
Instantiating Databases and checking platform viability.		
Implementing backend development.  Graphical User Interface continuation Based on HCI	1/3/2022	Interim report part 2
More testing.  Maintenance and debugging of the program.  Integrating AR.	1/3/2022	Interim report part 2 continuation
Adding more functionality  Testing of overall app.  Checking for bugs. Debugging sessions.	10/3/2022	
Correcting functionality.  Testing out the application with industry standards.	25/3/2022	Maintenance Report
Debugging & Error correction Final system testing	5/4/2022	Final System
Assembling the final report and project	18/5/2022	PRCO303 Report and system

Table 13.1 : Project Management & Schedule

\*The completed tasks are highlighted in Green

## 14. Risk Management

Risks manifested	Actions taken to mitigate
Creep Scope Certain plans have altered as a result of the shift in methods, offering me a new field to research while imposing time limits on me.	I adopted a pilot implementation strategy, using what I've previously done and tweaking it with a new area of study, all while doing sprints to evaluate my performance on projects. To track the time I have, I created a critical path with identified area.
Feature creep More features kept flooding the application and was wasting time on certain features	As previously said, I took a different approach to working on my major duties. Started to focus on the core components first.
Multiple project overlaps and deadlines	The final year of university brings a lot of challenges. Multiple courses works and exam is no easy task to manage together since every module is critical.

Table 14.1 : Risk Management

## 15. Testing

Testing is essential to the development of any project since it uncovers problems and errors that must be rectified prior to deployment. Testing the system thoroughly would assure its dependability, security, usability, and stability. I have employed a variety of testing techniques, bearing in mind the perspective of the user, to ensure that all functionalities meet the expected performance level.

### 15.1 Unit Test

Unit testing is the process of developing and automatically executing tests to check that your code performs the functions you intend it to. A unit is the smallest component of a system, and as discussed earlier, test-driven development (TDD) is performed during this phase when each unit is subjected to TDD. With unit tests, code refactoring is feasible. This, in turn, revolves around the Agile Method because, if any modifications were to be taken at this point, the agile method would permit it (Hamilton, 2022).

### 15.2. Functional Testing

This testing approach is based on the expected outcomes of the application being evaluated. Its performance is based on and evaluated against the standards and specifications. This ensures software quality by including failure routes and edge

situations in testing. After each sprint, these tests were conducted frequently to check that functionality are implemented as specified (Hamilton, 2022).

### 15.3 Functional Testing

Usability testing has a variety of objectives, including Identifying design flaws, Identifying potential for improvement, Learning about the preferences of target users.

Usability testing is the typical method for evaluating usability. Here, the users are tasked with performing a series of activities to evaluate the program. Users are urged to provide comments and verbalize their thoughts.

After completion, participants are prompted to an evaluation that inquiries about their experience. The information obtained from the entire survey was used to enhance usability further (Moran, 2019).

### 15.4 Usability Testing

Usability testing has a variety of objectives, including

- Identifying design flaws
- Identifying potential for improvement.
- Learning about the preferences of target users.

Usability testing is the typical method for evaluating usability. Here, the users are tasked with completing a series of activities to evaluate the software. Users are urged to provide comments and verbalize their thoughts.

After completion, participants are prompted to an evaluation that inquiries about their experience. The information obtained from the entire survey was used to enhance usability further (Moran, 2019).

## **16. End Project Report**

### **16.1 End project summary**

Overall, the project was successful because all major requirements were met on schedule.

The major objective was to develop an android and web application for the administrators.

The app's primary aims AR support, voice assistant A.I., and 3D model view are successfully implemented while covering the remainder of the program with all the required features for an ecommerce store with a user-friendly interface.

The web application has also achieved its objectives. Where administrators can check store statistics and administer the store.

### **16.2 Analysis of user requirements for mobile application**

In this section, user functionality was assessed, and information was taken from previously defined existing strategies. In addition, the research papers detailing the elements of a highly AR ecommerce store provided me with the knowledge necessary to execute the Ecommerce app.

### **16.3 Analysis of technologies to be used**

This objective was accomplished by conducting in-depth research in the initial phases on the most efficient development technologies. Cost, scalability, security, documentation, and other factors are addressed. The significance of this step exceeds that of the development phase.

### **16.4 Analysis of user interface**

In the initial phases of development, the HCI principles governing the creation of user-friendly interfaces were explored. The whole app is made based on consistent HCI principles.

### **16.5 Designing of the mobile and web application architecture**

System architecture was planned and examined prior to project development. The first firebase for data storage and operations was selected and settled upon. User and administrator were provided with an activity diagram depicting how the system should function. A use case diagram was created to comprehend how the system will be managed and to gain an understanding of the system.

To determine the flow of data through a system and external entities, a context diagram was created. The software system as a whole is displayed as a single process (Msc.IT , 2011).

## 16.6 Development process

Prior to settling on the required features, the priority was to establish the essential functions. According to a previously provided schedule plan, I ensured that the essential requirements were accomplished within the time allotted.

The majority of desired features were incorporated during the latter phases of the project development life cycle.

## 16.7 Technology change review

After the mobile application was completed, the development of a web application commenced. Initially, the web application was intended to be developed using flutter web. Flutter web was picked because to its similar syntax and ability to save development time. However, when it comes to web development, flutter was not developed enough to be employed. Thus, the modifications to web application technology are complete. And transitioned to React.

# 17. Project Post-Mortem

## 17.1 Evaluation of objectives

My fascination for VR (Virtual Reality), AR (Augmented Reality), MR (Mixed Reality), and the upcoming XR (Extended Reality) prompted me to design a relevant application. I am also interested in business, so I decided to merge my two passions by creating an augmented reality application for ecommerce. After then, it was a matter of locating the appropriate technology and determining the project's workflow.

This project's two primary components are the mobile application and the online application. The mobile application handles the augmented reality (AR) and ecommerce components, and the online application manages all of the data given to ecommerce and incoming information.

## 17.2 Evaluation of development process

To ensure that the project remained within its restrictions, an agile methodology was employed. However, because I was unfamiliar with the majority of the employed technology, it was incredibly challenging to create a comprehensive development timetable. In light of this, I set aside time to master the technologies to a specific degree before continuing with my development strategy, which provided me with the skills to create both applications. As stated previously, Agile is the best method for software development due to its adaptability. Any phase of the project could implement alterations to the requirements.

## 17.3 Evaluation of technologies

Flutter has to be replaced with React for the web technology. Even though flutter had excellent advantages for my project , it lacked the functionalities I required. Thus, the decision to switch with react was made. Because the final technologies picked were the correct ones, there were no serious challenges during the

development process. All employed technologies It was a straightforward decision to use Firebase as the database and data storage. Firebase offers an SDK for the Android, iOS, and React platforms. Enables the developer to have a database operational rapidly.

#### 17.4 Developer performance.

Throughout the duration of the project, I established personal deadlines with buffer zones in order to finish duties. Despite attempting to work more than 25 hours each week on the project, there were instances when I fell behind owing to other obligations. as there were parallel initiatives happening concurrently with the current one.

Due to my lack of expertise, there was concern at the beginning of my project that there would be limitations. However, because I enjoy learning about this subject, I used my passion to motivate me to study more and finish more. I spent my time researching and studying while implementing and scribbling down any essential paperwork. As a result, my knowledge base was expanded, and I was able to achieve my objectives.

### 18. Future Plans

- I intend to continue improving this application until it is ready for industrial use by conducting additional research. I intend to discover a way to merge the native app and the augmented reality capabilities in future development phases so that users do not have to download and install an additional AR package. In addition, I intend to create and expand additional features that utilize AR technology.
- Notifications alerting users to future sales and promotions. This would provide users with additional information about things for sale, and from an organizational standpoint, competitive advantage may be enhanced.
- Flutter is a cross-platform technology that allows Android and iOS users to download the application. However, launching on IOS requires additional refinement.
- Tweak the A.I to respond to more advanced commands.

## 19. Conclusion

Online retail is a massive industry. Numerous websites and mobile applications give a variety of features and activities that can only increase their consumer base. Throughout the process of learning and constructing an AR mobile application, I discovered that Augmented Reality is a technology with the potential to solve a variety of problems and that it is so prevalent in the modern world. In future mobile applications, Augmented Reality may become one of the system's primary components. This project's development process afforded me numerous opportunities to make mistakes and learn, as well as gain experience and knowledge in many areas I was previously ignorant about. This project's learning curve helped me enhance my expertise of Mobile App Development and project management. This information and experience will be useful in the future.

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## 21. Appendices

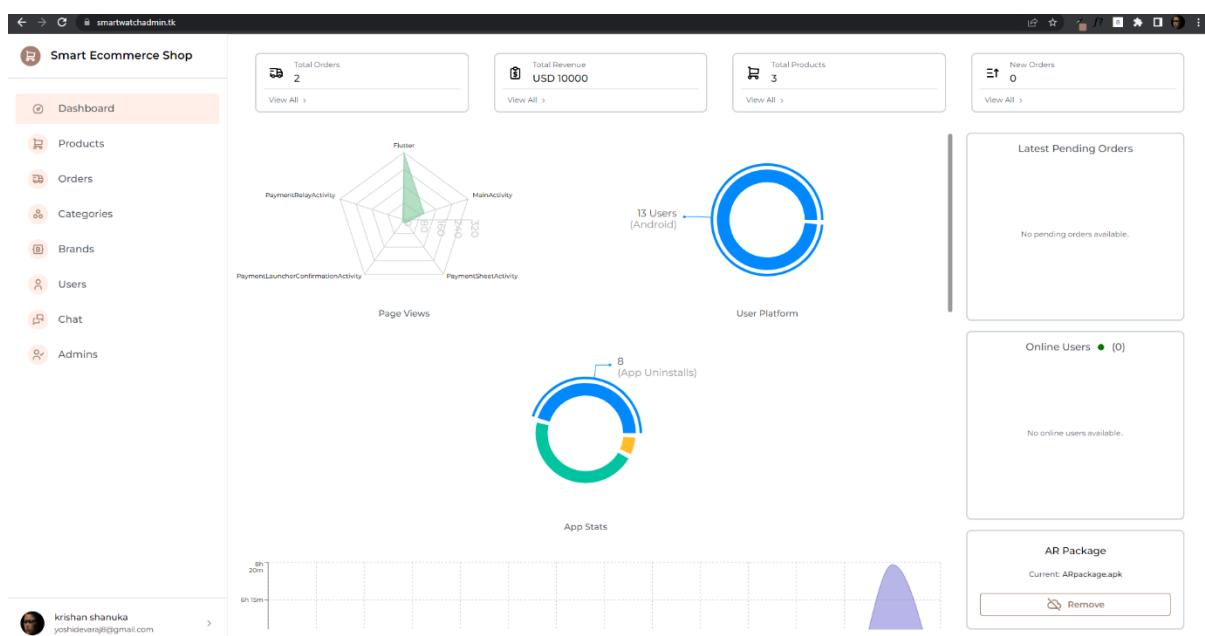
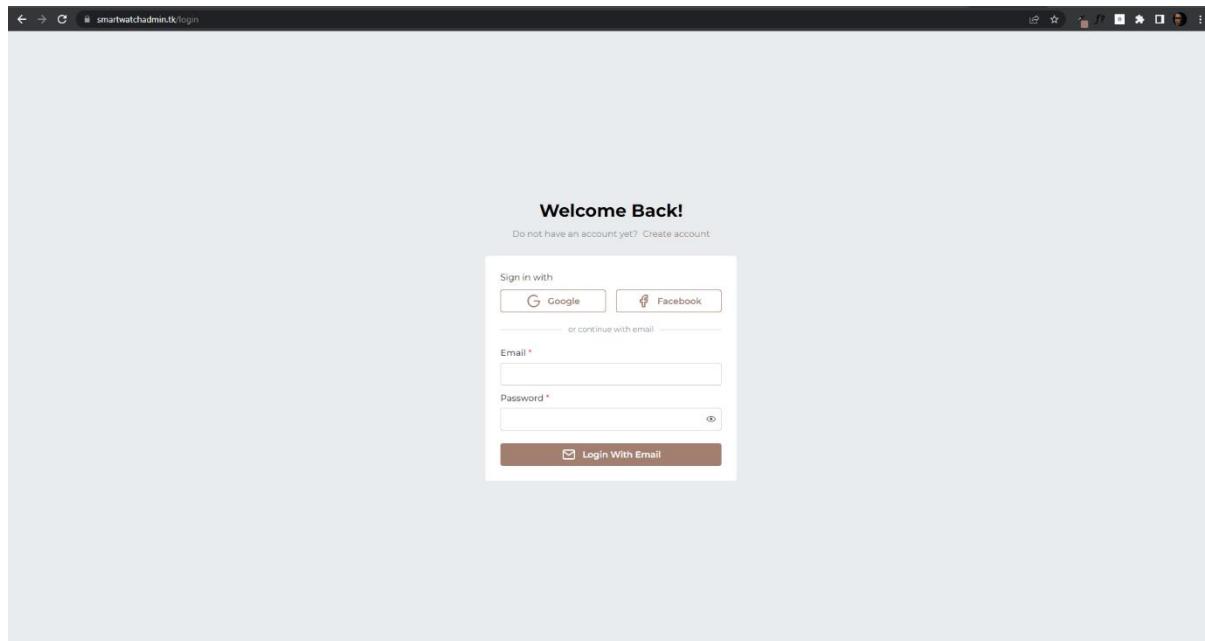
### 21.1 User Guide

To start using the admin panel go to

<https://smartwatchadmin.tk/login> and login with the following credentials

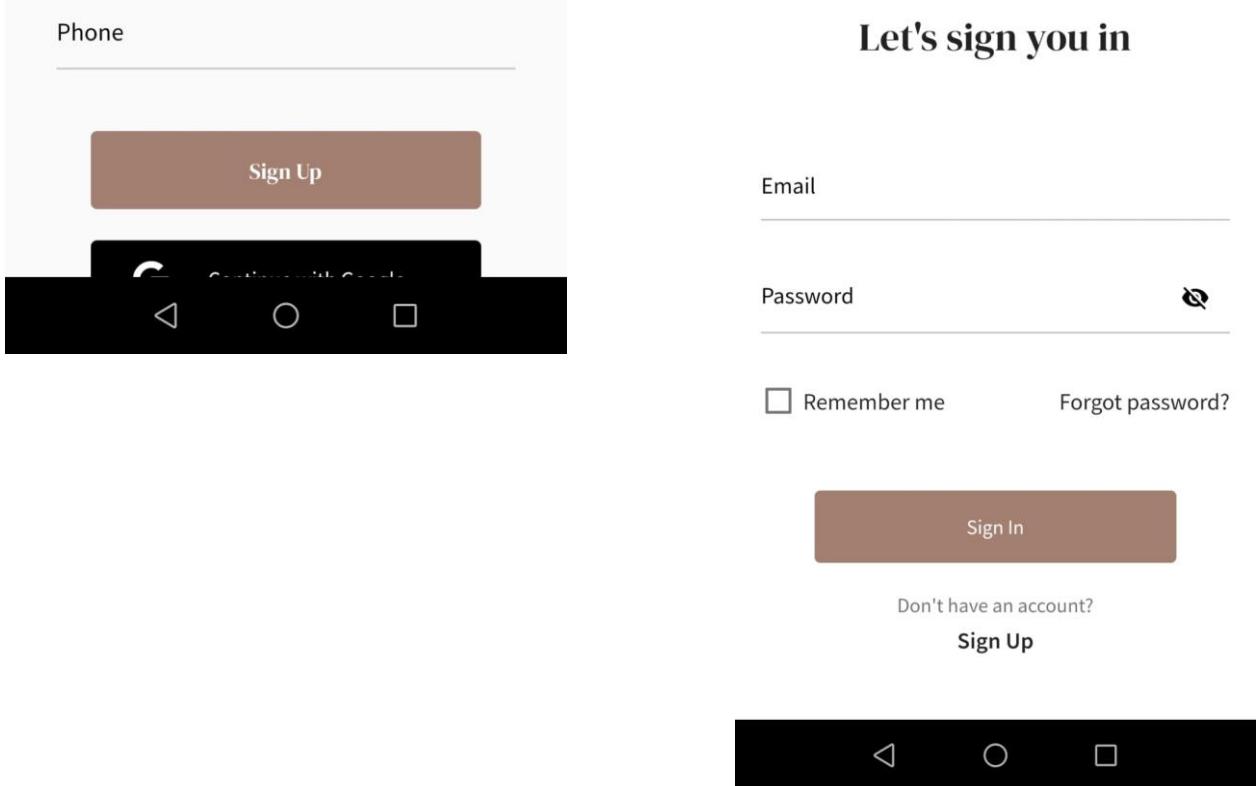
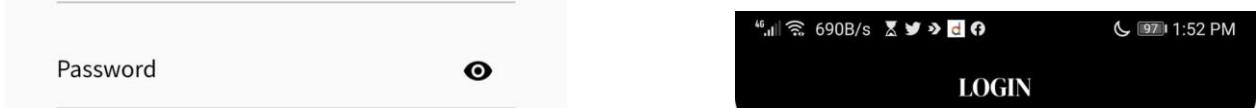
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password - peterpan1234

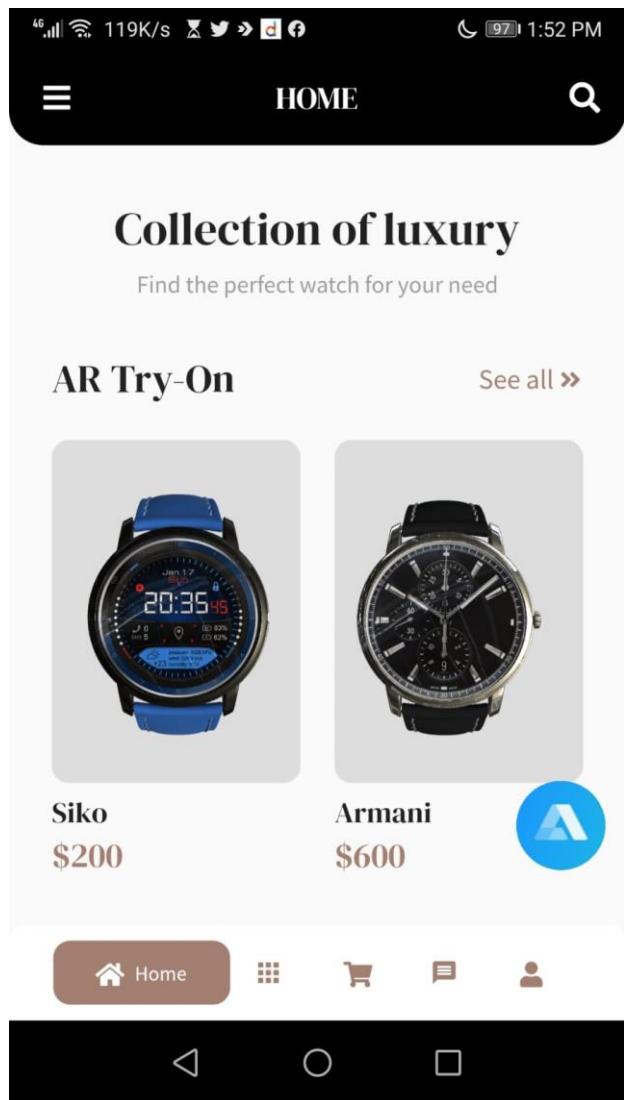




1. To start using the mobile app download the APK from the poster and install.
2. Sign up first.
3. Confirm email



4. Go to login screen and sign in with the registered credentials.



5. Start using the app.

## 21.2 Test Cases

### 21.2.1 Manual Testing

#### 21.2.1.1 Mobile app general test cases

Test Case	Test Description	Priority	Type-Negative / Positive	Prerequisites	Steps	Expected Results	Status
Register customer to system	Registers a user into the system with all the required details.	High	Positive	Requires user details.	1. Customer can sign up by opening the signup form in the application. 2. Enter all required fields and click on send authorization link to email.	Send an email to the registered email and display the customer a message to check the email.	Pass
Register admin to the system	Admins can register more admins to the system	High	Positive	Need to be logged into the system	1. In the Brower first go to the admin portal. 2. Sign in with admin credentials. 3. Go to profile. 4. Click on add admin. 5. Enter the required details and complete the regeneration.	Registers an admin to the system and later the registered admin can login to the system.	Pass

Login to system as a student	Students can use the credentials used to registered themselves in the system to login.	High	Positive	Need to be registered to the system	1. Open the mobile application. 2. Enter the email and password that's registered to the system. 3. Click on Enter	User should successfully be able to access the store.	Pass
Verify email	Verify if the email sent to the registered email is clicked on.	High	Positive	A customer first needs to enter registration details and press enter.	Follow test case "Register customer to system"	When the customer clicks on the email that's sent, the system gets notified and redirects the user to the store in the app.	Pass
Back to login	Verify if user is able to go to login from verify screen	High	Positive	A customer first needs to enter registration details and press enter.	Follow test case "Register customer to system"	Redirecting user from verify screen to login	Pass

Send verify email again	Test case to check if the verify email option is given to user again after 30 seconds	High	Positive	An email to confirm should be sent beforehand.	Follow test case “Register customer to system”	After 30 seconds, the Verify button should be activated again after sending a verification email.	Pass
Verify email error	Verify if the email sent to the registered email is clicked on.	High	Negative	A customer first needs to enter registration details and press enter.	Follow test case “Register customer to system”	When the email is not clicked after a minute, user is shown an email not verified error.	Pass
Login to the system as an admin	Admin can login to web portal by the credentials registered under their name.	High	Positive	Main admin first needs to register an admin to the system.	1. Open the Brower and launch the web application. 2. Enter the credentials given.	Access the admin controls.	Pass
Forgot password	If a user forgot their password, user is given the option to reset the password.	High	Positive	1. Needs to be registered to the system. 2. Needs to enter an email that's registered to the system	1. In the mobile application click on forgot password 2. Enter the email that's registered under a user's name	An email should be sent to the user containing the reset link.	Pass

					3. Click on send		
Update profile picture	Checks if the details updated by the user is affected in the database.	High	Positive	1. Needs to be logged in.	1. Log into the system. 2. Go to Profile section. 3. Options to change profile details are shown.	1. When user clicks on profile picture system should allow user to add a profile picture from gallery or camera and change the profile picture accordingly	Pass
Update login credentials.	Check If the updated credentials are reflected in the database	High	Positive	1. Need to be logged in	1. Log into the system. 2. Go to Profile section. 3. Options to change profile details are shown.	Password should be changed in the database and user will be shown a success message	Pass
User enters invalid credentials for login	Check If the user entered credential are valid.	High	Negative		1. Open the application assigned to designated role. 2. Enter credentials. 3. Press on login.	An error message will be shown to the user with respective to the error the user caused.	Pass
User leaves required fields empty in text fields.	Verify if the user has entered all required fields	High	Negative		Applies to all app text fields.	Display error message showing all required fields	Pass

Incorrect old password when updating password	A test to check the result of entering invalid old password	High	Negative	User needs to be logged in	1. Login to system. 2. Go to profile section. 3. Go to password manager. 4. Enter credentials.	Display user with invalid old password error.	Pass
Logout	A test to check if the user can logout of the store and the authentication token is destroyed	High	Negative	User needs to be logged in	1. Go to system and click on the hamburger icon and press logout	The user should be taken to the login page.	Pass

Table 14.1 : General Test Cases for both Web & Mobile

Test Case	Test Description	Priority	Type-Negative / Positive	Prerequisites	Steps	Expected Results	Status
View products	Check if all the products are correctly being fetched from the database	High	Positive	Users need to log in.	Login to the system.	1. All the products cards should be fetched with all the details for a specific product.  2. All the featured products should be separated and shown in a different section.	Pass

View Categories	To check if the system retrieves all categories and all products fall under their respective category.	High	Positive	User needs to login.	1.Login to the system 2.Navigate to categories from the home screen	1. Display all the categories. 2.Display products respective to their categories when clicked upon.	Pass
No products fetched	To check if user friendly error is displayed when products are not fetched properly	High	Negative	User needs to login.	Login to the system	1. Display loading skeleton till products are being fetched.  2. If no products are fetched display text message products are not available.	Pass
Product details	To check if each product details are displayed when the product card is clicked on.	High	Positive	1. User needs to login.  2. Product needs to exist in the store	1. Login to system.  2. Tap on a product card from home screen.	1. All the details related to the product should be displayed from the database.	Pass
Save Product	To check if the product user saves work exactly intended to.	High	Positive	1. User needs to login  2. Product needs to exist in the store.	1. Login to system.  2. Tap on a product card from home screen.  3. Tap on the bookmark icon to	1. The product should be saved to the database using the identity of the user.  2. The favourite icon of the product the user saved	Pass

					save product	should turn into the primary colour of the app	
Add to cart	To check if the product gets added to the cart list.	High	Positive	1. User needs to login  2. Product needs to exist in the store.	1. Login to system.  2. Tap on a product card from home screen.  3. Tap on the add to cart.	1. The respective product with the product details should be added to the cart list.  2. Display success message to user  3. If the same product is added more than twice, then it should update the quantity and keep the product in the cart the same.  4. Display updated message if the same product is added more than twice  5. If either product is added to cart or product is updated, the message should give user an option of either	Pass

						continuing shopping or go to cart.	
Delete cart item	Verify if user is able to delete cart item.	High	Positive	1. User needs to login.  2. A product should be added to the cart.	1. Login to system.  2. Go to cart through bottom navigation.  3. Slide left on the product.	Delete product from cart.	Pass
Update Cart Icon.	To check if the cart icon is updated throughout the store when a product is added to cart.	High	Positive	1. User needs to login  2. Product needs to exist in the store.	1. Login to system.  2. Tap on a product card from home screen.  3. Tap on the add to cart.	1. The shopping cart icon should update with the number of products available in the cart.  2. Cart shouldn't raise the count when two or more of the same products is available in the cart.	Pass
Navigate back to previous screen.	When the app bar back button is clicked, see if the user is routed to	High	Positive	1. User needs to login  2. Product needs to exist in the store.	1. Login to system.  2. Navigate to any	Navigate the user to the previous screen	Pass

	the previous screen.				new screen 3. Tap on the back arrow located in the app bar.		
Search product	Verify if the searched product is shown to the user	High	Positive	1. User needs to login	1. Login to system. 2. Click on the search bar in the home screen.	When the first letter of the product name is typed into the search bar, system should show the corresponding products.	Pass
App Drawer	Verify if the app drawer opens when the hamburger icon is clicked on	High	Positive	1. User needs to login	1. Login to system. 2. Click on the hamburger icon in the home screen.	The app drawer should open up with the options to sign out and option to check all saved products	Pass
Bottom navigation bar	To check if the screen state changes when the bottom navigation item is clicked.	High	Positive	1. User needs to login	1. Login to system. 2. Click on the bottom navigation item.	The screen needs to change according to what navigation item the user clicked.	Pass
Added to cart popup	Verify if a pop up appears with two navigation buttons when a product is added to cart	High	Positive	1. User needs to login	1. Login to system. 2. Click on a product. 3. Press on add to cart button.	Pop up should appear with two buttons. One button to go to cart screen and one to continue shopping.	Pass
Display cart Items	Check if the products that's added to cart is	High	Positive	1. User needs to login	1. Login to system.	1. Display all products the user added to basket	Pass

	shown in the cart screen			2. User needs to add a product to cart.	2. Click on a product. 3. Press on add to cart button and click on go to cart in the popup.	while shopping. 2. Product should contain the name, price and how many items of the same is added.	
Add address	To verify if user can add an address	High	Positive	1. User needs to login.	1. Login to system. 2. Click on a product. 3. Press on add to cart button and click on go to cart in the popup. 4. from cart click checkout	User should be able to add an address and save it.	Pass
Fetch address	To verify if users saved address is displayed in the address screen	High	Positive	1. User needs to login.	1. Login to system. 2. Click on a product. 3. Press on add to cart button and click on go to cart in the popup. 4. From cart click checkout	Display users address from database.	Pass
Update address	To check if user can successfully update an	High	Pass	1. User needs to login.	1. Login to system.	User can click on the update icon which will open up all	Pass

	existing address				<p>2. Click on a product.</p> <p>3. Press on add to cart button and click on go to cart in the popup.</p> <p>4. From cart click checkout</p> <p>5. Click on update icon</p>	<p>the address details.</p> <p>The updated changes should reflect throughout the app.</p>	
Delete address	To check if user can delete existing address	High	Positive	1. User needs to login.	<p>1. Login to system.</p> <p>2. Click on a product.</p> <p>3. Press on add to cart button and click on go to cart in the popup.</p> <p>4. From cart click checkout</p> <p>5. Click on the delete icon.</p>	<p>When user deletes existing address, the system should immediately open up the address fill up form.</p>	Pass

Display Order details.	Verify if the user can see their address, personal details, and ordered products.	High	Positive	1. User needs to login.	1. Login to system. 2. Click on a product. 3. Press on add to cart button and click on go to cart in the popup. 4. From cart click checkout 5. Click on next after adding an address.	Should be able to see all the information. The user can confirm if the details are accurate.	Pass.
Display Payment sheet.	Verify if the payment sheet is popped up when the “place order” button is pressed.	High	Positive	1. User needs to login.	1. Login to system. 2. Click on a product. 3. Press on add to cart button and click on go to cart in the popup. 4. From cart click checkout 5. Click on next after adding an address. 6. In order details screen click on place order.	User should be displayed with a payment modal.	Pass

Payment Success.	To check when payment is success the order details are sent to the admin.	High	Positive	1. User needs to login.	1. Login to system. 2. Click on a product. 3. Press on add to cart button and click on go to cart in the popup. 4. From cart click checkout 5. Click on next after adding an address. 6. In order details screen click on place order.	1. Send order data to admin, then return the user to the home screen and display a success message.  2. The cart should be cleared when the order is successful.	Pass
Payment error.	To verify is appropriate message is shown to user when payment error occurs.	High	Negative	1. User needs to login.	Follow previous row instruction	Display error message when invalid cards are used.	Pass.
Display all products	To verify all non-AR products are displayed in one place.	High	Positive	User needs to be logged in.	1. Login to app.  2. click on products in the bottom nav bar item	Should fetch all products and display in one place.	Pass

See all buttons.	Check if user is redirect to all products	High	Positive	User needs to be logged in.	1. Login to app. 2. Click see all from login screen	Redirect user to all products.	Pass
Cart no product message	Check if the appropriate message is displayed when cart is empty	Medium	Negative	User needs to be logged in.	1. Login to app. 2. Navigate to cart screen	Display error message in cart screen if cart is empty.	Pass
Hide checkout button when cart is empty.	Verify if checkout button disappears when cart items are 0	High	Positive	1. User needs to be logged in		Checkout button should be invisible when cart items are 0, and visible again when cart has an item.	Pass

Customer side chat	Check if the customer can communicate with the store owner effortlessly.	High	Positive	1. User needs to be logged in. 2. Authorization token.	1. Login to app. 2. Navigate to chat screen. 3. Click chat button.	1. Should redirect to the chat screen where customer can chat with the store owner. 2. If there's previous message with the store owner, the messages should be loaded.	Pass
Customer side send picture to admin.	Verify if the user can upload pictures.	High	Positive	1. User needs to be logged in. 2. Authorization token.	1. Login to app. 2. Navigate to chat screen. 3. Click chat button. 4. Click on the file icon in the chat bar.	Should open the customers gallery or file manager where user can upload a file.	Pass
Profile screen	Verify is the user information is loaded properly.	High	Positive	1. User needs to be logged in.	1. Login to app. 2. Navigate to profile screen from bottom navigation.	1. Display user information. 2. Display all the options under profile screen.	Pass

Change profile picture.	Verify if user is able to change profile picture successfully	High	Positive	1. User needs to be logged in.	1. Login to app. 2. Navigate to profile screen from bottom navigation. 3. Click on the camera icon in profile	1. Should give the option of picking a picture from gallery or taking a picture.  2. When user selects a profile picture the changes should apply after a refresh.	Pass
Password Manager	Verify if user is able to change password.	High	Positive	1. User needs to be logged in.  2. User needs to enter old password again.	1. Login to app.  2. Navigate to profile screen from bottom navigation.  3. Tap on password manager.  4. Enter credentials and press change password .	1. User must be able to change current password and login again with new password.  2. When password is changed, user should be logged out and destroy current authentication token.  3. Show success message.	Pass
Show user address.	Verify if user address can be fetched and managed.	High	Positive	1. User needs to be logged in.	1. Login to app.  2. Navigate to profile screen from bottom navigation.  3. Tap on my addresses.	Display the current saved password.  Give option to edit address.	Pass

Display order history.	Verify if user can see past orders and tracking details.	High	Positive	1. User needs to be logged in. 2. User needs to make a purchase.	1. Login to app. 2. Navigate to profile screen from bottom navigation. 3. Tap on my orders.	Display the order ID, order date, total amount paid, tracking data, and further information about the purchase.	Pass
Display Order details.	Check to see if the user can see live tracking, bought items, and the personal information needed to make the purchase.	High	Positive	1. User needs to be logged in. 2. User needs to make a purchase.	1. Login to app. 2. Navigate to profile screen from bottom navigation. 3. Tap on my orders. 4. Tap on view more details.	Show the consumer the live order data as well as the purchased goods.	Pass
Display Articles.	Display watch articles.	Low	Positive	1. User needs to be logged in.	1. Login to app. 2. Navigate to profile screen from bottom navigation. 3. Tap on articles.	Display articles to user.	Pass

Display AR marker and download marker	Verify AR marker is displayed to user and marker downloads on button press.	High	Positive	1. User needs to be logged in.	1. Login to app. 2. Navigate to profile screen from bottom navigation. 3. Tap on AR marker. 4. Tap download button.	The AR marker's PDF should be downloaded, and the user should be able to open it in pdf view.	Pass
Download progress indicator for downloads	When a download is initiated, check to see if the user is presented a download progress indication.	High	Positive	1. User needs to be logged in. 2. User needs to make a download.	1. Login to app. 2. Navigate to profile screen from bottom navigation. 3. Tap on a download button. 4. Tap download button.	Show the consumer a download progress circular indicator.	Pass
Wish List	Check to determine whether the user can view saved products.	High	Positive	1. User needs to be logged in. 2. User needs to save a product.	1. Login to app. 2. From home screen click on hamburger icon. 3. click on Wishlist	Display all saved products.	Pass

No saved products message	Check is "No saved products " is displayed when no products are found.	Low	Negative	1. User needs to be logged in.	1. Login to app. 2. From home screen click on hamburger icon. 3. click on Wishlist	Display error message to user.	Pass
Sign out	Verify is user is able to logout	High	Positive .	1. User needs to be logged in.	1. Login to app. 2. From home screen click on hamburger icon. 3. click on logout.	Destroy auth token and redirect user to login screen.	Pass

## 21.2.2 AR augmentation test cases

Test Case	Test Description	Priority	Type-Negative / Positive	Prerequisite	Steps	Expected Results	Status
Open AR	Verify if the AR package opens	High	Positive	1. Login to system 2. Require downloading the AR package	1. Login to system. 2. Click on an AR product 3. Click on the AR icon	Opens AR package camera.	Pass
Download AR package	Verify if the AR package can be downloaded	High	Positive	1. Login to system	1. Login to system. 2. Click on an AR product 3. Click on the AR icon	Download AR package if not downloaded .	Pass
Download package exists in app	Verify if unnecessary downloadin g is done when the package already exists.	High	Positive	1. Login to system 2. AR package should exist in the mobile app.	1. Login to system. 2. Click on an AR product 3. Click on the AR icon	If the AR package doesn't exist in the mobile, the package starts downloadin g. If package exists, the package is opened.	Pass
AR download progress indicator.	Verify is user is shown progress indicator when package is downloadin g	High	Positive	1. Login to system	Follow previous steps	Show a progress indicator based on download percentage.	Pass

AR button Disabled	Check if AR button is disabled for non-AR products	High	Positive	1. Login to system	1. Login to system. 2. Click on a non-AR product	Button should be disabled.	Pass
AR augmentation	Verify if watch augments on the user wrist.	High	Positive	1. Login to system 2. AR package should be downloaded	1. Login to system 2. Click go to an AR product 3. Click on AR button.	AR watch should be augmented to the user's wrist.	Pass
Switch between watches.	Verify if the user can switch between AR products.	High	Positive	1. Login to system 2. AR package should be downloaded	1. Login to system 2. Click go to an AR product 3. Click on AR button. 4. Click on another watch in the AR package	The selected AR watch should be augmented to the user's wrist.  2. The watch that's augmented should be shown to the user with the product details.	Pass

Change the colour of watch components .	Verify if user is able to change component of a watch	High	Positive	1. Login to system 2. AR package should be downloaded	1. Login to system 2. Click go to an AR product 3. Click on AR button. 4. Click on another watch in the AR package 5. Click on the watch's colour button.	When a user clicks a watch's colour button, the specified component's colour should change.	Pass
Watch close button	Determine if the watch's dismiss button closes the watch panel.	High	Positive	1. Login to system 2. AR package should be downloaded	1. Login to system 2. Click go to an AR product 3. Click on AR button. 4. Click on another watch in the AR package 5. Click on x button in the watch panel	The watch panel should collapse and display the additional augmentable watches.	Pass

Go back to app	Determine if the user is redirected to the ecommerce store.	High	Pass	1. Login to system 2. AR package should be downloaded	In the AR package click on the close button	Should go back to the store.	Pass
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### 21.2.3 A.I voice command test cases

Test Case	Test Description	Priority	Type-Negative / Positive	Prerequisite	Steps	Expected Results	Status
Voice command to activate voice command	Verify if the voice command replies to the command	High	Positive	Login to store.	Press of the A.I button.  Say "Hi, Alan".	Should reply with appropriate greetings	Pass
Voice command to check total	Verify if the voice command replies to the command	High	Positive	Login to store	Press of the A.I button.  Say "what's my total".	1. Should reply with total amount for the items in the cart.  2. Voice response given to user giving confirmation	Pass
Voice command to navigate to cart screen	Verify if the command given works.	High	Positive	Login to store.	Press of the A.I button.  Say "go to cart screen".	1. Should navigate to the cart screen.  2. Voice response giving confirmation	Pass

Voice command to add product to cart.	Verify if the command given works.	High	Positive	Login to store.	Press of the A.I button.  Say name of the product that needs to be added to cart along with "add to cart".	1. Should add the item to the cart.  2. voice reply asking if another product needs to be added	Pass
Voice command to checkout	Verify if the give command works	High	Positive	Login to store	Press of the A.I button.  Say "checkout"	1. Should navigate to the checkout screen.  2. Voice response giving confirmation .	Pass
Voice response given to the user after adding a product	Verify if user if the correct response is given	High	Positive	Login to store	Press of the A.I button.  Say " no, show me my shopping cart"	Should navigate to cart screen.	Pass
Voice response given to the user after adding a product	Verify if user if the correct response is given	High	Positive	Login to store	Press of the A.I button.  Say " yes"	Should tell the user to follow the command used earlier	Pass
Voice response when cart is empty and want to checkout	Verify if the user is noted that cart is empty	High	Negative	Login to store	Press of the A.I button.  Command A.I to navigate to checkout	If the store is empty. And wants to checkout A.I should stop the redirection and reply to the user with appropriate error message.	Pass

Voice response when cart is empty and want to know total	Verify if the total doesn't give invalid responses when there's empty cart	High	Negative	Login to store	Press of the A.I button. Command A.I and ask for "what's my total"	Should respond with 0 if cart is empty.	Pass
Voice response when navigate d to the checkout	Verify is the appropriate voice command is said.	High	Positive	Login to store	Press of the A.I button. Command the A.I to checkout.	Ask the user if they want to continue with current address or edit address.	Pass
Voice command to continue with same shipping address	Verify if the user is navigated to the order details screen with the saved shipping address	High	Positive	Login to store	Press of the A.I button. Command the A.I to continue with the same address	Navigates user to the order detail screen where all the details can be seen before paying.	Pass
Voice command to edit shipping address.	Verify if the user is navigated to the edit shipping address screen	High	Positive	Login to store	Press of the A.I button. Command A.I to edit shipping address	Should go to shipping edit screen.	Pass
Voice command to show all leather watches	Verify if all leather watches are shown to user	High	Positive	Login to store	Press A.I button. Command A.I to show all leather watches.	A.I should show all leather watches to user	Pass

#### 21.2.4 Web application

Test Case	Test Description	Priority	Type-Negative / Positive	Prerequisites	Steps	Expected Results	Status
Navigation to pages	Verify if user can navigate between pages	High	Positive	Login to admin panel	1. Login to admin panel. 2. Press on a tab	Open the page responsible for that specific tab	Pass
Page's view analytics in dashboard	Verify if payment activities are / main activities are shown to admin	High	Positive	Login to admin panel	Go to dashboard	Display how many times customer has viewed the main screen and payment screens.	Pass
User platform analytics in dashboard	Verify customers device OS is shown.	High	Positive	Login to admin panel	Go to dashboard	Display total number of android or IOS users.	Pass
Display total number of uninstalls, installs, data cleared analytics in dashboard	Verify if total number of uninstalls, installs, data cleared analytics in dashboard is displayed accurately	High	Positive	Login to admin panel	Go to dashboard.	Display total app installs, app uninstalls, all data cleared	Pass
Display total number of orders card in dashboard.	Verify if total number of orders is displayed.	Medium	Positive	Login to admin panel	Go to dashboard	Display total numbers of orders made by all the users.	Pass
Display total revenue card	Verify if the total revenue of the ecommerce business is displayed	High	Positive	Login to admin panel	Go to dashboard	Display total revenue calculated the store has made	Pass

Display new orders	Verify if total new orders are shown	High	Positive	Login to admin panel	Go to dashboard	Display total new orders.	Pass
Display user engagement analytics	Verify if total user engagement is displayed for the day.	High	Positive	Login to admin panel	Go to dashboard	Display total engagement time by users	Pass
Display total users' analytics	Verify if the total users registered on a specific date are displayed	High	Positive	Login to admin panel	Go to dashboard	Display new registered customers on a given day	Pass
Display total revenue made in a day	Verify if the revenue made for the day is displayed.	High	Positive	Login to admin panel	Go to dashboard	Display revenue made in a day	Pass
Display users' countries	Show the number of active users from based on countries	High	Positive	Login to admin panel	Go to dashboard	In the world map, show the countries where the users are from.	Pass
Filter revenue graph by months, days, and years	Verify if the filtering works.	High	Positive	Login to admin panel	Go to dashboard	Graph data should change based on the selected month, year, or day	Pass
Display latest orders in dashboard	Verify if the latest orders are displayed in dashboard	High	Positive	Login to admin panel	Go to dashboard	Display latest orders with username and order ID	Pass

AR package upload	Verify if the admin can upload the AR package.	High	Positive	Login to admin panel	1. Go to dashboard 2. Click on AR package upload	Admin should be able to upload AR package	Pass
AR package limit	Verify if only one AR package to be added by the administrator.	High	Positive	Login to admin panel	1. Go to dashboard 2. drop package or tap on click to upload	Admin shouldn't be able to upload more than one package	Pass
Remove AR package	Verify if the admin can remove the AR package	High	Positive	Login to admin panel	1. Go to dashboard 2. Click on AR package. 3. Click on remove package	Allow admin to remove AR package	Pass
Display products	Verify if admin is able to see all products added	High	Positive	Login to admin panel	1. Login to admin panel. 2. Go to products.	Display all products	Pass
Add new product	Verify if the admin is able to add a new product	High	Positive	Login to admin panel	1. Login to admin panel. 2. Click on add product.	Admin should be able to add a new product.	Pass

Add product multiple images	Verify if the admin can add multiple images	High	Positive	Login to admin panel	1. Login to admin panel. 2. Go to products. 3. Click on add product. 4. Click on add images.	Admin should be able to add an image.	Pass
Required field error	Verify fields are validated	High	Positive	Login to admin panel	1. Login to admin panel. 2. Go to products. 3. Click on add product.	Admin shouldn't be able to add a product without the required fields	Pass
Set product as featured	Verify if the admin can set a product as featured	High	Positive	Login to admin panel	1. Login to admin panel. 2. Go to products. 3. Click on add product	Admin should be able to set a product to be featured in the store	Pass
Search product in the store	Verify if the admin can search a product by name	High	Positive	Login to admin panel	1. Login to admin panel. 2. Go to products. 3. Click on search icon	Admin should be able to search a product from the list of products	Pass
Edit product	Verify if the admin can edit the product details	High	Positive	Login to admin panel	1. Login to admin panel. 2. Go to products. 3. Click on the edit icon	Admin should be abled to edit an existing product	Pass

Delete product	Verify if the admin can delete a product	High	Positive	1. login to admin panel	1. Login to admin panel. 2. Go to products. 3. Click on the delete icon.	Admin should be able to delete a product	Pass
Display orders	Verify if the admin is able to view all orders with order details	High	Positive	1. Login to admin panel.	1. Login to admin panel. 2. Go to orders	Display all orders in the store.	Pass
Display order items based on delivery status	Verify if the admin can view orders based on delivery status	High	Positive	1. login to admin panel	1. Login to admin panel 2. Go to orders. 3. click on filter by delivery status	Display orders based on the selected filter	Pass
Search order	Verify if the admin can search order based on order ID	High	Positive	1. Login to admin panel	1. Login to admin panel. 2. Go to orders 3. Click on search	Display an item based on order ID	Pass
Order details	Verify if the user can view specific order	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Go to orders 3. click on an order	Display order details, user details and address.	Pass

Order tracking	Verify if the admin can change the tracking order	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Go to orders 3. click on an order	Admin should be able to accept an order and changing order status	Pass
Display users	Verify if all the user's registered users are listed	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Go to Users	Admin should be able to view all registered users	Pass
View details arrow button	Verify if the button click takes to the respective screen details screen	High	Positive	1. Login to admin panel	1. Login to admin panel 2.Click on any arrow button in the admin panel	Admin should be able to view details of a specific item, user, or order clicked on	Pass
View user details	Verify if the admin can view users' past orders and user details	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Click on a user from the user list	Admin should be able to view user details and long with past orders	Pass
View customer favourited items	Verify if the admin can see favourite products	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Click on a user from the user list	Specific users' favourite should be displayed	Pass
Chat	Verify if the admin can view all chats from customers and able to communicate with them	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Go to chat section	1. Customers message must be shown to admin 2 . Admin should be able to communicate	Pass

						e with customer	
Super admin should only be able to see admins	Verify if only super admins can view admins	High	Positive	1. Login to admin panel	1. Login to admin panel 2. Click on admin tab	1. Only super admins should be able to view admins. 2. Normal admins should be able to access this panel	Pass
Add admin	Verify if the super admin can add admins	High	Positive	1. Login to admin panel 2. Super admin access.	1. Login to admin panel 2. Click on admin tab 3. Click on new admin	Only super admin should be able to add admins.	Pass
Super admin ability to change an admin to super admin	Verify if the admin can make an existing admin a super admin	High	Positive	1. Login to admin panel 2. Super admin access	1. Login to admin panel 2. Click on admin tab 3. Click on make an admin super admin	Super admins should be able to mark a basic admin to a super admin	Pass
Super admin should be able to delete any admin	Verify if the super admin can delete an admin	High	Positive	1. Login to admin panel 2. Have super admin access	1. Login to admin panel 2. Click on admin tab 3. Click on delete button	Super admins should be able to delete an admin.	Pass

Super admins edit admin password	Verify if the super admin can change password	High	Positive	1. Login to admin panel 2. Have super admin access	1. Login to admin panel 2. Click on admin tab 3. Click on edit button	Super admins should be able to edit an admin.	Pass
Only registered email addresses are verified by Google sign in.	Verify if the admins can use google sign in	High	Positive	Account needs to be registered to system	1. go to the admin panel. 2. click on google sign up	Admins should be able to use google sign up if the admin email is registered to the system	Pass
Unregistered google account sign in	Verify if access is denied to unknown google accounts.	High	Negative		1. go to the admin panel 2. Click on google sign in	Display an error message if authentication fails	Pass
Add category	Verify if the admin can add a category	High	Positive	Login to admin panel	1. click on categories tab. 2. Click on add category 3. Enter the relevant details.	Admin should be able to add category	Pass
Add Brands	Verify if the admin can add a brand	High	Positive	Login to admin panel	1. click on categories tab. 2. Click on add brands 3. Enter the relevant details.	Admin should be able to add brands	Pass

Display online status of user	Check to see whether the user's online status changes to green.	High	Positive	Login to admin panel	Admin can see user status from all users and dashboard	Admin should be able to online status of users who are online	Pass
Display total online users	Check whether the total online user count is displayed to admin	High	Positive	Login to admin panel	Display admin total online count	Admin should be able to see total number of online users	Pass

## 21.3 Project Proposal

# **Augmented Reality Watch Ecommerce Store with A.I Mobile Application**

## **Proposer**

Sadees Kumar Krishan shanuka (10707370)

## **Old Proposed Supervisor**

Mr. Shafraz Mohomed

## **New Proposed Supervisor**

Mr. Pramudya Thilakaratne

## **Problem statement**

When covid started almost everything became an online world. But real-life ecommerce stores suffered because normally customers come in and try their product, especially if it's a watch, shoe, or anything that's expensive. Not only does this application help during covid but it helps the customers to have an amazing experience using the App. As normal watch stores you can't try on the watches when you buy online. The beauty in AR is we can bring almost anything to life with the correct parameters.

## **Project description**

The Proposal I came up for my final year project is an online Augmented Reality Watch Ecommerce Store With A.I Mobile

Application . With this application customers don't have to doubt how the watch looks in their hand and the customer doesn't have to visit the shop. The customer can use the application to try on the watch and order then and there itself. The application has the following features to make the app a great application.

- The user is welcomed to a splash screen to help them with the app
- The user's information is collected from name to mobile number and an OTP is sent to check if the details belong to that specific user.
- The user is redirected to the marker download page where he can download the marker to his phone or print it if they wish to, this can be done anytime they want.
- The user is greeted in the home screen after that where he is shown different watches with different brands.
- When a watch is clicked upon a 3d model of the watch is shown where he can see it in every direction along with the details
- When the user clicks on the try-on button it will open the camera and fit the watch on their hand.
- The whole app can be controlled by voice command to make it compatible with every kind of user. This is done by A.I

- The user can add the item to the cart and his location will be asked (google maps will be used here to make it easier)
- The admin section where you can add the watch models
- A chat system will be integrated to communicate with the user.

Main New Features that are in the system

- Augmented Reality 360 view
- A.I controlled app
- User friendly chat bot (pending)

## **Project keywords**

Ecommerce, Augmented Reality, A.I, Flutter, Android

## **Requirements**

Need to acquire knowledge of how to implement the A.I voice command and properly learn to implement AR

## **Finance**

Cost less than \$300

## **External organizations**

No

## **Other staff**

No

## 21.4 Project Initiation Document (PID)

### 1. Introduction

#### 1.1. About Us

Currently- diving into the minor details, Sri Lanka is continuing to gain common ground in terms of keeping up with the global digital era's requirements. Closely examining this context which is in reference to 'Augmented Reality' (AR) is still in its infancy, slowly but steadily making its way into today's governing sectors. Whether it's about internet e-commerce or face-to-face interactions, AR has successfully constructed a name for itself around the world such as AR-based snapchat filters, AR based learning. The project I proposed as an undergraduate is to comprehensively acute with the AR technology and merge it with an online watch e-commerce store (Mileva, 2020).

#### 1.2. Introduction

In the modern world as we observe closely we seem to take notice of the fact that a lot of people go the mall to try on watches and purchase them but why do they do this? One of the reasons is because they prefer to have a direct contact and therefore purchase with the watch they desire to buy. Hence to briefly explain they prefer to see how it looks on their wrist beforehand. When e-commerce shopping bloomed many started to buy product's online, but the major downfall was that users couldn't try on a product they liked. Users solely depended on the reviews of the product and the static picture that was uploaded. An e-commerce store is said to be successful when it has a 2% conversion rate for every 5000 visits, but many Apps and website fail to reach such high demand and standardized base goal because there is no dynamic interaction with the customer (Shlomo Trachtenberg, 2021). Shopify revealed fresh data showing there's a 94 percent greater conversation rate using Augmented Reality than interaction with a non-AR-enabled store (Papagiannis Helen, 2020). When the covid-19 pandemic started, the visits to e-commerce Apps and website exploded. But many of the e-commerce store's especially watch store's has static images of different watches. These arises different issues like the following enlisted below –

4. Return of the product increases.
5. Low conversion rates.
6. The "try before you buy" mindset.

As a person I would visit a store or mall to purchase a watch, because I would first want to see how the watch suits my hand and rarely would I return if it suits me. But when it comes to e-commerce watch store's, we can argue that its not the same case as going to the mall and trying it on. A plain static image of a watch isn't going to give any justification on how the watch is going to look on the wrists of the customer. There's a 40 percent decrease in return of products reported by Shopify when 3D visualization was involved instead of a plain image. This is because the general population has a "try before you buy" mindset (Matt Anderson, 2018) (Mike Boland, 2021).

'Kuwait Smart Watch Store' is a mobile application which would eliminate two of the major issues faced by an online e-commerce store by implementing Augmented Reality. With AR it allows the customer to virtually try on the watch before purchasing the product thus reducing returns up to 40 percent. The proposed project also helps in customer satisfaction because instead of a static image, A dynamic 3D model will be used. The customer can either try on

the watch or view the 3D model as it is, this helps to reduce the “try before you buy ” mindset (Matt Anderson, 2018) (Mike Boland, 2021).

### 1.3. Background & Motivation

The market is filling up with great AR applications there's a huge growth in 2020 because of Tech giants like Microsoft, Google, Apple. And moreover, covid-19 has helped to push more Augmented Reality applications into the market. AR has made a huge impact, in the year 2020, 32% consumers of different sort used Augmented Reality to shop online. AR market is looking at about 68.5% growth by 2027. Studying and implementing Augmented reality on my application would help me to understand how to implement AR and VR on much more complex apps in the future. When AR and VR becomes the future and to be a part of AR since the time of my higher education would definitely help me in my future career. (Andrew Makarov, 2021) (Sergei Vardomatski, 2021)

One of the main reasons I would like to take on the proposed project is to learn and become familiar with the current trend that is Augmented Reality. Apart from the major education institutes that study the principles of augmented reality, ANIMAX is the only known company in Sri-Lanka that specializes in this field. Other are made up of AR is still in its infancy but with time it will undoubtedly become widespread awareness. Some more reasons would be

3. Other reasons I want to pursue the proposed project is because of how interesting the project is and the amount of new knowledge that I'll come across in the software development life cycle.
4. The proposed project is supposed to be a final year-based project but for me I want to fully develop the application and launch it in the market and start a small-scale ecommerce business.

## 2. Business Case

### 2.1. Business Need

If we take an ecommerce watch store the ultimate goal is to become a successful business. And what does it take to become a successful online watch store business? A high conversion rate defines an ecommerce store. But to achieve this goal we need to dive into a bit of human psychology. The buying impulse of humans is broken into Desire, Trust and Ease (Emily Usher, 2020). And this is an issue with an online watch ecommerce business ad there's none of these pillars exist in a new consumer. A typical online watch store has a plain image along with some texts and reviews. A static image of a watch on a screen isn't going to persuade a consumer to buy the product because the customer doesn't have any dynamic interaction with the product. A huge trust issue plays a role as the customer doesn't know how the watch is going to look In their wrists.

In 2019 covid-19 turned the whole world online and it became a hassle to shop physically at a store. Retailers started to implement online ecommerce stores with images of their watches,

but this causes a major uncertainty for the customers as they don't know if the watch will look good in their wrist. This discourages the customer to check out and thus the store will have a low conversion rate. Shopify data released data revealing stores with Augmented Reality had a 96% more conversion rate than a store with no AR (Papagiannis Helen, 2020). And what makes an online watch store worse is the return of products. But when there is an AR implementation there was a 40% decrease in return products according to Shopify and 25% decrease In AR-guided purchases reported by SeekXR (Mike Boland, 2021). With the AR implementation customers can try on every watch the store has to offer on their wrist just with their phone and see what fit them the best this solidifies the "try before you buy" mindset.

### 2.1.1. Underlaying Problem

E-commerce watch stores struggle in today's market because customers doesn't know the look of the watch on their wrist. In order for an ecommerce store to become successful it requires the customer to check out of their store and also have a low return rate of the product. But so many stores have plain images of many watches in their online store, and this makes the customer very confused on what watch is going to look good in their wrist. If the customers check out and didn't like the product, the customer tends for a refund. The issue of refunding arises for mainly two reasons customers buy many products so when delivered they can see the product themselves and make up their mind and the other is because the description of the product didn't match the expectation of the consumer. To put the returns that are based on products that didn't match the customers expectation is 64.2% (GRAHAM CHARLTON, 2020).

## 2.2. Business Objectives

Using Augmented Reality Mobile based application with A.I where customers can try the watch on their wrists helps solve the following problems

- Reduces returns up to 30%
- Customer can try their favorite watch virtually just with a smart phone.
- Customer expectation on how the product looks increases by 64.2%
- Conversion rate on AR store increases by 40% according to Shopify
- Provides future trust on the store
- Implementation of A.I voice command increases attraction to the application.
- Improves efficiency of the store's return policy by 33%
- Buying a customer intended watch increases.
- The psychological factor that impulses one to buy a product Is met.
- The active trend of AR implementation would increase downloads of the app, especially during covid as customers can't visit stores and physically try on the watch.

(GRAHAM CHARLTON, 2020) (Emily Usher, n.d.) (Mike Boland, 2021)

## 3. Project Objectives

- To provide a watch ecommerce store a better way to shown to the customer.
- Analyze AR technology and implement them so the customers can try on the product before buying.

- Analyze A.I voice to command and implement in the app.
- To provide an updated version of UI for the customer.
- Improve the current features of an ecommerce watch store.
- Implementation on a user-friendly chat service between the buyer and seller.
- Provide stripe service for consumers
- Analyze how to create an ease way of checkout
- Analyze more on consumer requirements.
- Analyze requirements for store owner's dashboard.
- Analyze on how to get user started on using the AR feature

## 4. Chapter 4: Initial Scope

The initial scope of this online ecommerce watch store is produced by learning the watch industry and having a good knowledge in online ecommerce business. With these two components I have come with how to make an online watch business much more successful than static online business.

I am going to approach my project according to the flow of System Development Life Cycle. And in order for external parties to understand the project all the business processes and procedures will be documented using UML diagrams, Jira, and GitHub. This helps others to understand the scope of the project as well as help me maintain the application.

The application will use Vuforia and unity to track a marker on the customers wrist and with object tracking a virtual watch will be placed on the customers watch. To keep track of data of the watches and user's and for Vuforia to access the watches data a centralized database will be used for the project. The initial application has some great features where the consumer and the seller can access. Some of these features are

9. Customers can use the Augmented reality feature to try on the watch they would like to buy
10. Customers are provided with a secure ecommerce store.
11. A 360-degree model is uploaded instead of a static image so users can view the watch from every corner.
12. Allow customers to personalize and modify the watch to some extent .
13. Provide stripe service and google map for easier checkouts.
14. Implementation of A.I voice to command help special needs and consumers.
15. Sellers have a Web application and a dashboard to add and maintain their stores and also provide them with different kinds of business analytics.
16. A chat service to have better customer-seller relationship.

There are many competitions in the online ecommerce world, Augmented reality try on feature and Voice to command, and the other small, detailed features can make the proposed project stand out in the current market.

## 5. Method of Approach

Keeping three things in mind that is, how to work with Consumer's satisfaction, Sellers's satisfaction, and Augmented reality and moreover to enable entire application to be controlled by Artificial intelligence the main tools to approach these areas would be

- Flutter framework
- Dart object-oriented programming language
- Firebase
- Unity
- Vuforia
- AR Core
- Google maps API
- Rest API
- Android studio

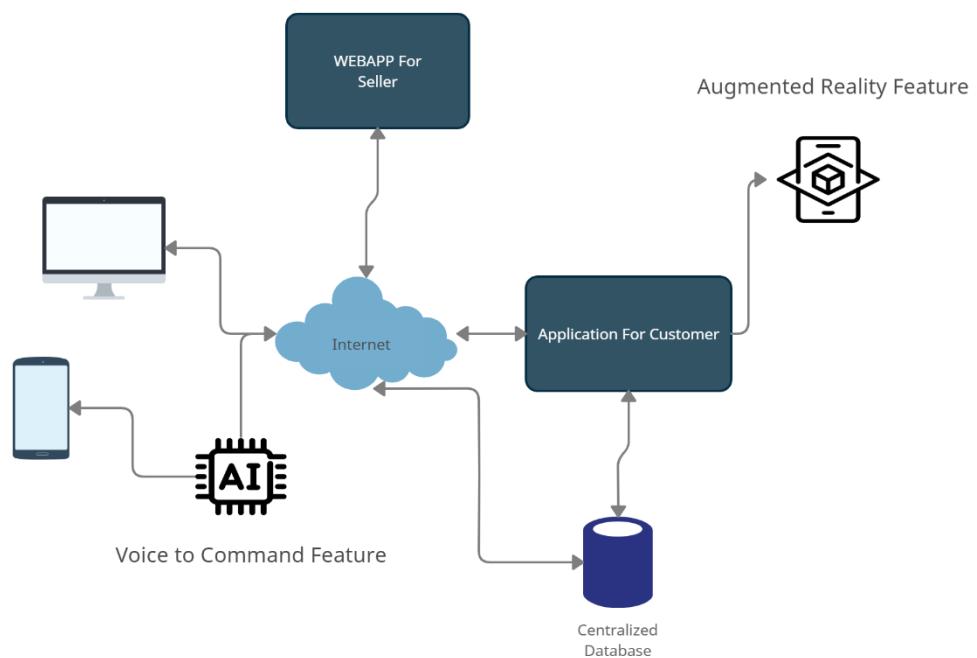


Figure 1. A Diagram That Explains A Basic Project Overview

### 5.1 Control Plan

Using different kinds of methodologies, I will be using a PRINCE2 based control plan.

- ✓ Weekly meetings with my chosen supervisor (Mr. Pramudya Thilakarathne sir) to review the progress I have made and there after plan the next steps.
- ✓ Short, briefed reports at the end of each phase
- ✓ Communication plan (section 6.2)
- ✓ Risk Management plan (section 7)
- ✓ Quality Management plan (section 8)
- ✓ Exception reports and plans if needed.

## 5.2 Communication plan

In addition to ad-hoc supervisor meetings as necessary, planned review/feedback meetings will be held at the end of each stage in order to discuss the end-Stage report, the next Stage plan, and to review any technical deliverables produced during the stage. Feedback meetings will also be held following the submission of the two Interim reports.

Stage	Est.Start date	Est.End date	Deadline	Deliverable
Problem Identification	15/10/2021	28/10/2021	1/11/2021	Project Proposal
Initiation	1/11/2021	16/11/2021	17/11/2021	PID
Investigation & Requirements	15/10/2021	01/11/2021		Analyze projects related to mine. Steps to improve ecommerce watch store Plan on how to build the application step by step.
High Level Design	27/11/2021	10/12/2021		Prototype, UML diagrams
Increment 1	13/12/2021	1/1/2022		Interim report 1 Providing users and sellers to register, login, managing profile.
Increment 2	3/1/2022	30/1/2022		Dashboard for the customers Interim report 2
Increment 3	1/2/2022	27/2/2022		Implementing Augmented reality to view the products virtually for the customers
Increment 4	20/2/2022	15/3/2022		Admin dashboard.

Increment 5	11/3/2022	30/3/2022		Chat system, A.I control voice to command feature
System testing	1/4/2022	5/4/2022		Final System
Assembling the final report and system	6/4/2022	11/4/2022		PROCO303SL Report

Table 1. Project Management Plan

#### Stage 2 of the Project Management Plan

Task	Deadline	Deliverable
Analysis of similar projects and Analysis of existing business process		Documentation of similar project examples and classifications. Documentation of Business process
Requirement Specification	Estimated time to complete all 25/1/2022	Requirement Specification Document
Evaluation Specification		Report emphasizing on available technologies, issues, outcomes, best to use and reasons

## 6. Initial Risk List

Coming with a challenging project. We need to always assess the problems that we may face and have a way to solve those problems. Here are the problems that may become an issue and their solutions

Risk	Management Strategy
Schedule Overrun	<ul style="list-style-type: none"> <li>Contingency is been integerated to the problem plan</li> <li>The project supervisor will monitor the progres of the proposed project and advice on how to keep it on a proper schedule</li> </ul>

	<ul style="list-style-type: none"> <li>More days will be added to the estimated dates incase of project overrun with the supervisor's permission.</li> </ul>
Project Complexity	<ul style="list-style-type: none"> <li>Research on the project would be done along with the technologies that's going to be used to implement the project. A feasibility analysis also would be done.</li> </ul>
Issues regarding the technologies used for implementing the proposed project	<ul style="list-style-type: none"> <li>For each feature of the project a very basic prototype can be made to check the working concept of the feature.</li> <li>Selecting a technology where you have a good understanding helps in the success of the project.</li> </ul>
Loss of data/ Technical failure	<ul style="list-style-type: none"> <li>Keep regular backups in Github or Bitbucket.</li> </ul>
More issues that can be expected	<ul style="list-style-type: none"> <li>There will be other projects in development running parallel with the current project.</li> <li>A proper time management would be necessary.</li> </ul>

Table 3. Initial Risk List

## 7. Initial Quality Plan

A quality plan must be implemented to keep up with the competitive market and providing the users with a proper application. This ensures the application is up to standards.

Quality Check	Strategy
Requirements	During the second stage, requirements will be verified to ensure that they are correct, relevant, complete, feasible and demonstrative. Prototype of the project will be implemented based on the user's requirement.
Design Validation	<ul style="list-style-type: none"><li>Follow HCI guidelines.</li><li>Feedback from users for the implemented design.</li></ul>
Usability Validation	To be conducted at each phase.
System Validation and User Acceptance	To be conducted in the 8 <sup>th</sup> stage.

Table 4. Quality Plan

### 21.5 Interim I

#### 1. Introduction

##### 1.1. Abstract

Augmented reality has become one of the norms in the digitalized world or we could call it the internet. There was Virtual Reality which allowed us to experience a totally different world within the living room but then came augmented reality with a different concept of its own. AR allowed us to bring anything to life and the only limit was the human imagination.

Augmented reality has become a huge in different sectors around the world. Teaching hospitals use AR for training the newbies. The military uses to enhance the soldiers training skills. The education field uses AR to keep lessons much more interesting than the usual boring textbooks. Gaming sector has utilized AR to boost entertainment exponentially. In 2017, During the League of Legends finals in the Bird's Nest Stadium at Beijing, Riot Games partnered up with the world's largest virtual studio Zero Density. A massive dragon was summoned center stage using Zero Density Reality Engine. The dragon had phenomenal number of details and later took flight middle of the stadium and ended with a huge roar. The fans were astonished by the show and talked about it for days (Zero Density, 2021).

All of this said, Sri – Lanka is developing towards Augmented Reality but there was a quote from the founder of the Academy of Artificial intelligence at the Colombo innovation tower quoting ‘The world of Artificial intelligence, Augmented reality and Mixed reality is coming’ with all the development that’s happening. And personal opinion the country is developing rapidly towards Augmented Reality.

With the Covid-19 pandemic there was a massive boost in VR and Augmented Reality in the business sector as work turned into remote work. The spending on AR and VR technologies, software, services, and hardware by consumers came up to \$12 billion, this is a 50% increase compared with 2019 (Sergei Vardomatski, Sep 14, 2021). Augmented Reality has come a long way spanning across various sectors. And with no doubt AR technologies is going to have a very bright future.

## 1.2 Progress...

Keeping everything said above, I have decided to proceed with my project that is an Online AR Ecommerce Watch Store with a little touch of Artificial Intelligence. Watch stores with static images has to come to an end. Almost anyone buying a watch online has some amount of dissatisfaction without trying the watch on.

The two countries I spend the most time in that is Sri – Lanka and Kuwait have very limited amount of AR related technologies. Most are either in experimental stages or actually not existing. I have chosen to implement a working AR watch store for a few reasons,

1. The future is now becoming virtual day by day. For example, we can take Metaverse. Metaverse is a virtual place to hang out, play games, work and more. Knowing and working on a virtual technology will help me to have an edge in my future.
2. Working on Augmented Reality is a new concept for me. Other than making a traditional management system, an AR concept interest me and challenges me in new ways.
3. One of my goals is, people or governments to use the technology I created with a good amount of satisfaction. If the application is implemented with proper guidelines and deployed in the Kuwait or Sri-Lanka market with respect to watch business owners it could potentially have a good success rate.

An Online shopping store is a place where consumers can buy the products put up by business owners. Online shopping allows consumers around the world to easily access a product they desire and purchase it, but this comes with a major flaw.

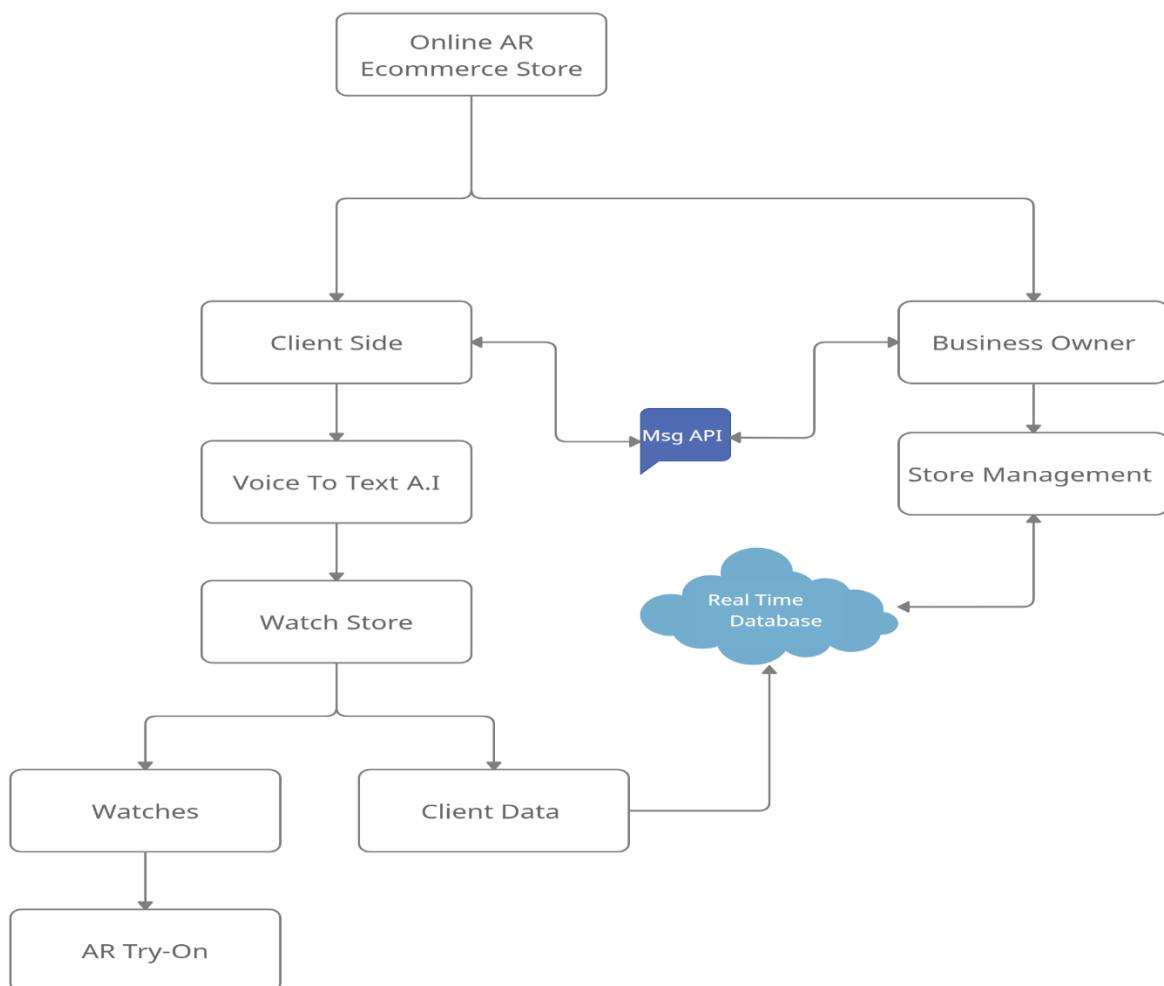
Let’s take the online watch ecommerce industry. There are many watch ecommerce business online but the consumer is limited on trying the watch on their wrists. As in the consumer can’t touch and feel the watch around their wrist or moreover see the watch in a 360° view as most ecommerce store’s has static images of their watch.

The best possible solution for this is to use Augmented Reality and bring the watch to the real world. The customers can try on the watch just using their smartphones. This increases customer satisfaction and also decreases return of watches.

The application will use an image tracking to track the wrist of the customer and target the image to bring the watch to reality. I have chosen Vuforia to do the certain task as it allows storing of multiple image targets, and also easily converts the targets to the watch that's chosen by the customer. Vuforia is a great first time AR platform that can be implemented with a certain amount of knowledge. Its ability to create 3D watches is why Vuforia is chosen as the main AR platform. The application totally together will accomplish

1. Customers can try on the watch they like in the online store.
2. 360° view of the model can be seen by the customers.
3. The A.I that's implemented will allow customer to easily shop and find the watch they would like to see.
4. Customers can keep in touch with the sellers during the entire process of purchase.
5. Business owners have the option of putting the watches online for sale.

## 2. System Overview



### **3.Tasks Undertaken And Outcomes**

#### **3.1. Augmented\_Reality**

##### **3.1.1.Working With Augmented Reality**

As discussed before, The project is going to be based on Augmented Reality. AR has an interesting learning curve that challenges individuals. When it comes to the concept of AR there is a lot of documentation and videos, we can gain knowledge from. For my project I decided to use Unity and Vuforia to develop the AR environment. Vuforia engine is a great software development kit for adding AR to an application. It allows to render 3D objects in the real world where people can interact with them.

##### **3.1.2.Obstacles Faced With AR**

Augmented Reality is a completely new technology that I am going to be working on. Knowing the complexity of AR. I first started with intense research about AR and on how to implement the technology into a project, As new technology always is a threat without knowing anything about it.

Insiders have given the following information that AR technology doesn't necessarily apply and moderate to their business models or in other words "gimmicks". So, the following observation has been made as the number of expanding customers that are just beginning to use Mobile AR for the very first time. So, withholding the combination of the two, examining AR contributions to productivity, participation, exhaustion of the scarce resources, acquiring accidents to the minimalist standards and managing labor unit rates are some ways in adapting the system of joining the early majority (Jessica Baron, October 28, 2021).

##### **3.1.3.Outcomes**

The research done on how to implement Augmented Reality looks very promising. The overview method of bringing a 3D object relied on image tracking. I have researched more about how online ecommerce stores to get some inspirations based on that. Some of the stores I checked into were Daraz, AliExpress, eBay. New tech solutions have been formalized during the modification of lifestyles during the conquest of the Covid 19. New doors have been opened with wider space to opportunity for the rise in augmented reality. AR technology uses the most prominent training as research including surveys has discovered the capability and potentiality of its employees stated by the executives in addition to the accurate study rounding off to 25% . Relying on the 95% that agreed to the betterment of rising expectations of customers resolving that, AR creates solutions to organizations as well (Jessica Baron, October 28, 2021).

#### **3.2. Firebase By Google**

##### **3.2.1 Working With User Data**

For the past years, I have been using Firebase for my projects. Firebase is a great technology that can create a great backend with easy. It provides different

complexity for different types of applications. All of the user data of the application will be stored using Firebase real time database.

### 3.2.2 Drawbacks

One of the main drawbacks of Firebase is it's not made for complex queries. This means it has limited capability of filtering user data. But during my use of Firebase, I have haven't still come to any complications yet.

### 3.2.3 Solution

One of the solutions when faced with incompatibility is to switch to another backend that's capable of handling complex data. But Firebase can be used to store only user data and Vuforia for complex data.

## 4. Products Produced And Product Quality

At first my project was put up to be reviewed and accepted by the supervisor. After the go ahead was given I have been working on the design and mock-up of the application. The mock-up are low fidelity wires showing how the app should be built. It provides a predesign of the application. This helps a lot when coding as I don't have to randomly code the application graphical user interface . I can use the mock-up designs as reference to code the application.

It's important that the memory is cleared before running the application and has multiple unique pointers to help recognize the wrist of the user, otherwise Vuforia and unity will fail to connection When saving image targets in Vuforia's database, proper methods should be used for faster load times.

The client side will be coded using flutter framework which uses dart as its coding language. Flutter helps to develop application that can be run on IOS systems.

Flutter helps to create a clean graphical user interface by using widget system.

Widgets are like building blocks with code inside it developed by Google. This helps to create great mobile application with much less hassle.

Firebase will be used as the backend data storage unit. Firebase as pre-made functions that help developers to apply clean functions on the application. Firebase is easily integrated and uses less code to implement storage functionalities. Firebase and Flutter were developed by Google which makes integrating both hassles.

## 5. RISK MANAGEMENT

### 5.1 Risk to be Materialized

When the project initiation document (PID) was made potential risks were considered. Some of the risks were mitigated with the solutions provided by the PID risk management section. But going onwards, more risks have risen. Risks are a natural part of a project, there's also a quote saying, "Higher the risks, Higher the rewards". It's the duty of ours to mitigate and adapt to the risks that arises on our way as risks are inevitable. In addition, software development encounters risk mainly due to the complexity of the project as well as its novelty. And because of that, more

commonly occurring risks are identified below using risk management techniques like referring to projects related to the topic and having expert advice.

1. **Time constraint** in project management is described as the project schedule deadlines. It contains each phase of the project's deadlines and the final deliverable dates. When we take time constraint in a project its essential a proper regime is followed. When time constraints become tight, it leads to further deviations and weird imbalances in the project. During the development of a project a proper schedule has to be maintained as all this effects the scope of the project and the feature creep.

As learned in the module project management, when time gets effected the scope and budget for the project gets fluctuated. This is called the Iron Triangle rule, if one of the sides of the triangle gets effected the whole triangle changes. So, its mandatory to manage time properly otherwise it leads to fatal complications during the projects last stages. The important part of the project is the client satisfaction, and this would be an issue if feature creep or scope creep settles in. Below are solutions that help to mitigate time constraint.

Probability of happening : 50%

Solution :

- a) Plan ahead : This part should contain the core goals of the project, and how achieve these goals, this should include the step-by-step process of planning and the tools used in the project.
- b) Scheduling : When developing a software its mandatory that you don't deceive yourself with fake hopes of reaching a certain deadline and should stick to realistic time frames for the project deliverables.
- c) Monitor the process : After the planning and the scheduling is done. It's important to furthermore keep an eye on the different stages of the project as scope creep, hope creep and feature creep maybe lurking around the corner. That's why analysing the project with each stage is Important to avoid such complications.
- d) Gantt Chart and similar tools : Gantt chart helps to analyse project timelines and check whether the project is within the proper time constraints. It's one of the most used tools in the industry to analyse progress (Wrike, n.d.).

2. **Overlapping Of Projects** : Currently I am in my final year, final semester. This brings a complication has there are other module project deadlines close to the final project. The attention priority can deviate from one project to another. Its important to keep the follow of each project and reach the deadlines given. Overlapping could have a positive or a negative impact.

Probability of happening : 60%

Solution : Can allocate a small amount of time to develop each task and complete the task within that time and produce the required deliverables in that allocated

period. In project management we call this as sprints. When the large projects are broken down into small tasks it helps to progress each project at the same time. A sprint shouldn't exceed more than a month. Each task should be given days or a week to complete the projects within the deadlines.

**3. Possibility Of Feature Creep :** Feature Creep or also can be called as Scope Creep is when an excessive number of features are added to the project. Adding additional features have a positive or negative effect. Features sometimes can make a client or the user of the application satisfied but the negative effect is when the application becomes complex for development or wont meet the project deadlines. Scope creep is one of the most common occurring creeps in project management. It's very easy to go out of budget or miss deadlines when the feature creep increases. The project stakeholder in this that would be me , is mainly responsible for the increase of feature creep and they may reassess the project or change the different features. If an eye for feature creep is not kept, it could lead to fatal complications (Nick Babich, Sep 8, 2021).

The reasons why scope creep materialises is mainly because of poor planning before commencing of the project. And prioritizing the wrong area of the project. Any new feature that will be added or going to add to a project is going to be considered out of scope as it was not planned in the start of the project.

There's a golden rule "Ship the right features to the right people". Business applications should base their ideas on this rule

Probability of happening : 40%

Solution :

- a) **Using tools to document the project requirements :** The most important thing to avoid feature creep is to document the project requirements, by documenting the project requirements it allow me to understand the scope of the project. Prioritizing the features as it could be a possibility that every feature won't be implemented. The document with all the project details is called requirement management plan. It should also contain the process that needs to be taken to change the features of the project.
- b) **Project Schedule :** After deciding on the project scope based on the requirements gather at the initiation of the project, A work breakdown structure (WBS) can be created displaying all the requirements and how the tasks need to be achieved. Commonly can use a Gantt Chart .
- c) **Verifying The Scope With Supervisor :** Having a supervisor is the biggest advantage a person can get. Updating the supervisor and maintaining a proper communication with the supervisor will lead to the success of the project. A supervisor can give he/her expert advice on whether to update the requirements or to keep it the same as they know from experience if the updated features will flop the entire project.

#### **4. Certain technology being harder than expected:**

For creating an Augmented Reality Ecommerce Watch Store application, a lot of unfamiliar technologies or hard to learn concepts exists at this stage of the project.

The application uses Flutter framework run by Dart language to create the graphical user interface. And for the backend user data storage Firebase will be used. Flutter and Firebase won't cause much of an issue as there's plenty of knowledge and references surrounding that specific area. The issue arises when it comes to AR. The application main components are made using Vuforia platform and Unity to create the Augmented Reality effect. There needs to be a lot of experience with 3D objects and how AR works with flutter.

Possibility of happening : 30%

Solution :

- a) Gaining more knowledge from the internet is a start. LinkedIn offers plenty of free knowledge related to Augmented Reality.
- b) To analyse similar technology and adopt to the given situation. A flexibility is a must when it comes to project managements. As many unexpected circumstances might arise. If this happens again, have a backup plan in place that allows you to switch approaches while maintaining the same objective. That's when adopting the Agile technique is beneficial. As far as the term "agile" is concerned, it refers to someone who is open to change and adaptable. All changes and upcoming changes should be documented at this phase in the project.

Accordingly, there's many risks that can materialize, but with the correct assessment procedures in place, we can minimize and control the risks which have already materialized, as well as reduce the likelihood of new risks materializing.

## 5.2. Materialized Risks & Solutions

1. Resources related to Augmented Reality were much harder to implement much harder than anticipated. Thus, leading to gain more knowledge on the area and pushing the deadlines.

Solution : Having supervisor advice and discussing about technology related about Augmented Reality helped moving forward.

2. Overlapping Projects : Many deadlines are crashing with the final year project. This causes an issue on which project needs the most attention.

Solution : Figured out when and where I'd have to work with my other projects and did my best to accomplish some objectives relevant to this project as soon as possible. This is currently being monitored by Gantt chart so every project can be completed within the given deadline.

3. Communication : Because of the pandemic almost everything came to a halt. Students couldn't visit their supervisor, and this led to having no bond or proper form of communication between the two.

Solution : Supervisor made sure there was regular online meets using teams or zoom. Provided with the necessary needed feedback through online platform.

4. Schedule Overrun : developed a proper project plan and since I have got the approval by my Project supervisor for the project , I can continue with the workload according to the project plan.

## 6. Schedule

The importance of a schedule was explained briefly above. This is the current plan undertaken to accustomed to time management of project completion.

The improvised schedule because of overlapping projects is

Stage	Deadline	Deliverables
Problem Identification	1/11/2021	Project Proposal
Initiation	17/11/2021	Project Initiation document (PID)
Proper planning and scheduling tasks.  Continuing with the research for the selected topic.  Implementing a low fidelity diagram.  Designing the graphical interface of login, registration screens.  Deep research into Augmented Reality technologies.	24/1/2022	Interim report part 1. Progress video
Further research and unit testing of functions.  Debugging and Maintenance.  Instantiating Databases and checking platform viability.	15/2/2022	Requirement Progression

Implementing backend development.  Graphical User Interface continuation Based on HCI	To be announced	Interim report part 2
More testing.  Maintenance and debugging of the program.  Integrating AR.	1/3/2022	
Adding more functionality  Testing of overall app.  Checking for bugs.  Debugging sessions.	10/3/2022	
Correcting functionality.  Testing out the application with industry standards.	25/3/2022	Maintenance Report
Debugging & Error correction Final system testing	5/4/2022	Final System
Assembling the final report and project	22/4/2022	PRCO303 Report

## 7. Resource Used And Why

- **Android Studio**

Android studio is the official IDE of android. Its purpose is to build fully functional commercial applications for free. Since my project is a mobile application based on android the best IDE to go for is Android Studio. Some of the benefits for choosing Android Studio are :

- a) Applying changes to the application without even restarting. In simple words when a developer makes a change to an application, the application has to be restarted to see that change be reflected but with android studio that's not necessary (Android Studio, n.d.).

- b) By providing enhanced code completion and code refactoring, the developer becomes more effective and efficient when writing code.
- c) With step-by-step instructions directly inside Android Studio, the Firebase Helper lets you communicate your app to Firebase and add services like Authentication, Notifications, and etc.

- **Firebase Real Time Database**

Firebase is a googled owned backend service that's lets developers store data and provide multiple features with it. Firebase allows to build mobile application and web application for a business. Some reasons why I considered using firebase as my database

- a) The budget significantly reduces because firebase is free.  
There's additional cost only if the limits exceed.
- b) There's no need of SQL knowledge as firebase is a no SQL database. And because there's no SQL the data load and read is faster.
- c) Firebase Manages its database in real time. This makes the exchange of data fast.

- **Flutter**

Flutter is a google developed framework used for creating clean and impressive mobile application user interface. Flutter can be used to develop web-based applications and have a single database for both mobile and web application.

- a) Hot Reload : One of the most popular features of flutter is hot reload. The hot reload feature allows to reflect the change made to the application instantly. This helps to reduce time taken to develop or debug.
- b) Dart : Dart is a programming language created by Google. Its mainly created for mobile apps, web application and backend. The language is optimized for clients, so they perform the task fast and clean.
- c) Flexible UI : Flutter can be used for creating beautiful graphical user interface. Flutter allows the developer to control every pixel that's in the screen. It uses a widget in a tree system which makes it much easier to develop a GUI compared to native frameworks.

- **Unity**

Unity is a great platform used for dealing with 3D models. 3D modelling is the process of digitalizing a real word or fictional object.

The watches are 3D objects rather than static and unity comes to the rescue to work on the 3D objects that imported.

- **AR Core / Vuforia**

Vuforia is a platform used for creating augmented reality application for mobiles. I used image tracking for creating 3D objects in the real world.

Using of 2D images has become old school. And it's not very interactive with the users. But however, using Vuforia we can create 3D objects in the real world. This increases the user experience and thus increasing business and traffic to the business.

- **Google Maps API**

Google Maps API provides the location and helpful data that is used towards the customer checkout areas.

- **Messaging Bot**

Messaging bot helps to connect the consumer and business owner to maintain some form of communication between the two. This way the consumer can ask the business owners about the product or any inquiries that the user have in mind.

- **Alan Speech Assistant**

Alan is a powerful Speech AI Platform that lets developers integrate a voice interface into their app. Alan is a conversational AI platform that allows developers to create sophisticated and dependable in-app voice assistants and chatbots.

## 8. Learning Undertaken

### 8.1 Personal Development

Augmented technology is a new technical challenge that necessitates extensive research and understanding of components such as virtual reality, object-oriented ideas, scene identification, and real-time data operations.

A lot of time was spent on learning and researching about Vuforia & Unity to identify the majority of its widgets and integrated components.

More time was spent learning the integration of unity with flutter. How to implement a 3D object into a flutter application took time to understand . And more Research was done on materializing the 3D object into the wrist of a customer using markers.

## 8.1 Knowledge Needed

The core component that is the Augmented Reality feature has the most complexity. It is a must to do the proper research and have the proper knowledge to work on it. Integrating the Augmented Reality with flutter application brings more issues. As there's documentation on how this process is done. A more intensive knowledge on flutter technology is a must.

## 9. Prototype

The developed low fidelity prototype link is below. It contains the screens and the prototype. Need to note that the low fidelity prototype can undergo changes. The design may slightly change, and more screens added.

The link below are the screens

<https://www.figma.com/file/A2IgvzpkETWEaPOXA5KI1B/FYP?node-id=0%3A1>

The link below is the prototype.

<https://www.figma.com/proto/A2IgvzpkETWEaPOXA5KI1B/FYP?node-id=5%3A35&scaling=scale-down&page-id=0%3A1&starting-point-node-id=8%3A96>



## 21.6 Interim II

### 1. Introduction

#### 1.1. The progress so far...

Due to the ease of the current pandemic. Travel restrictions has reduced thus allowing to have better communication with the selected supervisor and progressing exponential in the project. The Augmented Reality Watch has come is becoming a greater concept day by day as the word is slowly turned virtual and in the future will become a virtual place. Continuing with the project taught me the concepts of how augmented reality works. The work that needs to create depth in images, so they look real to us and much more. Continuing with the project will me from participating in the future concepts on Augmented Reality and Virtual Reality.

So far, as explained in the previous reports. We learnt the importance of augmented reality. How augmented reality helps in bringing objects on the internet to the real world. This concept is useful in various fields. Augmented reality can be found anywhere from the gaming field to the medical field. Gaming sector has utilized AR to boost entertainment exponentially. In 2017, During the league of legends finals in the Bird's Nest Stadium at Beijing, Riot Games partnered up with the world's largest virtual studio Zero Density. A massive dragon was summoned center stage using Zero Density Reality Engine. The dragon had phenomenal number of details and later took flight middle of the stadium and ended with a huge roar. The fans were astonished by the show and talked about it for days (Zero Density, 2021). And now the current project will be brining augmented reality to the field of ecommerce. Many companies, like MobiDev, Unity Technologies, and Apple Inc., have attempted and succeeded, albeit at a cost. There are various limitations to the approaches employed, and as Unity stated in a forum, "there is no one-size-fits-all approach to building an ecommerce augmented reality watch store ." Detection of a person wrist brings a lot of trouble as the Machine learning and artificial intelligence is involved. But another way to approach this problem is to use markers. Markers explained in unity terms could be said as how to detect an object in reality and how to place a 3D object over it or around it. Because most technologies that work with the IDE Unity have a lot of limitations, the process of developing the suggested system has been anything but simple. However, the challenge has broadened my horizons and allowed me to experiment with many of the capabilities that unity currently provides, so I begin there and work my way up.

#### 1.2. Introduction of the process to be...

To focus on the augmented reality part of the application on virtualizing a watch from an ecommerce store. The project is broken down too many parts. The parts mostly include core complements of the application. It works by making working prototypes of each core component and then later the core component is integrated together to make one whole application. The applications core components are explained briefly in the interim I. Being very short about the client side of the application. The application is made with flutter and firebase. It uses unity and Vuforia to assist in the augmented reality department. The application consists of 4 different main components and extras .

1. Display 3D objects of the watch, where the user is able to view the watch from different angles .
2. Allow the user to try on the selected watch using Vuforia and unity.
3. Give the client an option to communicate with the seller.

#### 4. Power the application search capabilities with artificial intelligence.

report explains the different kinds of component that makes the application and also explain how the features will be made.

## 2. System Architecture

### 2.1. Context diagram

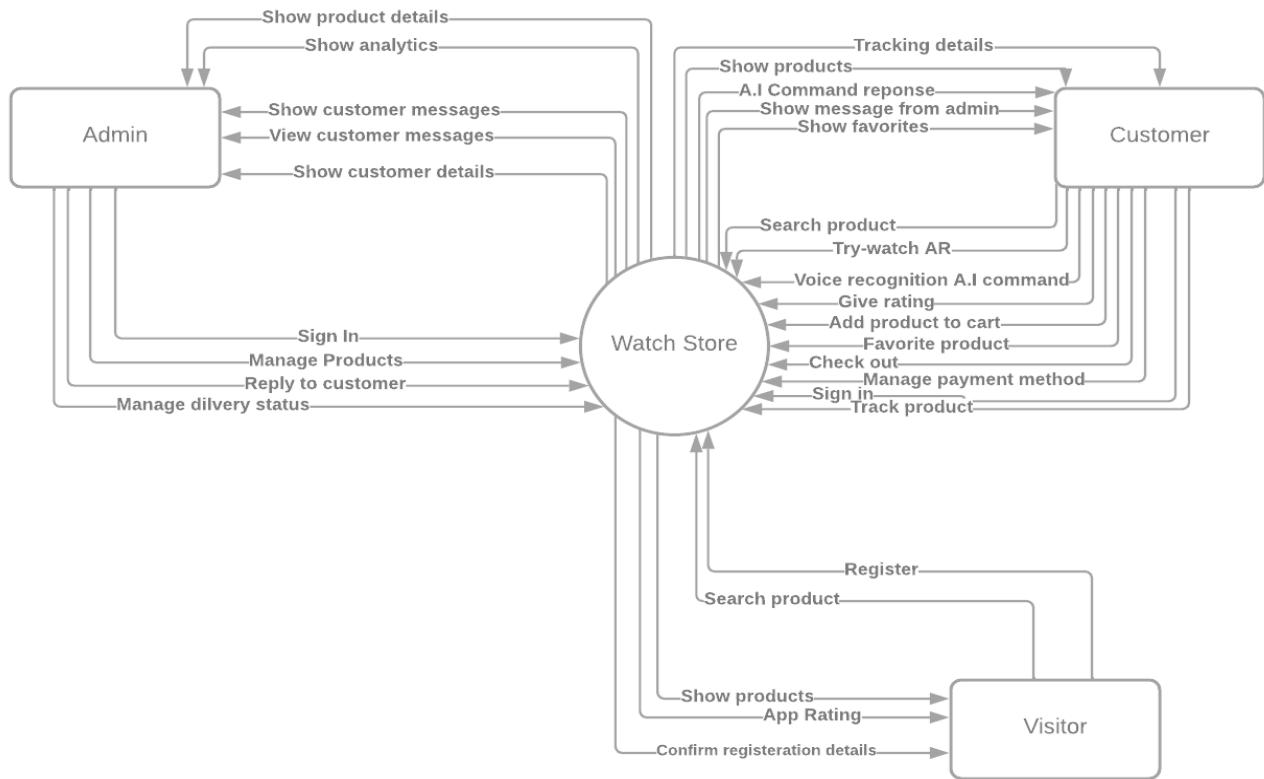


Figure 1 : Context diagram

## 2.2. Level 1 diagram

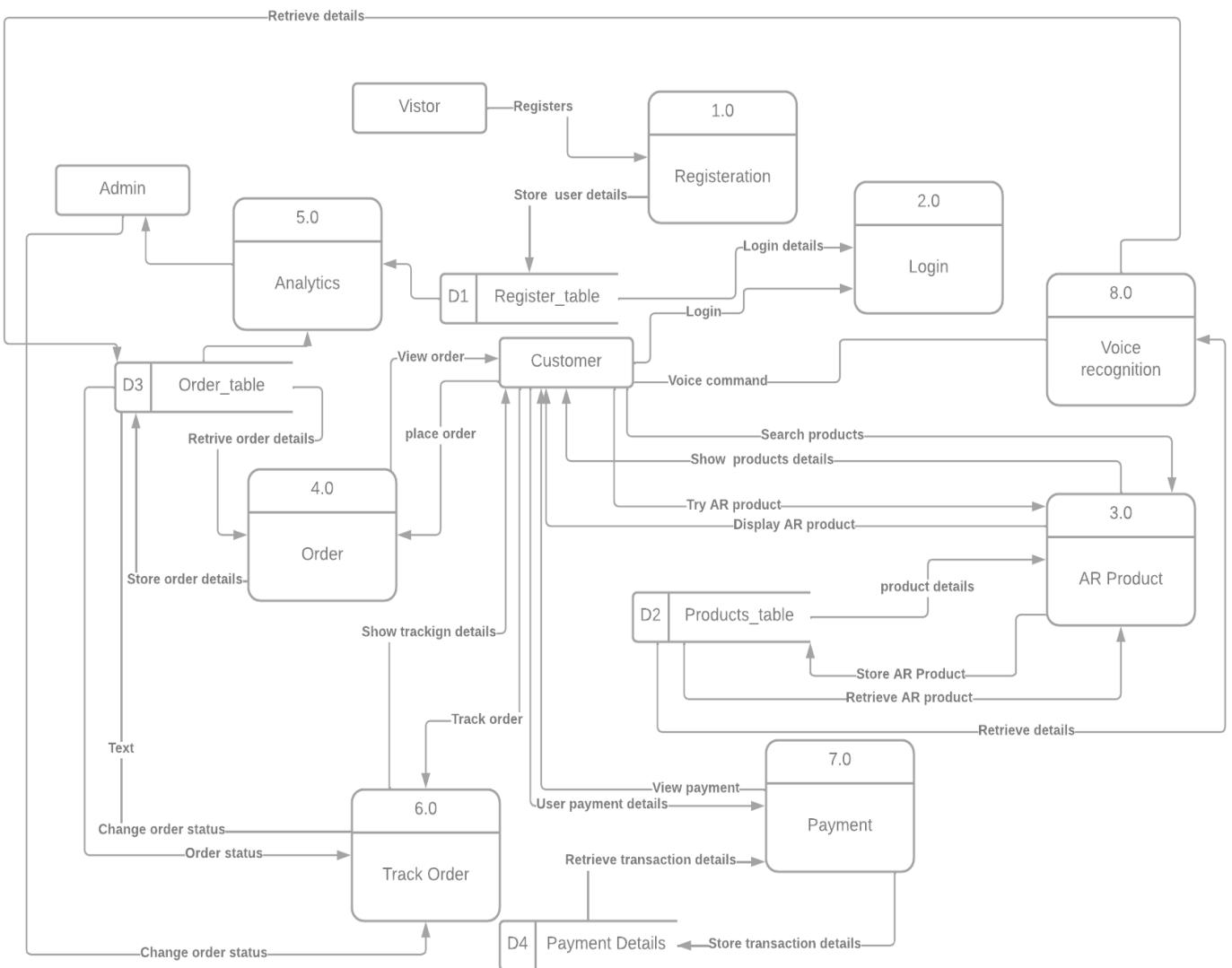


Figure 2 : Level 1 diagram

## 2.3 Use Case and Outcomes

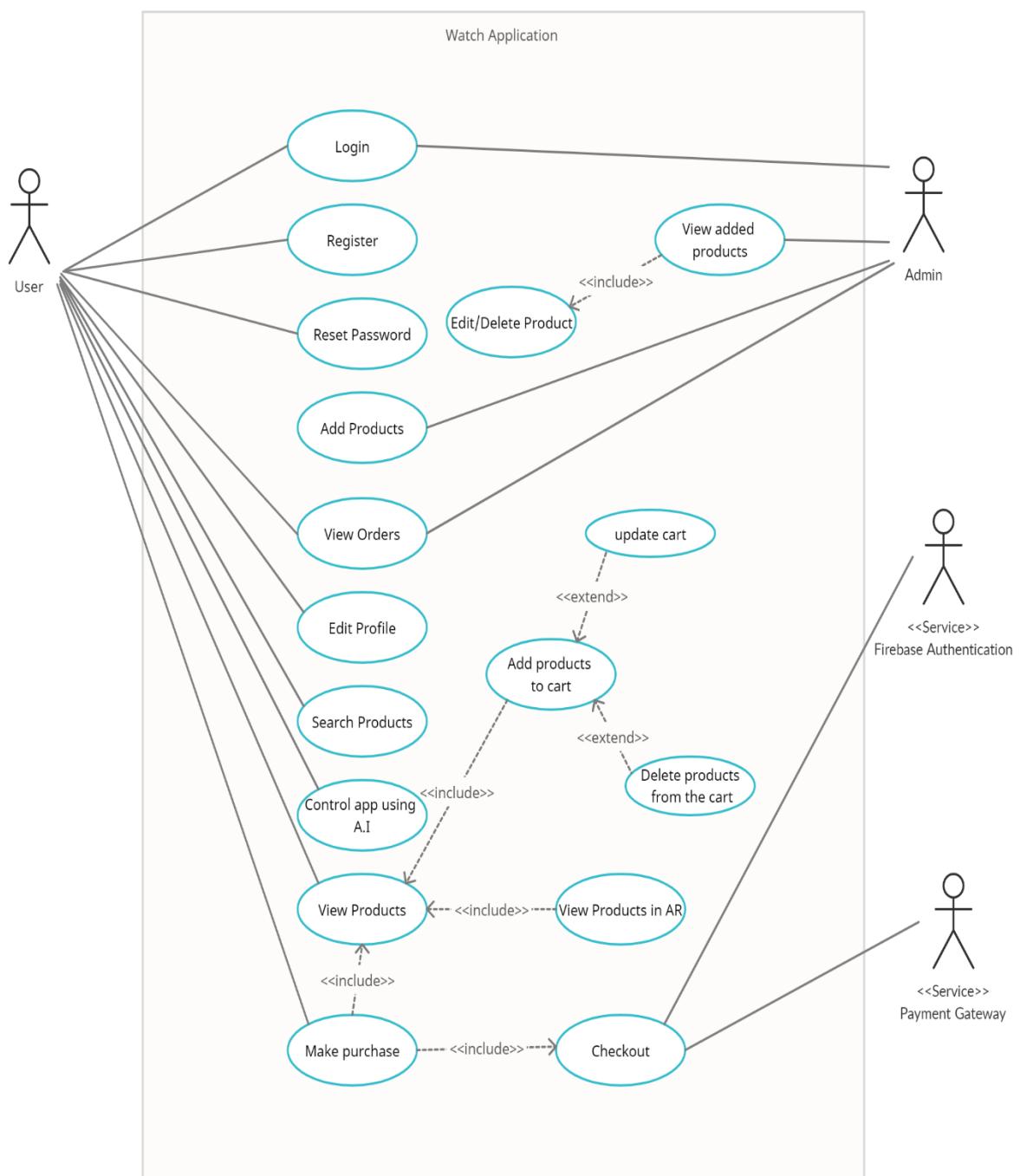


Figure 3 : Use case diagram

## 2.4. Entity Diagram

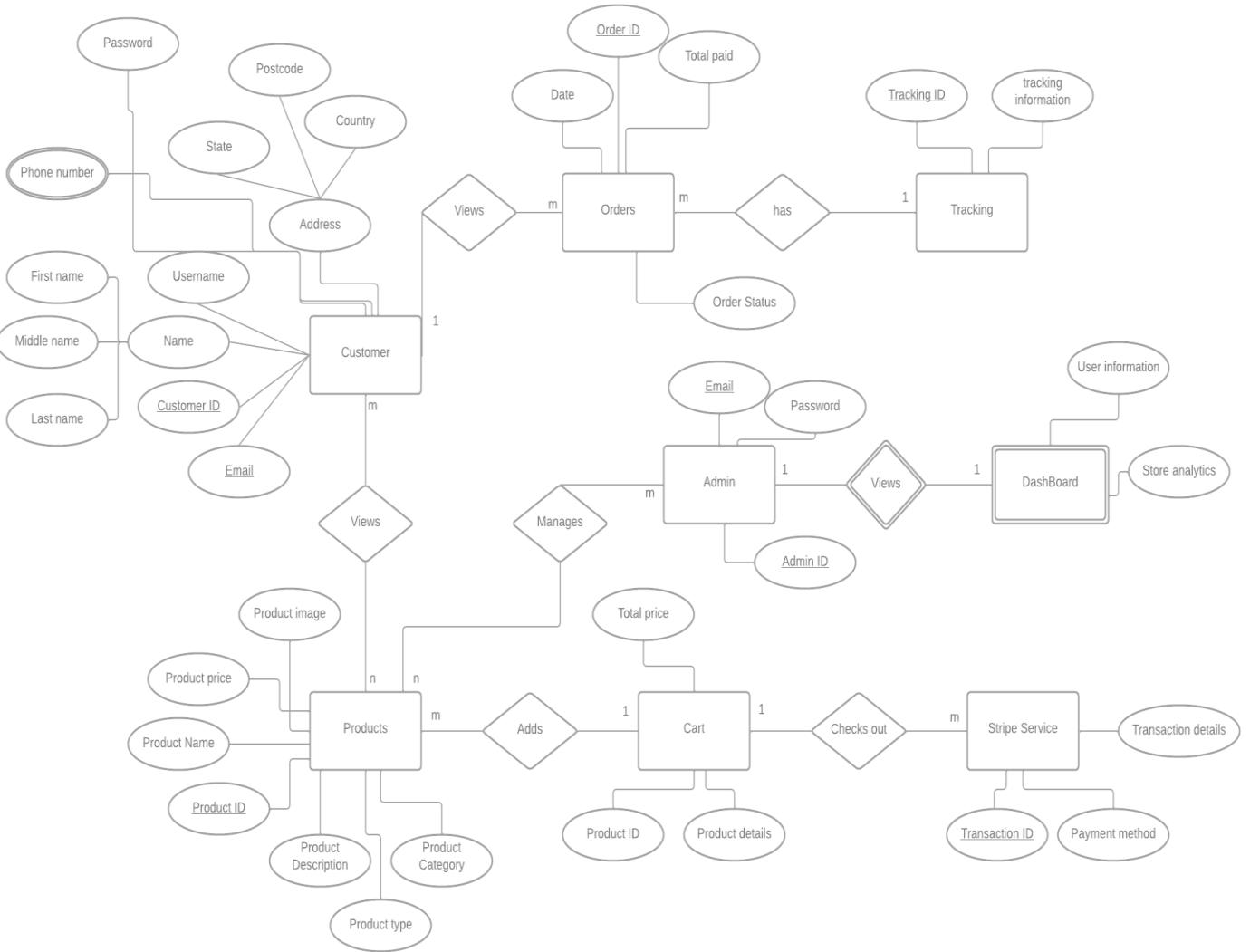


Figure 4 : Entity Diagram

## 2.5. System Architecture

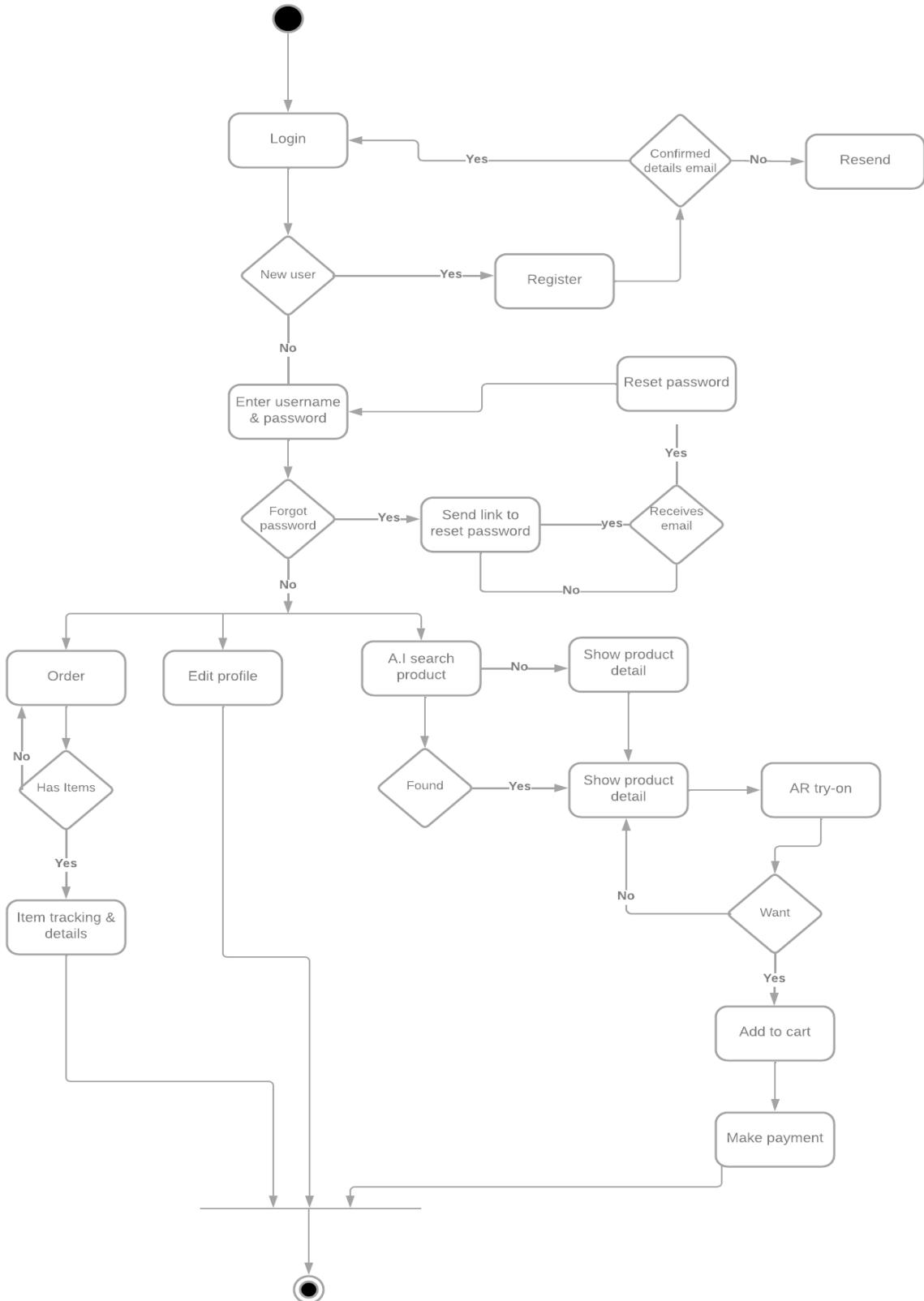


Figure 5 : Activity Diagram

## 3. Deeper dive into the Application

### 3.1.1. Working With 3D Models

A simple introduction to 3D models can be said as an object which has three dimensions. These objects can be made by using specialized software's like unity, blender, etc. 3D models are special because the customization on the object is the limits of your imagination. As good as everything sounds there's some drawbacks of using 3D models in mobile applications. First of all, 3D objects are very heavy. A simple model can be up to 100 mb and more. So, using a 3D object in an application looked practically impossible as it increases the size of the application exponential. Second, working with 3D object formats in flutter is just chaos. But at the end of the tunnel there was a solution to get a 3D object running in the application without many drawbacks.

The 3D objects first need to be created and designed in unity. Then pictures of the object from different angles needs to be taken. Using these pictures, a 3D looking object can be created in flutter. The prototype of this feature is tested and was a successful run.

### 3.1.2. Augmented Try-On

As the last interim report stated. Vuforia has the ability to store 3D objects to something called markers. More research showed how unity and Vuforia works together to show 3D are brought into reality. Basically, an 2D image is used to store marker points in the image. When the Vuforia camera scans the image, it sees it as if its part of unity. This triggers the 3D object that was stored into the marker.

The downside of this is the method that is used. For the client to use the augmented reality Try-On the client needs to have the marker accessible.

The work around to this problem is providing a printable band to the user in the application. The user can print the band and use it to try on the different watch selections. The prototype of this feature is tested and was a successful run.

### 3.1.3. Communication

The importance of communication in business cannot be overstated. When there is good communication between the seller and the buyer it builds trust on the seller. Having a good communication allows the seller to listen to individual customer needs and cater those needs. And this makes the customer loyal to the business. Which is the key to a successful business. And thus, it makes sense in implementing a way of adding a means of communication between the client and the seller.

So, the application comes with an inbuild chatting application where the customer can communicate with the seller. This feature improves the rating of the application. The customer can inquire any inquires within the app hassles (Kristina Martic, 2022).

### 3.1.4. Artificial Intelligence Voice to Command

Having some kind of accessibility is important in an app. It makes the application user friendly and thus increasing the application user friendly rate. The application comes with advanced voice Artificial Intelligence. Users can now control the application with just their voice. Moreover, adding a voice recognition AI helps business sales. Ecommerce businesses with voice recognition software has sold more than 55% of their products by simply integrating a voice recognition feature. The number rises when customers get comfortable with the speech recognition technology (RingCentral, 2022). Users can use the AI to add product to the cart or search for a product using the voice command. This helps in different ways.

1. While driving, the AI can read out the information of a product or the user can checkout just using the AI.

2. People with accessibility now can just user their voice to use the application.

### 3.1.5. User Payment Gateway

One of the ways users can buy a product is by using a master or visa card. The implementation of Stripe API helps users to checkout effortlessly. Stripe is an online credit/debit card processor that is used in online businesses for users to pay for the product. The other way a user can pay for the product is cash on delivery. This method is available because it gives user more options to pay and thus increases more checkouts of the product in the cart. And also, it gives the user more freedom on how they would like to pay thus increasing app ratings.

## 3.2 Administration

The administration is basically the store owner. The admin will have full control of the application. Employees of the store can manage by having different accounts made for them. Employees are well-known for not being permanent resources and frequently changing employment. However, in order to prevent unauthorized individuals from accessing the administration program, it is self-evident that everyone should not use the same credentials. Signing up and then signing in is one approach, but that is just for protecting individual information and if you are a direct stakeholder.

The admin panel will be a web application. The web application will be made by flutter. The reason for choosing flutter is because it makes it less complicated to share data between the mobile application and the web application. Every action the admin takes on the web application should reflect real time on the mobile application. The web application will be hosted using Microsoft azure if the azure credits given were graceful.

### 3.2.1. Editing Products

It's the admin job to keep the store up to date. But to keep the store up to date on the latest models they would need a way in accomplishing this task. That's why every admin can add new products to the store as they wish. As much as the store needs to display new products they need to remove outdated products or edit existing products. These all can be easily achieved from the admin panel.

### 3.2.2 Store Analytics

Firebase analytics is a feature offered by Firebase store created by Google. Firebase analytics is a key feature in monitoring the app usage. It provides various information such as average revenue made per month, year, weekly or daily. This helps the organization to modify the store based on the data.

Firebase analytics also provide data such has how many active users in a week. It also provides demographics of users which can be used advertisement based on region.

Firebase analytics offer great ways to show the organization on how a user behaves within the app. This helps the organization to improve user experience and sales. All of these great features can be used by the watch store admin panel.

## 4. Short coming of Unity and Flutter

Managing an augmented reality application that has 3D models can be challenging. Especially when hosting. When it comes to hosting, research show that ARJS can be used instead of hand-writing code in threejs or aframe. Playcanvas, a web-based program similar to Flutter and Unity combination, but it is another option that costs greats amount of money. The disadvantage of this tool is that, unlike Unity, it has poor tracking and performance, not to mention that I'd have to start studying and constructing from scratch. The remaining alternative is 8th Wall, however this asset costs around \$800 to \$1500 per month, which is out of my price range.

Downloading the WebGL setup as a support for your Unity platform will allow you to host the application. However, it only works with 2D and 3D applications, not AR. Unity Technologies "mfuad" demonstrates how WebGL is supported by Unity on major browsers and desktops but not on mobile devices. As a result of these limits, the online deployment of AR-based apps has been hampered.

There may be potential to use runtime to enable AR, but there is still a lot of ground to cover before that becomes a reality. Finally, the idea of using augmented reality on the web is currently being researched.

## 5. Products and Produced Quality

### 5.1. Quality Plan Table

Quality check	Strategy
Validation and requirements	To be conducted after each stage and unit development. Ensuring the gathered requirements are function able by prototyping and continual unit testing and integration testing.
Validation of the system design	Using the HCI (Human Computer interaction) principles when designing to make it user friendly. Receiving feedback after user intervention.
Validation on design architecture	UMLs, DFDs would measure and synchronize data flow and functions

Figure 6: Quality Plan

The goal of the above table is to compare quality criteria in Mc Call's List to monitor product and process quality. (For instance, reusability, flexibility, portability, and integrity.) Quality planning would guarantee that the Work structure was broken down, and the agile approach for specification and design quality would be used.

To ensure that the aforementioned is in action, quality control would compare my prototypes to the final product to assess performance levels.

### 5.2 Quality Control

When it comes to Quality, there are two ways to ensure that a product and the process on which it was developed were of high quality.

One is verification. The task at hand is to compare and evaluate the requirements. The requirement definition may be confirmed by comparing the needs originally acquired during the feasibility research time to the functionality I have adapted on.

"Am I taking the proper steps?" is the question that has to be answered positively. Due to time restriction of other projects, a lack of supporting documents, , I've implemented the Agile approach to planning and by breaking down the project process into a work break down structure, constant system testing, and having my records of the problem in hand, I've verified its objective. Third-party reviews and questionnaires can aid in the matching of instances to the scenario.

After creating a prototype for each feature, the question that comes to mind is have you done correctly. Prototyping key features like Augmented reality watch try on, 3D model rotations, chatting system, Artificial Intelligence voice recognition and having track records on these features after completing them would be very beneficial to the person who would read the project and me.

The product's functionality would be ensured through integration testing and a final system test. A user acceptability test would be conducted by a third party acting as the customer. The input obtained would guarantee that the verification process went well

Test Case	Activation	Test Data	Expected Results	Status
AR try-on	Vuforia camera	3D object	3D watch in reality	success
Showing 3D objects	Product Screen	Using 3D models	Rotating 3D models in app	success
Artificial Intelligence voice recognition	Voice command button click	Human voice	Controlling application using voice commands	Pending
Chat system (Buyer side)	Open chat screen	User unique login ID	Communication between seller and buyer	Pending
User Authentication	Firebase authenticate API function	User details	Successful registration and logging in user	Success
Crud Operation	Insert() Update() Delete() Retrieve()	Input of user data	Updating database based on user actions	Success

Verification	Firebase Verify	User OTP	Confirm user identity	Pending
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Figure 7: Client-Side Key Cases

Test case	Activation	Test Data	Expected Result	Result
Analytics	Retrieve data	Recorded data from user activity in app	Generate charts for business decisions	Pending
CRUD Operations	Insert() Update() Delete()	Data recorded in firebase database	Maintain the application	Success
Chat Application (Seller Side )	Open chat screen	User unique login ID of seller	Communication between seller and buyer	Pending

Figure 8: Administrative Test Cases

## 6. Risk Management

### 6.1 Risks manifested and overcome

Risks manifested	Actions taken to mitigate
Creep Scope Certain plans have altered as a result of the shift in methods, offering me a new field to research while imposing time limits on me.	I adopted a pilot implementation strategy, using what I've previously done and tweaking it with a new area of study, all while doing sprints to evaluate my performance on projects. To track the time I have, I created a critical path with identified area.
Feature creep More features kept flooding the application and was wasting time on certain features	As previously said, I took a different approach to working on my major duties. Started to focus on the core components first.

Multiple project overlaps and deadlines	The final year of university brings a lot of challenges. Multiple courses works and exam is no easy task to manage together since every module is critical.
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Figure 9 : Risk Management Table

## 6.2 Predicted risks and their mitigation techniques.

The threats that are expected for the future are based on what has already happened (see section 9.1).

## 6.3 Risk Assessment Matrix

Risks to be manifested	Probability
Scope creep	30%
Feature creep	30%
Multiple project overlaps and deadlines	40%

## 7. Schedule

The importance of a schedule was explained briefly above. This is the current plan undertaken to accustomed to time management of project completion.

The improvised schedule because of overlapping projects is

Stage	Deadline	Deliverables
Problem Identification	1/11/2021	Project Proposal
Initiation	17/11/2021	Project Initiation document (PID)
Further research and unit testing of functions.		
Debugging and Maintenance.	15/2/2022	Requirement Progression
Instantiating Databases and checking platform viability.		

Implementing backend development.  Graphical User Interface continuation Based on HCI	1/3/2022	Interim report part 2
More testing.  Maintenance and debugging of the program.  Integrating AR.	1/3/2022	Interim report part 2 continuation
Adding more functionality  Testing of overall app.  Checking for bugs. Debugging sessions.	10/3/2022	
Correcting functionality.  Testing out the application with industry standards.	25/3/2022	Maintenance Report
Debugging & Error correction Final system testing	5/4/2022	Final System
Assembling the final report and project	22/4/2022	PRCO303 Report

\*The completed tasks are highlighted in Green

Figure 10 : Schedule

## 7.1 Control Plan

Control Plan is still applied to the project using the following techniques

- 1) Weekly Highlighted Performance reports
- 2) Communication plan (see section 7.2)
- 3) Risk management (see section 6)
- 4) Quality management (see section 5)

## 7.2 Communication plan

In order to discuss project performance, project progress supervisor meeting will be held to have constructive feedback for the project. Feedback meetings will be held after the submission of interim II so that the project has a high-quality production and high project competition rates.

Supervisor Name: Mr. Pramudya Thilakaratne / Mr. Mohamed Shafraz

Date	Reviews	Supervisor
9/11/2021	- Introduction to the project - Explaining the key features	Mr. Shafraz
15/11/2021	- Individual project discussion - Project topic - Project scope	Mr.Pramudya
23/11/2021	- Confirm project - Talks about admin panel - Talks about creating a web application for admin panel	Mr.Pramudya

Figure 11: Supervisor Meeting Minutes

## 8. Resources and Methodologies

### 8.1 Using Agile Method

In the face of unpredictability, most project life cycles can be planned to use an agile methodology. Using agile methodology an early prototype can be made to have a look and feel of how the product is going to turn out. This gives a certain perspective of how the product is going to look and more importantly whether to proceed with the project (Corasystems, 2021). Here are some of the reasons why the project was developed using agile methodology

1. Quality : Testing comes with agile methodology. Testing is crucial to finding bugs and fixing them. Thus, producing high quality product.
2. Predicting risks : Since every step is recorded and measured predicting project risks and mitigating it becomes easier. Ensures the product is built efficiently and effectively.
3. Flexibility on further development : Agile methodology revolves around iterative process. Which means there will be many visions of the project and each new version won't repeat previously made mistakes (kissflow, 2021).

### 8.2. Technologies

1. Unity - Unity is a great platform used for dealing with 3D models. 3D modelling is the process of digitalizing a real word or fictional object.  
The watches are 3D objects rather than static and unity comes to the rescue to work on the 3D objects that imported.

2. Vuforia - Vuforia is a platform used for creating augmented reality application for mobiles. I used image tracking for creating 3D objects in the real world.
3. Firebase – Firebase database by google will be used to store all the store app data. Firebase allows to build both mobile application and web application for a business.
4. Android Studio - Android studio is the official IDE of android. Its purpose is to build fully functional commercial applications for free. Since my project is a mobile application based on android the best IDE to go for is Android Studio.
5. Flutter - Flutter is a google developed framework used for creating clean and impressive mobile application user interface. Flutter can be used to develop web-based applications and have a single database for both mobile and web application.
6. Dart - Dart is an object-oriented programming language that can be used to for multipurpose tasks.

### 8.3. Learning Materials

1. Vuforia documents
2. Flutter documents
3. Pudev documents
4. GitHub
5. Stack overflow
6. LinkedIn
7. YouTube
8. Alan A.I documents
9. Unity documents

## 9. Learning Undertaken

### 9.1 Augmented Reality Try-On

At present, Augmented reality exploded in popularity because of the pandemic. Now a lot of attention has been given to Augmented Reality and Virtual Reality. So, the platforms that's used for development of AR are developing and taking steps in improving the overall developer experience.

Augmented Reality had intrigued me on how amazing we can alter reality and how effective it would be in the future. When I started my project based on AR I had no knowledge on how it worked at first. But then slowly learnt how AR works and the different types of Augmented Reality methods. I learnt the difference of marker-based AR and marker-less AR (Gatis Zvejnieks, 2019).

After days of research on marker-less AR I decided to go with marker-based AR because

1. Marker-based is beginner friendly. Allows one to explore the world of AR without a lot of complication.
2. To implement marker-less AR it required machine learning and Artificial intelligence. This wouldn't be an issue if time constraint was an issue. As a lot of projects needed crucial attention as well. The risk of not completing or undercutting other projects

would be high and cause devastating effect. See figure 6 : Risk management table for more information.

3. Marker-based AR allows to provide high quality AR experience compared to marker-less. Where In marker-less tracking is very unstable and quality is reduced.

At the end weighting down the pros and cons of each type. The best path of course would be marker-based AR.

## 9.2. Developing using flutter

Flutter a language developed by Google has a bright future in the programming word. A lot of companies are migrating to cross-platform development. And moreover, is slowly gaining demand in the industry. So, decided to take a course on flutter and develop the mobile application and web application using flutter (Odedeyi Feyisayo Anthonia, 2022).

Dart is a programming language created by Google. It's mainly created for mobile apps, web application and backend. The language is optimized for clients, so they perform the task fast and clean.

## 9.3. Unity

Unity is a great platform used for dealing with 3D models. 3D modelling is the process of digitalizing a real word or fictional object. Some website offered free 3D models of watches that I could utilize in the project. And some I created using unity.

The watches are 3D objects rather than static and unity comes to the rescue to work on the 3D objects that imported. This is important as it has a unique feature compared to other apps.

# 10. A Draft Table of Contents for the Final Report

Acknowledgment

Abstract

Chapter 1: Introduction

- 1.1 Project Background
- 1.2 Project Scope
- 1.3 Project Objectives
- 1.4 Problem Domain
- 1.5 Solution Outline

Chapter 2: System Analysis

- 2.1 Identifying problem
- 2.2 Requirement identification
  - 2.2.1 Functional Requirement
  - 2.2.2 Non –Functional Requirement
- 2.3 Resource Identification
  - 2.3.1 Software resources
  - 2.3.2 Human resources
- 2.4 The Software Process Model

Chapter 3 : Literature Review

- 3.1 Online shopping mobile apps and Technologies.
- 3.2 Summarization and comparison of application feature.
- 3.3 Technologies and Tools evaluation.

Chapter 4: Design

4.1 Overview of the system.  
4.2 use case Diagram  
4.3 Class Diagram  
4.4 High level Architecture design  
4.5 User Interface design  
Chapter 5: System Implementation  
    5.1 Development Environment  
    5.2 System Increment  
    5.3 Problems and limitations  
Chapter 6: Risk Management  
Chapter 7: Quality Management  
Chapter 8: Testing  
    8.1 Scope of testing  
    8.2 User Interface testing.  
    8.3 Functionality testing.  
    8.4 Test Result Evaluation.  
Chapter 9: Evaluation and Conclusion  
    9.1. Identified Problems  
    9.2. Conclusions  
    9.3 Future enhancements  
Chapter 10: Appendices  
    10.1. PID  
    10.2. Interim I & Interim II  
    10.3. Abstract  
Chapter 11: Meeting Minutes  
References

## 11. A Draft of a sample chapter from the final report

### Chapter 1: Introduction 1.1

#### Project Background

The world's present trends introduce us to a new type of internet use known as online shopping. What is the definition of online shopping? It is a type of electronic commerce that lets users to use a web browser to immediately access, purchase, or sell items or services. Online shopping has progressed throughout time, making it easier for customers to access any goods from anywhere on the planet.

With the advancement of mobile phones, the online shopping sector expanded even further, resulting in the creation of shopping Apps, allowing customers to browse without being restricted to their computers. One of the most significant issues with online shopping is that customers cannot see what they are purchasing. This turns off a lot of potential customers.

Figure 12 : Final report sample

## 21.7 Meeting Minutes

**Final Year Project – Supervisory meeting minutes**

Meeting No: 01

Date : 09/11/2021

Project Title : AK Smart Watch Store

Name of the Student : K. Shanuka

Students ID : 10207370

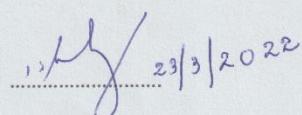
Name of the Supervisor : Mr. Mohamed Shafraz

**Items discussed:**

- About the project
- Discussed whether the scope was enough

**Items to be completed before the next supervisory meeting:**

- Project initiation document (PID)
- Confirmed design structure

  
23/3/2022

Supervisor (Signature & Date)

Instructions to the supervisor: **Do not sign** if the above boxes are blank.

**Final Year Project – Supervisory meeting minutes**

Meeting No: 02

Date : 15/11/2021

Project Title : AR Smart Watch

Name of the Student : K Shanuka

Students ID : 10707370

Name of the Supervisor : Mr. Pramudya Thilakarathne

**Items discussed:**

- Individual final year project discussion
- Project topic
- Scope of the project

**Items to be completed before the next supervisory meeting:**

- Low-fidelity prototype

.....  
Supervisor (Signature & Date)

Instructions to the supervisor: Do not sign if the above boxes are blank.

<https://plymouth.zoom.us/j/92510236619?pwd=WWJFV29RbGV6cEhMejh5ai8xZDBhQT09>

(First online general meeting)

**Final Year Project – Supervisory meeting minutes**

Meeting No: 03

Date : 23/11/2021

Project Title : AR Smart Watch Store

Name of the Student : K Shanuka

Students ID : 10707370

Name of the Supervisor : Mr. Pramudya Thilakaratne

**Items discussed:**

- Admin side of the project
- Design for the admin side
- Confirmed the project

**Items to be completed before the next supervisory meeting:**

- prototype of the project (rough)

.....  
Supervisor (Signature & Date)

Instructions to the supervisor: **Do not sign** if the above boxes are blank.

<https://plymouth.zoom.us/j/98606567606?pwd=VG43UlZhd2ZmRVQzcHhiQ0RMbVJCQT09>

**Final Year Project – Supervisory meeting minutes**

Meeting No: 04

Date : 14/03/2022  
Project Title : AR Smart Watch Store  
Name of the Student : K. Shanuka  
Students ID : 10707370  
Name of the Supervisor : Mr. Pramudya Thilakaratne

**Items discussed:**

- Store A-I
- Stripe Service

**Items to be completed before the next supervisory meeting:**

- Functioning of store A-I

Supervisor (Signature &amp; Date)

Instructions to the supervisor: Do not sign if the above boxes are blank.


**Pramudya Thilakaratne**  
To You

14 Mar

...

Dear Krishan

Shall we meet at 4:30pm local time today? If so,  
please send me your NSBM email address.

Thank you.

**Regards**
**Pramudya Thilakaratne**
**Lecturer**
**Course Coordinator Plymouth University Degree**
**Programs - FOC**
**Department of Computer Science & Software Engineering**
**Faculty of Computing**

NSBM Green University Town, Mahenawatta, Pitipana,  
Homagama

Office: [94-11-5446000](tel:94115446000) | Fax: [+94-11-54450009](tel:941154450009) |

Email: [pramudya.h@nsbm.lk](mailto:pramudya.h@nsbm.lk) | Web: [www.nsbm.lk](http://www.nsbm.lk)


## Accepted: Final Year Project Discussion



You

To Pramudya Thilakaratne

14 Mar

...



Mon, 14 Mar, 5:00 PM (15m)

You accepted.

(Invite based)



### Final Year Project – Supervisory meeting minutes

Meeting No: 05

Date : 23/03/2022

Project Title : AR Smart Watch Store

Name of the Student : K Shanuka

Students ID : 10707370

Name of the Supervisor: Mr. Pramodya Thilakaratne

#### Items discussed:

- The upbring of the mobile app
- The admin panel

#### Items to be completed before the next supervisory meeting:

- Complete adding products and managing them.
- Manage users

.....  
Supervisor (Signature & Date)

Instructions to the supervisor: Do not sign if the above boxes are blank.

### Physical meeting



### Final Year Project – Supervisory meeting minutes

Meeting No: 06

Date : 18/05/2022  
Project Title : AR Smart Watch Store  
Name of the Student : K. Sharanya  
Students ID : 10707370  
Name of the Supervisor : Mr. Pramodya Thilak Karatne

#### Items discussed:

- Spoke about the admin panel
- Improvement's needed.
- Report
- Testing

#### Items to be completed before the next supervisory meeting:

- Dashboard completion
- Report.

.....  
Supervisor (Signature & Date)

Instructions to the supervisor: Do not sign if the above boxes are blank.

[https://teams.microsoft.com/l/meetup-join/19%3ameeting\\_ZWM2M2VINTgtZDZkOS00OGM0LWI4MWEtMWEyNTViZDE5YjBi%40thread.v2/0?context=%7b%22Tid%22%3a%229486ac65-39d3-4d25-977c-76d9c31c0046%22%2c%22Oid%22%3a%2267a2c8d5-0cc5-4c5c-a89b-8a91d3392f47%22%7d](https://teams.microsoft.com/l/meetup-join/19%3ameeting_ZWM2M2VINTgtZDZkOS00OGM0LWI4MWEtMWEyNTViZDE5YjBi%40thread.v2/0?context=%7b%22Tid%22%3a%229486ac65-39d3-4d25-977c-76d9c31c0046%22%2c%22Oid%22%3a%2267a2c8d5-0cc5-4c5c-a89b-8a91d3392f47%22%7d)

**Final Year Project – Supervisory meeting minutes**

Meeting No: 07

Date : 24/05/2022

Project Title : AR Smart Watch Store

Name of the Student : K. Shamala

Students ID : 10207370

Name of the Supervisor : Mr. Pramudya Thilakarathne

**Items discussed:**

- completed dashboard
- final year report
- poster

**Items to be completed before the next supervisory meeting:**

- Supplying dashboard with data
- To make progress in the report.

.....  
Supervisor (Signature & Date)

Instructions to the supervisor: **Do not sign** if the above boxes are blank.

[https://teams.microsoft.com/l/meetup-join/19%3ameeting\\_MTVIZGFmNTktNjEzMy00MjY2LWJiTctZGU4ZThjMDg2MDcy%40thread.v2/0?context=%7b%22Tid%22%3a%229486ac65-39d3-4d25-977c-76d9c31c0046%22%2c%22Oid%22%3a%2267a2c8d5-0cc5-4c5c-a89b-8a91d3392f47%22%7d](https://teams.microsoft.com/l/meetup-join/19%3ameeting_MTVIZGFmNTktNjEzMy00MjY2LWJiTctZGU4ZThjMDg2MDcy%40thread.v2/0?context=%7b%22Tid%22%3a%229486ac65-39d3-4d25-977c-76d9c31c0046%22%2c%22Oid%22%3a%2267a2c8d5-0cc5-4c5c-a89b-8a91d3392f47%22%7d)

**Final Year Project – Supervisory meeting minutes**

Meeting No: 08

Date : 27/05/2022  
Project Title : AR Smart Watch Store  
Name of the Student : Mr. Shanuka  
Student ID : 10707370  
Name of the Supervisor : Mr. Pramudya Thilakaratne

**Items discussed:**

- Completed dashboard
- Demo of the web application.
- Admin management

**Items to be completed before the next supervisory meeting:**

- Finalize report
- To check online status of users.

Supervisor (Signature & Date)

Instructions to the supervisor: Do not sign if the above boxes are blank

[https://teams.microsoft.com/l/meetup-join/19%3ameeting\\_MDRkNmJkODctZTRmNS00ZTRhLWizNmEtM2MwZjc0ZWQ3MjFj%40thread.v2/0?context=%7b%22Tid%22%3a%229486ac65-39d3-4d25-977c-76d9c31c0046%22%2c%22Oid%22%3a%2267a2c8d5-0cc5-4c5c-a89b-8a91d3392f47%22%7d](https://teams.microsoft.com/l/meetup-join/19%3ameeting_MDRkNmJkODctZTRmNS00ZTRhLWizNmEtM2MwZjc0ZWQ3MjFj%40thread.v2/0?context=%7b%22Tid%22%3a%229486ac65-39d3-4d25-977c-76d9c31c0046%22%2c%22Oid%22%3a%2267a2c8d5-0cc5-4c5c-a89b-8a91d3392f47%22%7d)