A PROJECT REPORT ON

Augmented Reality Application for Home Shopping in Mcommerce using Markerless Tracking

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY ,
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REQUIREMENTS FOR THE AWARD OF THE DEGREE

BACHELOR OF ENGINEERING
(Computer Engineering)

BY

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SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
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CERTIFICATE

This is to certify that the Project Entitled

Augmented Reality Application for Home Shopping in Mcommerce using Markerless Tracking

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is a bonafide work carried out by them under the supervision of Prof. Yogita Narwadkar and it is approved for the partial fulfillment of the requirement of Savtribai Phule Pune university, Pune for the award of the degree of Bachelor of Engineering (Computer Engineering).

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Acknowledgement

It gives us pleasure in presenting the partial project report on **'Augmented Reality Application for Home Shopping in Mcommerce using Markerless Tracking'**.

Firstly, we would like to express our indebtedness appreciation to our internal guide **Prof. Yogita Narwadkar**. Her constant guidance and advice played very important role in making the execution of the report. She always gave us her suggestions, that were crucial in making this report as flawless as possible.

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Last but not the least, the backbone of our success and confidence lies solely on blessings of dear parents and lovely friends.

Ankur Chaudhari
Aditi Rupade
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Abstract

Augmented reality brings components of the digital world into a person's perception of the real world. Mcommerce is constantly changing and those wanting to get ahead in the market need to have their finger on the pulse. More than half number of shoppers abandon their carts before completing a purchase or return a particular product saying that it was not as expected. This indicates that retailers need to do a lot more to convince customers to follow through with their choice and purchase items online. Augmented reality has the potential to reshape the world of retail.
The Augmented Reality Application for Home Shopping will help users to get a better view of the product by providing its virtual representation. It gives the user a mocked-up version of how their home could look when fitted out with various items or products. The major problems that Mcommerce sites face is users feedback that the product was not as expected. The entire scene that users see is a virtually generated version of a home, and the immersive experience allows them to become spatially aware of how various products would appear. The current market works on Marker-based Tracking which hampers the true value of Augmented Reality. The proposed methodology provides an idea of using Markerless Tracking which is more efficient and requires less effort from users side as compared to Marker-based Tracking.

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List of Abbreviations

AR ..... Augmented Reality

CNN ..... Convolutional Neural Network

SIFT ..... Scale-invariant feature transform

SDK ..... Software Development Kit

GPS ..... Global Positioning System

QCAR ..... Qualcomm Augmented Reality

CMS ..... Content Management System

DAO ..... Data Access Object

1.

Introduction

1.1 Overview

The application is being developed with the intention of providing a better shopping experience to the users. The disadvantage of online shopping is that users dont get what they expected. This leads to lots of rejections and the users may abandon the usage of the site which in turn may lead to decrease in the user base of the retailer. The application provides a virtual view of the products which the user intents to buy. As it uses Markerless Tracking, it provides a greater scope to the user to drag and drop the product in the physical view, as and where required.

1.2 Motivation

1. The major disadvantage of online shopping is that users don't get the product as they expected it to be.They don't like what they see which leads to return of the product and may further lead to abandoning of the website by the user.Due to these returns and rejections, the user base of the retail company reduces. Also, this may lead to unnecessary waste of transportation.

2. This application is hence being build with the concern to avoid such sort of rejections and returns of the product.The aim is to increase the user base of the company, to provide a better shopping experience to the users and to achieve high return on investment.

3. As AR is a young technology, people are fascinated by it's features. This will help to provide a better shopping experience to the users. Users will be excited to use such an application as it will provide a better insight on how the product will appear in the real environment and also will be a fun way of shopping.

1.3 Problem Definition and Objectives

The hypothesis is to build an augmented reality application having the capability of showing virtual images of the products in the real world while shopping online using Marker-less Tracking through Vuforia SDK which uses QCAR algorithm for object detection and feature extraction.

1.4 Project Scope and Limitations

1. The current market works on Marker-based tracking which hampers the growth of AR. This application hence uses Marker-less Tracking to detect the real world environment accurately.

2. Use of professional studios for developing virtual representation of the real world entities , i.e. products in this case. The use of these studios will help to develop good quality products and will further help rendering them in a better way.

3. The application is available on all devices, i.e. Android, iOS, UWP devices. There is no restraint on the device OS. The same application can be built for various devices.

4. The limitation of this application is that it supports only those devices that are supported by Vuforia SDK. Those devices are termed as Fusion-Supported devices. If the device is not available in this list, then it won't support ground plane analysis functionality.

1.5 Methodologies for Problem Solving

1. Problem Definition :
   The hypothesis is to build an augmented reality application having the capability of showing virtual images of the products in the real world while shopping online using Marker-less Tracking through Vuforia SDK which uses QCAR algorithm for object detection and feature extraction.

2. Problem Analysis :
   The application needs to provide virtual images and render them to fit the view in all 360 degrees rotation. While the user is moving, the virtual object should remain in the same place as well as the user shoudl be able to see the object in all directions.

3. Solution :
   The input frame is processed through many steps to get the output frame. The input frame is firstly converted into pixel format and send to Vuforia module.The vuforia tracker module uses QCAR algorithm. QCAR consists of a few number of algorithms to identify and to track the target and three-dimensional objects, allowing the user to adjust position of a virtual objects with real world images that are displayed through the smartphone screen in real-time. The tracker in the module will track the position of the image in real-time so that the view of the object and its environment can be in accordance with the user's view in the applications, which create virtual objects that appear similar to the real world.

2.

Literature Survey

2.1 Literature Survey

Table 2.1: Literature Table

Sr.No.	Title of Paper	Authors	Publications	Summary of paper
1	Implementation of Mobile Augmented Reality Based on Vuforia and Rawajali	Cheng Xiao, Zhang Lifeng	2014 IEEE 5th International Conference on Software Engineering and Service Science	This paper proposes an application framework, the function of system core class and application workflow. This paper illustrates the use of Vuforia SDK for image recognition, to trace and register image markers and the working and Architecture of Vuforia.
2	Augmented Reality in E-commerce with Markerless Tracking	Xinyu Li, Dongyi Chen	2010 2nd IEEE International Conference on Information Management and Engineering	This paper proposes an approach to feature point correspondence of image sequence based on transient chaotic neural networks. Through this approach a new markerless visual tracking technology with image feature can be used in AR E-commerce applications.
3	Implementation of Augmented Reality System for Smartphone Advertisements	Young-geun Kim, Won-jung Kim	International Journal of Multimedia and Ubiquitous Engineering,Vol.9, No.2 (2014), pp.385-392, 1955	This paper has used the markerless augmented reality system on smartphones to design and implement the smartphone application service aimed at efficiently conveying information on advertisements to users. This paper has also elaborated a few examples of Markers and Non-markers in Augmented Reality.
4	Augmented Reality Using Vuforia for Marketing Residence	Dennise Adrianto, Monica Hidajat,Violitta Yesmaya	2016 1st International Conference on Game, Game Art, and Gamification (ICGGAG)	This study paper was made to produce an application by applying Augmented Reality on the Android platform that is intended for marketing promotions of residence. This paper uses a software named Vuforia (QCAR) to implement augmented reality in mobile applications for marketing residence.

3.

Software Requirements Specification

3.1 Assumptions and Dependencies

The Ideal Case :

1. When the user logs in with the appropriate login credentials, then proper authentication should be done in order to ensure security.
2. The quality of all the models should be good and the rendering must take place properly.
3. The real environment view must be captured accurately in the camera frames.
4. The objects boundaries must be detected and when the virtual object is placed, overlapping should not take place.

Dependencies :

1. AR is supported for Android 6+ version and iOS 9+ version.
2. This app works properly on fusion-supported devices only.
3. For development, Vuforia SDK with support for Unity is required.

3.2 Functional Requirements

3.2.1 Interface requirements

1. Login/Register screen for user.
2. A menu or itemlist to browse through the product catalog.
3. Rendered view of the selected product.

3.2.2 Business Requirements

1. Product must be selected before capturing the real environment.
2. After selecting the product, the flow moves to the camera preview where the real environment is captured frame by frame.
3. Before rendering the final view, the processing takes place to calculate the location of the objects in the environment and to ensure that no overlapping takes place between the virtual product and real world entities.

3.2.3 Regulatory/Compliance Requirements

1. Only registered users having appropriate login credentials can have access to the application.
2. The users database is consistent and up-to-date and is always up and running.
3. The processing takes place on the server, hence this server is also up and running.

3.3 External Interface Requirements

3.3.1 User Interfaces

1. Android Version 6+
2. iOS Version 9+

3.3.2 Hardware Interfaces

1. Mobile Device
2. AR Headset (optional)

3.3.3 Software Interfaces

1. Unity IDE - 2018 version
2. Vuforia SDK

3.3.4 Communication Interfaces

1. Internet Connectivity
2. Vuforia Databse Repository

3.4 Nonfunctional Requirements

3.4.1 Performance Requirements

1. The quality of the models should be good as they should appear as if they were real.
2. The rendering of the converted frame should be faster.
3. The target buffer should be fast and should refresh and flush the frames without any hindrances.

3.4.2 Safety Requirements

1. Proper testing should be carried out in all phases of the development.
2. The testing carried out should include GUI testing, Unit testing, Integration and System testing, Regression testing and Compatibility Testing.

3.4.3 Security Requirements

1. The users can login and view only their own profile. They cannot add or remove any other users as well.
2. Administrators can add and remove users.Administrators also have to maintain the cloud database where various products are stored.

3.4.4 Software Quality Attributes

1. **Correctness :** The application should perform correct calculations regarding boundaries of other objects in the real world environment and overlapping if any should be avoided completely. Also, the object should be placed on the ground plane, not above or below it.
2. **Reliability :** The rendering of the object should take place faster without any hindrances. The quality of the rendered objects should be good, so as they should appear like the real world objects.
3. **Usability :** The application should be easy to use. All the elements in the application should be well understood and easily accessible. The text and colour contrast should be proper.
4. **Availability :** The Vuforia cloud where the models are stored should be available to the user always. Also, the server where the processing and calculations for rendering the frame takes place should be available.

3.5 System Requirements

3.5.1 Database Requirements

1. Vuforia Cloud Database : To store the models of the products.
2. Vuforia Target Database : To perform feature matching with training dataset.

3.5.2 Software Requirements

1. Unity 2017+
2. Vuforia SDK (with Unity compatibilty)

3.5.3 Hardware Requirements

1. Mobile Device
2. AR Headset (Optional)

3.6 Analysis Models: SDLC Model to be applied

RAD Model :

Rapid application development is a software development methodology that uses minimal planning in favor of rapid prototyping. A prototype is a working model that is functionally equivalent to a component of the product. In the RAD model, the functional modules are developed in parallel as prototypes and are integrated to make the complete product for faster product delivery. Since there is no detailed preplanning, it makes it easier to incorporate the changes within the development process. RAD projects follow iterative and incremental model.

Following are the various phases of the RAD Model

1. Business Modeling The business model for the product under development is designed in terms of flow of information and the distribution of information between various business channels.
2. Data Modeling The information gathered in the Business Modeling phase is reviewed and analyzed to form sets of data objects vital for the business.
3. Process Modeling The data object sets defined in the Data Modeling phase are converted to establish the business information flow needed to achieve specific business objectives as per the business model.
4. Application Generation The actual system is built and coding is done by using automation tools to convert process and data models into actual prototypes.
5. Testing and Turnover The overall testing time is reduced in the RAD model as the prototypes are independently tested during every iteration.

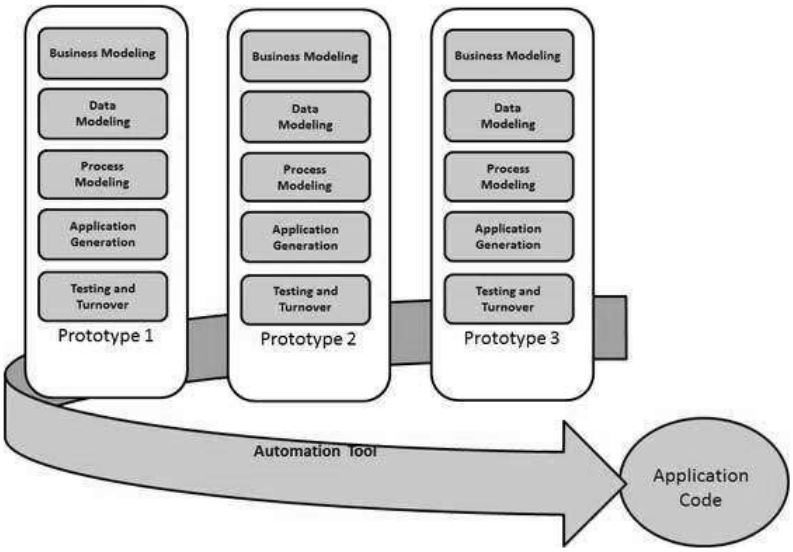

Figure 3.1: RAD Model

4.

System Design

4.1 System Architecture

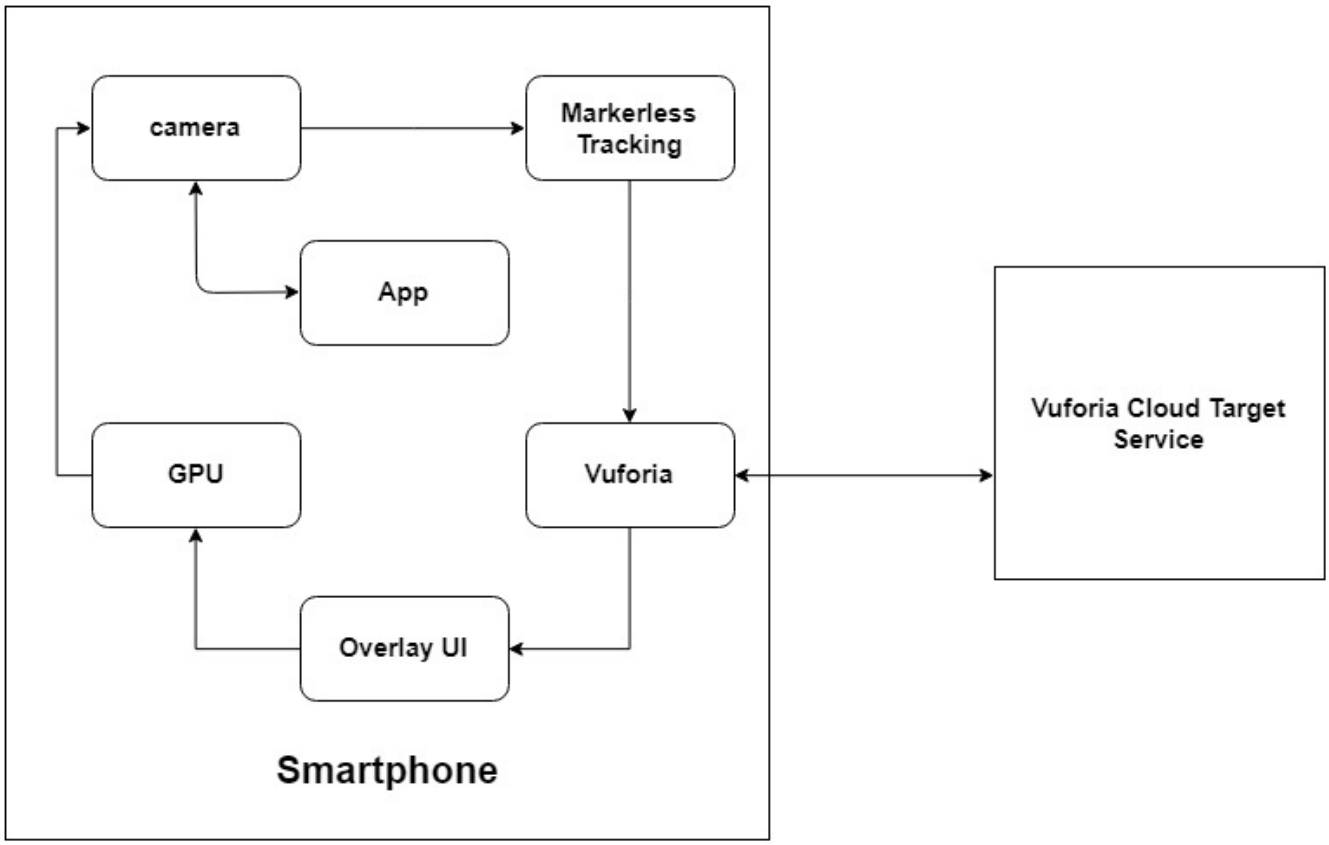

Figure 4.1: System Architecture

1. **Input :** The physical view of the environment (frame) where the user desires to view the virtual object. The input view is captured through Mobile camera or Headset. It captures the images frame by frame and later all the operations are performed on these frames.

2. **Methodology :** The input frame is processed through many steps to get the output frame. The input frame is firstly converted into pixel format. The reason to perform this conversion is that the application will be used on different platforms which will be having different hardware and graphics card specifications. To match this incompatibility, the frames are converted into Pixel Format. There are various formats available like rgb, bgr, gray scale, etc. Usually gray scale conversion is used for frame markers and RGB/BGR is used for other types of targets. As this application is uses Image Targets, therefore RGB/BGR conversion is required. This converted frame along with user defined targets is provided as input to the tracker module. The vuforia tracker module uses QCAR algorithm.
   QCAR vuforia consists of a few number of algorithms to identify and to track the target and three-dimensional objects, allowing the user to adjust position of a virtual objects with real world images that displayed through the smartphone screen in real-time. The virtual object will track the position of the image in real-time so that the view of the object and its environment can be in accordance with the user's view in the applications, which create virtual objects that appear similar to the real world. It uses SIFT for feature extraction and neural networks for feature matching.

3. **Output :** The desired output of the application is superimposition of virtual object on the physical view of the environment. The virtual model can be dragged and dropped in the environment wherever the user desires to place the product.

4.2 Mathematical Model

1. Input:
   The physical view of the environment (frame) where the user desires to view the virtual object. The input view is captured through Mobile camera or Headset. It captures the images frame by frame and later all the operations are performed on these frames.

2. Databases:
   Vuforia Engine device databases enable the application to rapidly recognize targets. Device databases can be included in the app at installation or updated dynamically from a server. The database consists of the 3D models that will be fetched once the user clicks on the model in the application.

3. Processing:
   QCAR algorithm of vuforia consists of a few number of algorithms to identify and to track the target and three-dimensional objects, allowing the user to adjust position of a virtual objects with real world images that are displayed through the smartphone screen in real-time. It consists of SIFT and CNN for processing. The two algorithms, SIFT and CNN will help to calculate distances from users point of view in accordance to user defined targets.
   The tracker module will return an object consisting of the converted frame and target snapshot. Target snapshot acts as a buffer so that when the user is continuously changing the view (by moving the cameras angle), there wont be any hindrances. This object will be send to the Android Application. The android applications elements are accessed using Query State Object which is a DAO class in Android. Through this, the application logic is updated. Finally the cameras view is rendered so that user can see the Virtual Object.

4. Output:
   The desired output of the application is superimposition of virtual object on the physical view of the environment. The virtual model can be dragged and dropped in the environment wherever the user desires to place the product.

4.3 UML Diagrams

4.3.1 Class Diagram

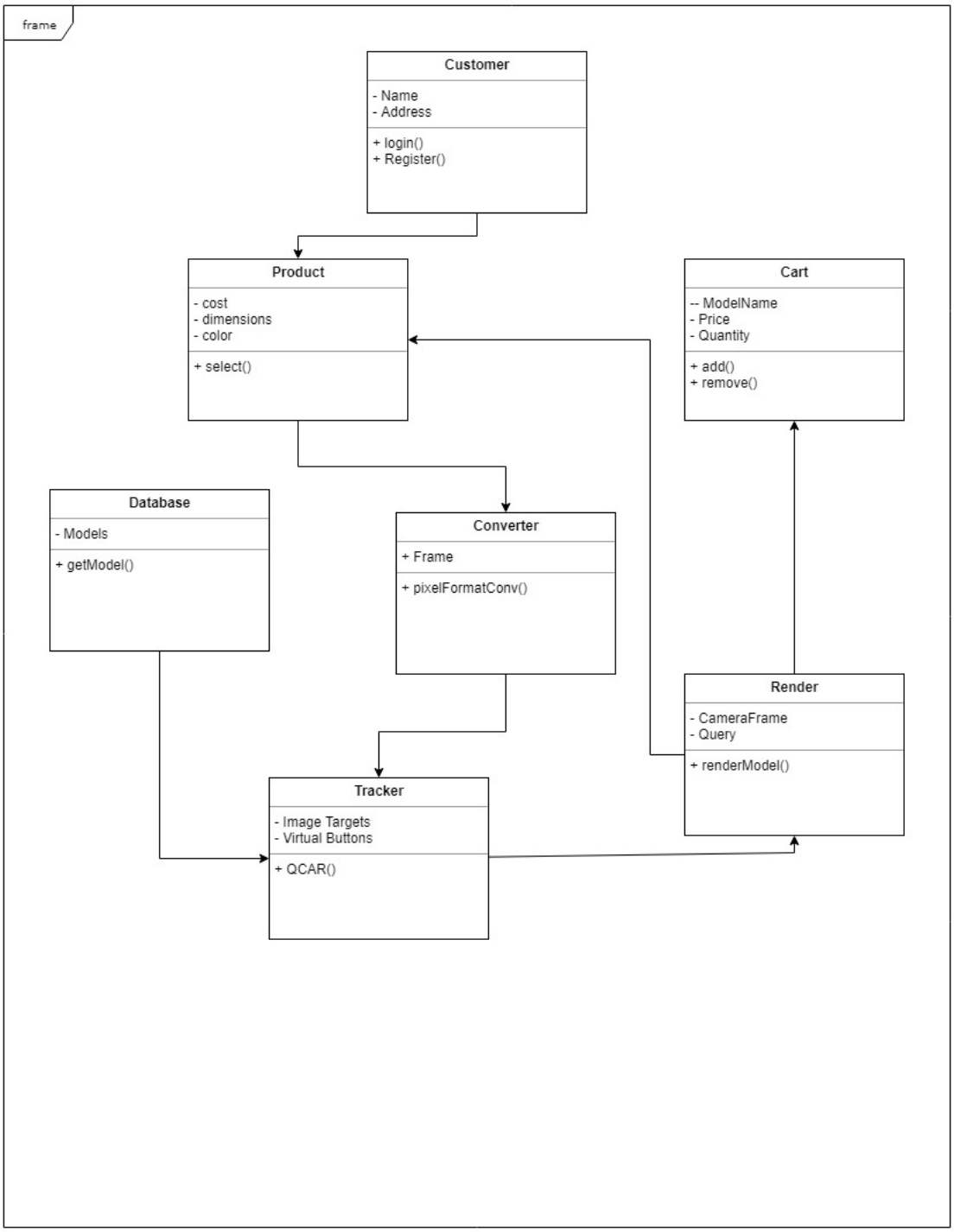

Figure 4.2: Class Diagram

4.3.2 Activity Diagram

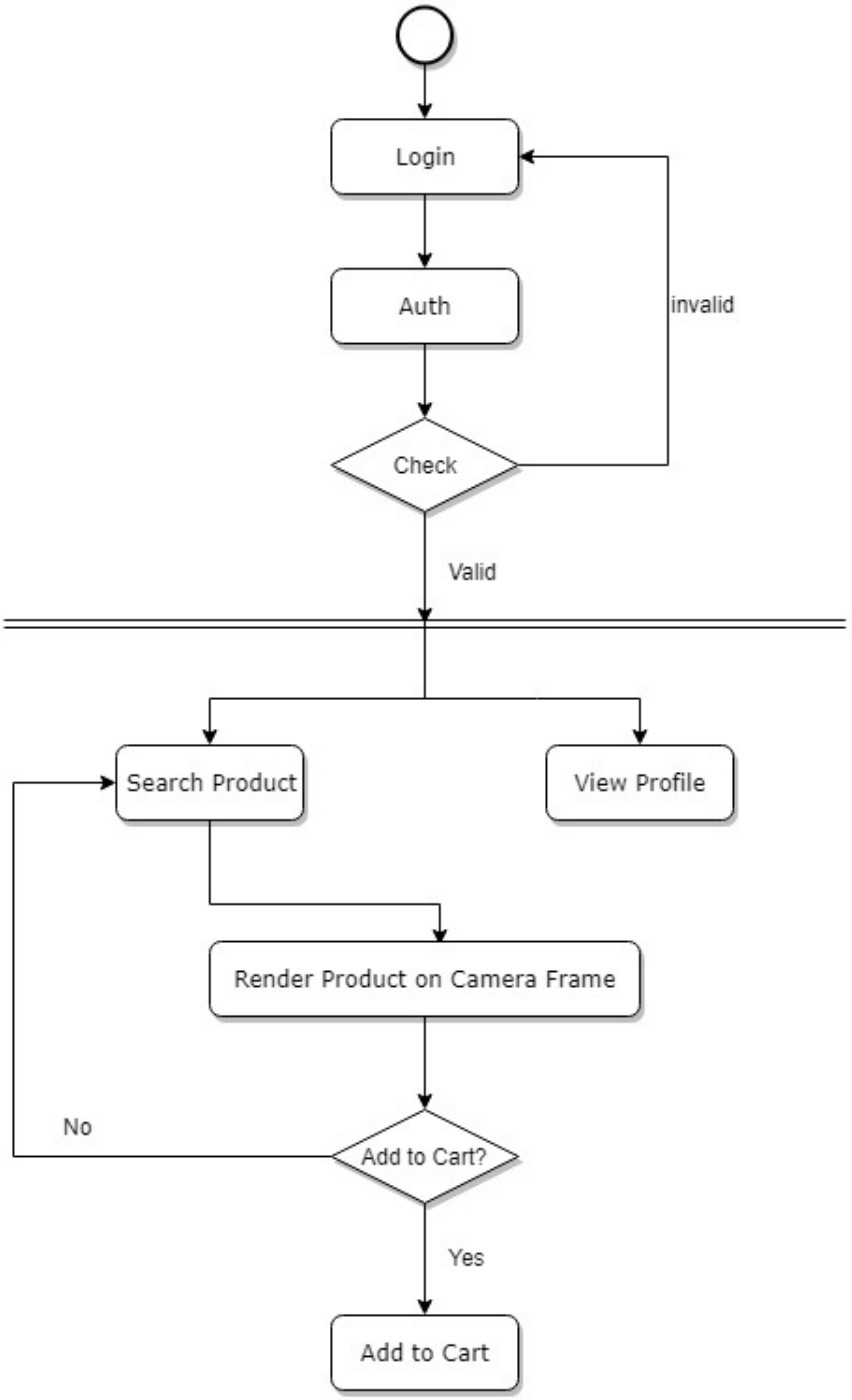

Figure 4.3: Activity Diagram

4.3.3 Usecase Diagram

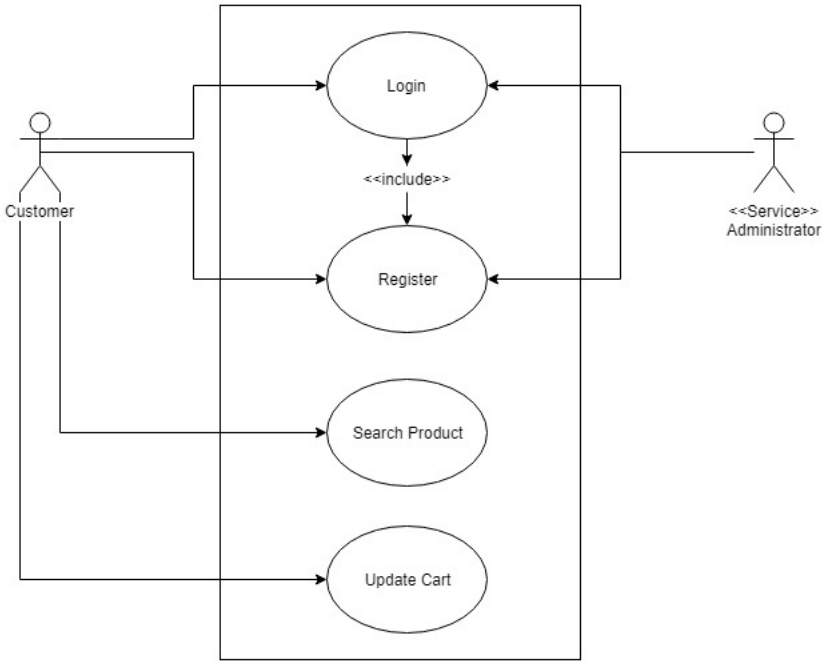

Figure 4.4: Usecase Diagram

4.3.4 State Machine Diagram

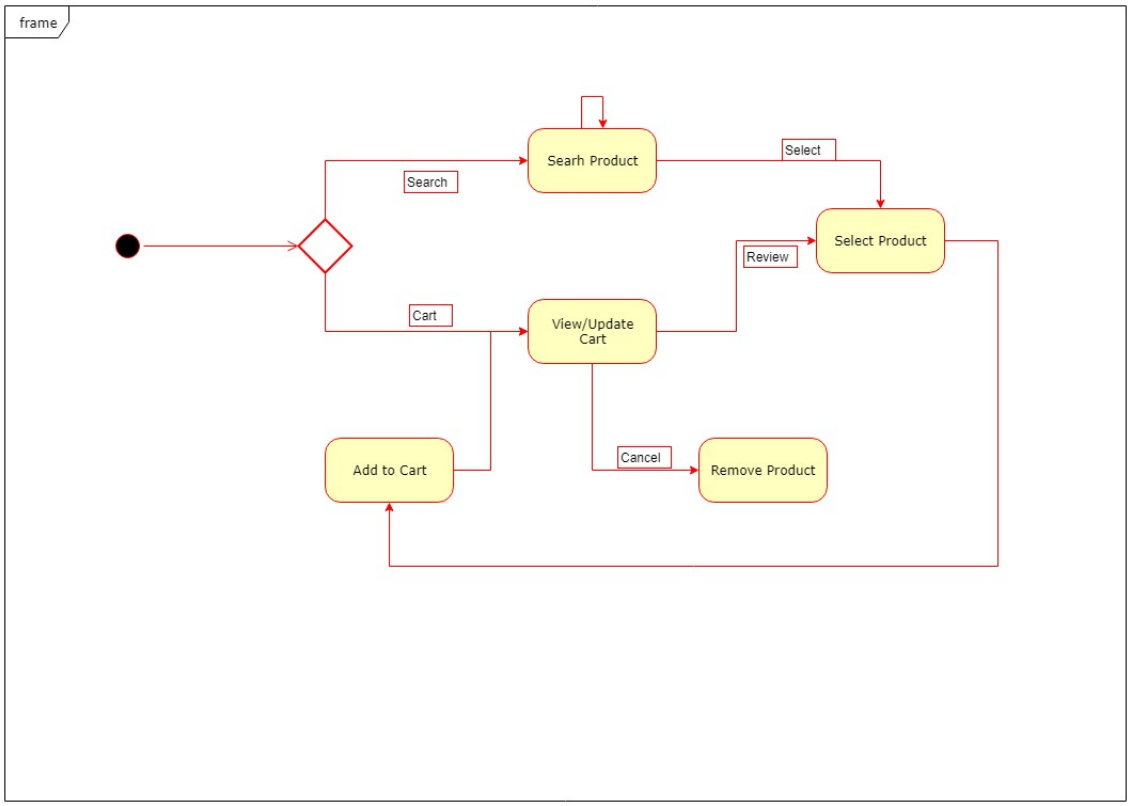

Figure 4.5: State Machine Diagram

4.3.5 Component Diagram

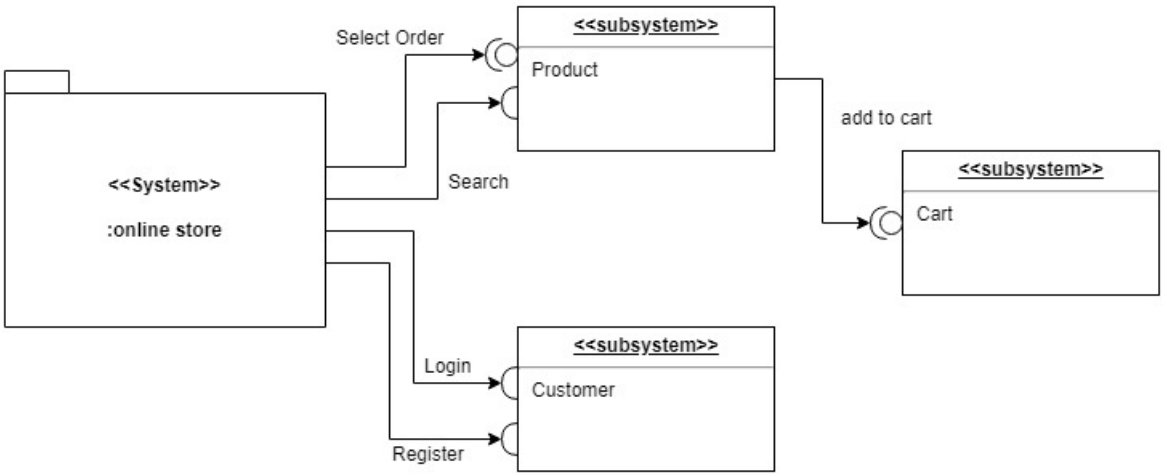

Figure 4.6: Component Diagram

4.3.6 Communication Diagram

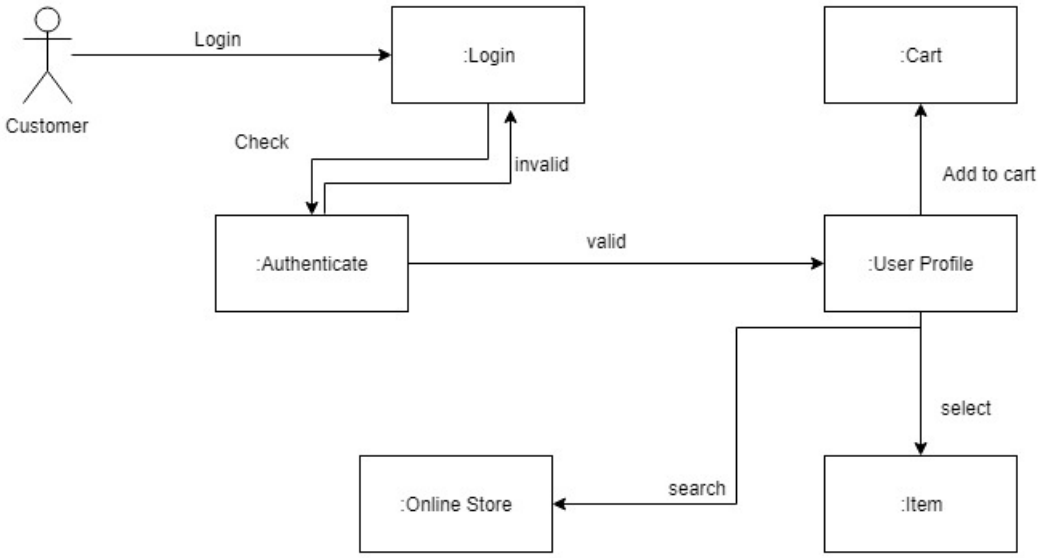

Figure 4.7: Communication Diagram

4.3.7 Sequence Diagram

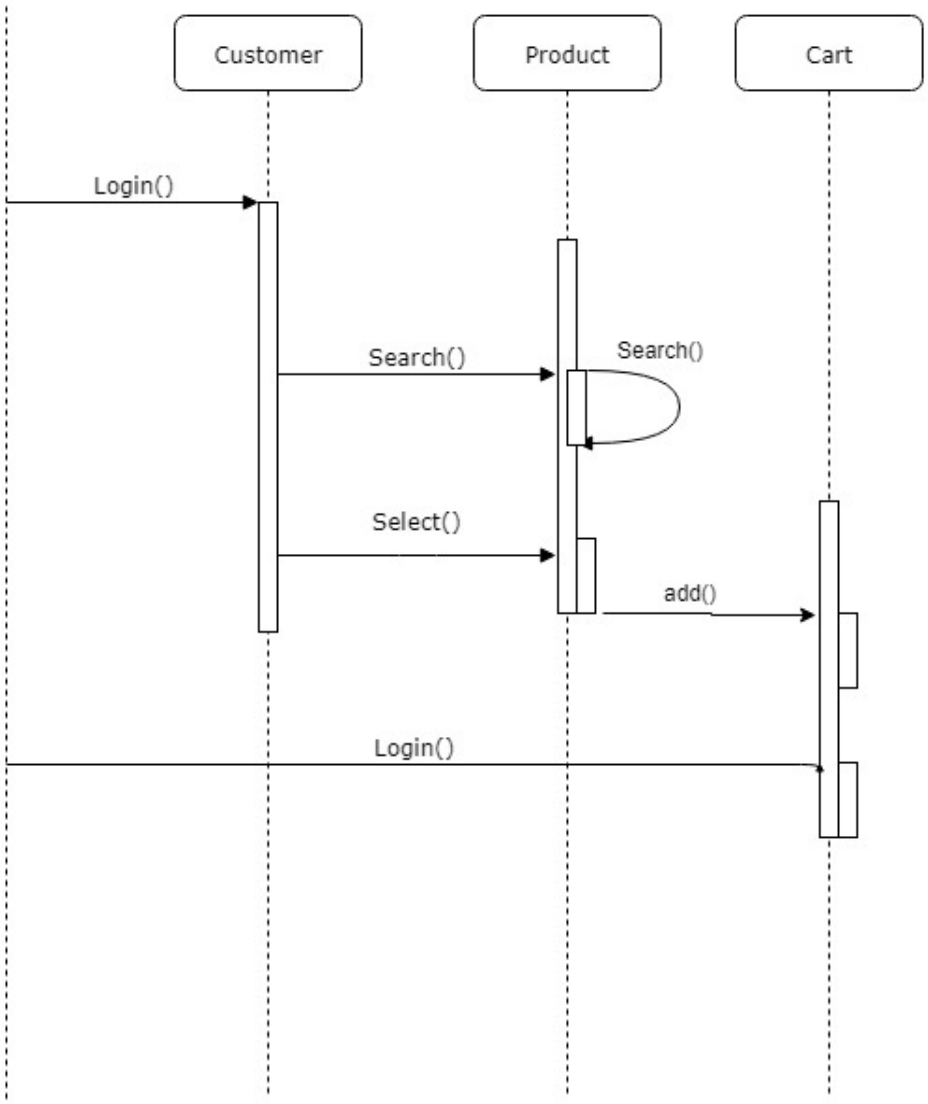

Figure 4.8: Sequence Diagram

4.3.8 Package Diagram

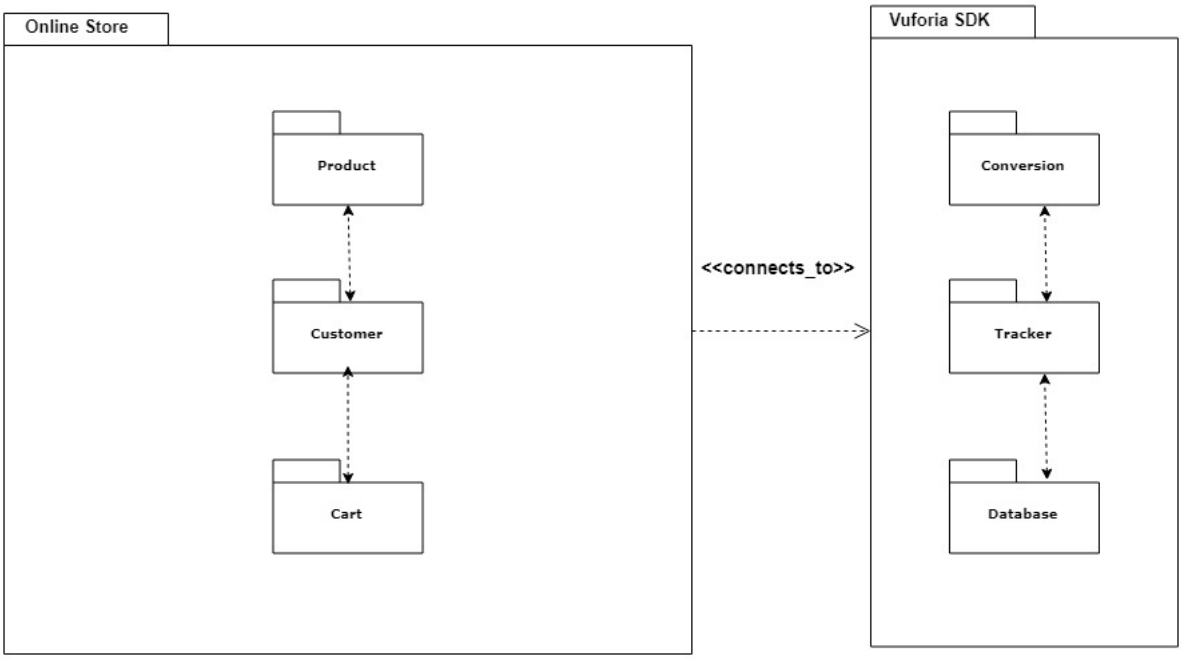

Figure 4.9: Package Diagram

4.3.9 Deployment Diagram

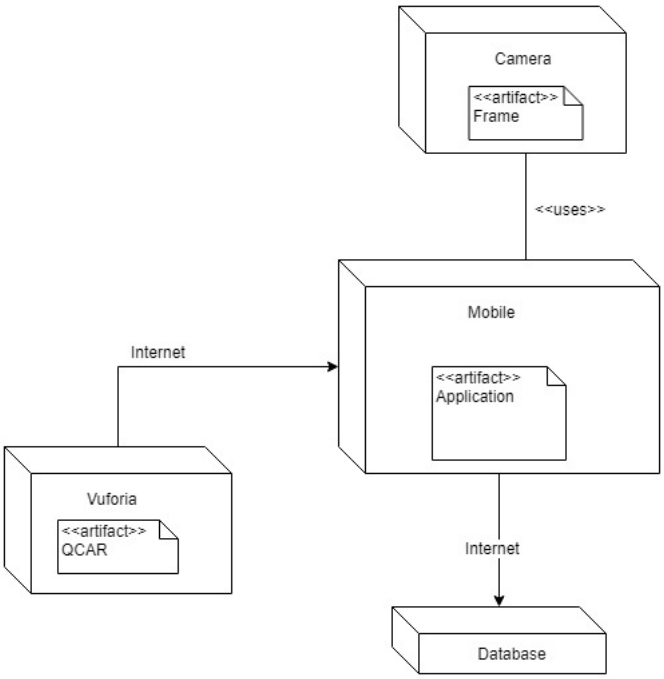

Figure 4.10: Deployment Diagram

5.

Project Plan

5.1 Project Estimate

5.1.1 Reconciled Estimates

1. Software costs :
   (a) Unity IDE 2018v - Free
   (b) Vuforia Engine 8.1 - Free
   (c) In case of increasing database memory of Vuforia - Rs.3000 - 7000
2. Hardware Costs :
   (a) AR headset - Rs.8000

5.1.2 Project Resources

1. Windows Laptop/MacBook
2. Fusion supported device
3. Unity IDE with support for Vuforia

Table 5.1: Risk Table

ID	Risk Description	Probability	Overall Impact
1	Network Connectivity	high	high
2	Ground plane detection	medium	low
3	Overlapping of objects	medium	low

5.2 Risk Management

5.2.1 Risk Identification

For risk identification, review of scope document, requirements specification and schedule is done. Answers to the questionnaire revealed some risks.

5.2.2 Risk analysis

1. If network connectivity is lost then database will not be connected to the application and thus, models will not be fetched.
2. If fusion supported devices are not used then ground plane detection will not work. Ground plane

Table 5.2: Risk Probability Definition

Probability	Value	Description
High	Probability of Occurence	greater than 75 percentage
Medium	Probability of Occurence	26 - 75 percentage
Low	Probability of Occurence	less than 75 percentage

detection will take place within 10 meter distance.

3. Virtual objects may overlap with real world objects which may cause confusion.

5.3 Project Schedule

5.3.1 Project Task Set

Table 5.3: Project Task Set

No	Task	Start Date	End Date
1	Idea Research	15th Jun 2018	30th Jun 2018
2	Idea Finalization	1st Jul 2018	20th Jul 2018
3	Software and Hardware Requirements	21st Jul 2018	15th Aug 2018
4	Scene 0 Development	20th Aug 2018	25th Sept 2018
5	Ground Plane Detection	27th Sept 2018	24th Oct 2018
6	Database Management	24th Oct 2018	2nd Nov 2018
7	Scaling Problem Solved	10th Dec 2018	25th Dec 2018
8	Developing GUI	3rd Jan 2019	29th Jan 2019
9	Integration of above Modules	1st Feb 2019	25th Feb 2019
10	Testing	28th Feb 2019	20th Mar 2019

5.3.2 Task Network

Task Network is a graphic representation of the task flow for a project. It depicts sequence, concurrency and dependency. It points out inter-task dependencies to help the team ensure continuous progress towards project completion.

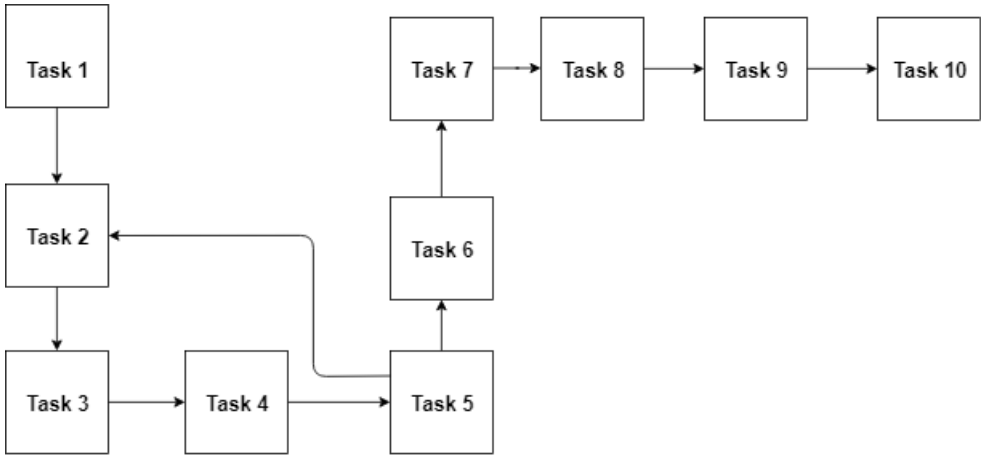

Figure 5.1: Task Network

5.3.3 Timeline Chart

A timeline is a type of chart which visually shows a series of events in chronological order over a linear timescale. The power of a timeline is that it is graphical, which makes it easy to understand critical milestones, such as the progress of a project schedule.

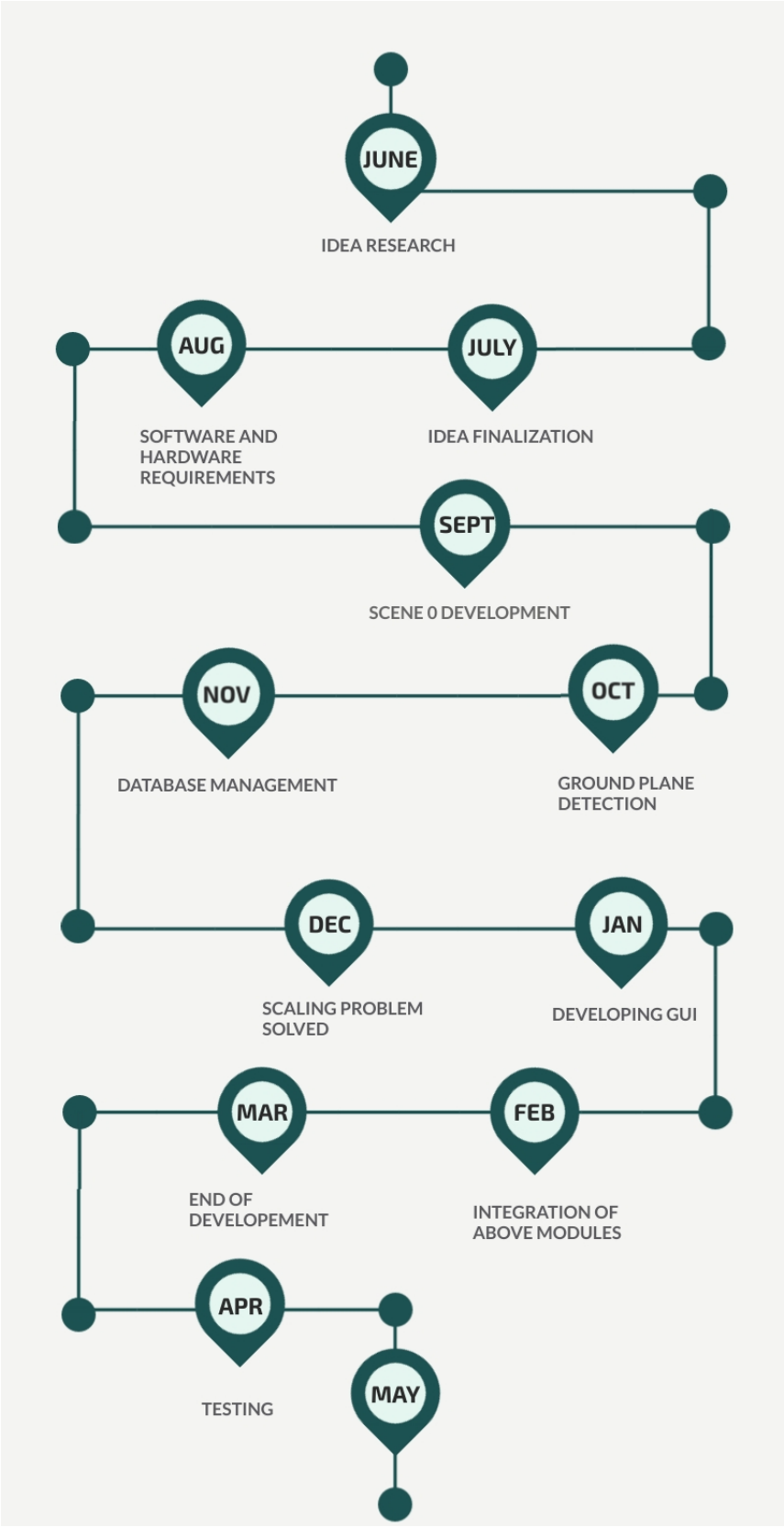

Figure 5.2: Timeline Chart

5.4 Team Organization

5.4.1 Team Structure

The project consists of 3 students. Their roles and responsibilities are as below:
Ankur Chaudhari: Modules development , implementation of ground plane detection, rotation of models.
Aditi Rupade: Integration of modules, database management, documentation.
Abhilasha Talele: GUI development, testing, documentation.

5.4.2 Management reporting and communication

We have to report to the following staff:

1. Internal Guide - Guidance on deciding project path, documentation, testing and deployment.
2. Project Coordinator - Guidance on documentation and coding style.

Any progress or doubts are cleared by internal guide. Any changes or suggestions are made/ adhered to.

6.

Project Implementation

6.1 Overview of Project Modules

The system is divided in number of modules to simplify the development and to get a clear idea of the working. Later on, these modules are integrated to form the system as a whole. The modules in the project are Pixel Format Conversion, Tracker, State object, Database and Application. The functionalities and implementation of each module is explained as follows :

1. Pixel Format Conversion:
   The input frame is processed through many steps to get the output frame. The input frame is firstly converted into pixel format. The reason to perform this conversion is that the application will be used on different platforms which will be having different hardware and graphics card specifications. To match this incompatibility, the frames are converted into Pixel Format. There are various formats available like rgb, bgr, gray scale, etc. Usually gray scale conversion is used for frame markers and RGB/BGR is used for other types of targets. For this application, we are using Image Targets, therefore we will be using RGB/BGR conversion. This converted frame along with user defined targets is provided as input to the tracker module.

2. Tracker:
   The vuforia tracker module uses QCAR algorithm. QCAR vuforia consists of a few number of algorithms to identify and to track the target and three-dimensional objects, allowing the user to adjust position of a virtual objects with real world images that displayed through the smartphone screen in real-time[6]. The virtual object will track the position of the image in real-time so that the view of the object and its environment can be in accordance with the user's view in the applications, which create virtual objects that appear similar to the real world [6]. It uses SIFT for feature extraction and neural networks for feature matching.Feature point extraction is an important preprocessing step in image processing and computer vision for applications such as image registration, object recognition among others [2]. SIFT transforms an image into a large collection of feature vectors, each of which is invariant to image translation, scaling, and rotation, partially invariant to illumination changes and robust to local geometric distortion. The objects in the frame are detected using SIFT. The features of these objects is extracted considering various viewpoints, scale invariance, rotations and illuminations.Using CNN, Vuforia will perform feature matching. Vuforia has an online target resource database in which images of various objects are stored. The user defined targets are compared with the images in this database and accordingly, CNN performs the feature matching.

3. State object:
   The tracker module will return an object consisting of the converted frame and target snapshot.Target snapshot acts as a buffer so that when the user is continuously changing the view (by moving the cameras angle), there wont be any hindrances. This object will be send to the Android Application.

4. Database:
   Vuforia Engine Cloud Recognition Service allows Vuforia Engine-enabled application to recognize image targets through a cloud database, giving the ability to update targets dynamically, integrate with the existing CMS, and manage more than one million image targets for a single app. When the user selects the products they desire to view in the physical environment, these products are fetched from the Vuforia Cloud Database.

5. Application:
   The android applications elements are accessed using Query State Object which is a DAO class in Android. Through this, the application logic is updated. Finally the cameras view is rendered so that user can see the Virtual Object. The application also consists of login page and Cart to add the products which the user desires to buy. These GUI elements are developed using Unity IDE.

6.2 Tools and Technologies Used

1. Programming Language :
   C#
2. Tools :
   Unity IDE 2018v
3. Frameworks :
   Vuforia Engine 8.1
4. Databases :
   Vuforia Cloud Database
   Vuforia Target Resource Database

6.3 Algorithm Details

6.3.1 Algorithm 1

1. On opening the application, get a view of the environment using mobile phones camera.
2. Convert each Frame in Pixel Format.
3. Detect new Objects in these converted frames using QCAR algorithm. Calculate dimensions and distances of these objects from user.
4. Using QCAR algorithm, detect all the edges in the converted frame for fitness criteria.
5. Place the virtual object in the frame according to the the calculations done in previous steps. Track this object using tracker module.
6. If the user moves, for example to view the object from different angle, then repeat steps 2-6.
7. Render the camera view and Graphics in the application and show the final converted frame on the application window.

7.

Software Testing

7.1 Types of Testing

There are many types of testing as follows:

1. Unit Testing
   Unit testing is the testing of an individual unit or group of related units. It falls under the class of white box testing. It is often done by to test that the unit he/she has implemented is producing expected output against given input.
   For Example:
   To test all the modules as mentioned in previous section, i.e. to test Tracker module to check whether the calculations are done properly or not and the object is placed in the available space or not.

2. Integration Testing
   Integration means combining. Integrating testing checks the data flow from one module to other modules. For Example, The testing of the whole application is done. The login credentials are checked, then only the user logs in. All the objects are tested to check whther they are rendered correctly.

3. System Testing
   System testing is performed on a complete, integrated system. It allows checking system's compliance as per the requirements. It tests the overall interaction of components. It involves load, performance, reliability and security testing. System testing most often the final test to verify that the system meets the specification. It evaluates both functional and non-functional need for the testing.
   For Example:
   Testing the objects from all degrees.

4. Functional Testing
   Functional testing is the testing to ensure that the specified functionality required in the system requirements works. It falls under the class of black box testing.
   The main functionality of this application is to check whether the objects are rendered without any hindrances and through all degrees. Also to check whether ground plane detection takes place and objects are placed on the ground only.

5. Stress Testing
   Stress testing is the testing to evaluate how system behaves under unfavorable conditions. Testing is conducted at beyond limits of the specifications. It falls under the class of black box testing. To check if the user moves too close to the virtual object, then what will happen. If the user is not connected to the internet, then what will be the scenario of working.

6. Performance Testing
   Performance testing is the testing to assess the speed and effectiveness of the system and to make sure it is generating results within a specified time as in performance requirements. It falls under the class of black box testing.
   For Example:
   The objects are rendered continuously and faster as the the State Object module holds a buffer for this processing which it refreshes while the user is moving continuously.

7. Regression Testing
   Every time new module is added leads to changes in program. This type of testing make sure that whole component works properly even after adding components to the complete program.
   For Example:
   If new models are added to the database, then it won't affect the processing. Another module

that was later added to the application was manual rotation. This also didn't affect the overall processing and functionalities.

8. Beta Testing
   Beta testing is the testing which is done by end users, a team outside development, or publicly releasing full pre-version of the product which is known as beta version. The aim of beta testing is to cover unexpected errors. It falls under the class of black box testing.
   For Example:
   Many students tried this applcation and faced problems like automatic scaling.

7.2 Test Cases and Test Results

Table 7.1: Test Case Table

ID	Test Case Description	Expected Output	Actual Output	Status
1	Pixel Format Conversion	RGB	RGB	Pass
2	Real World Object Detection	Object and edges detected	Object and edges detected	Pass
3.	Rendering	In all degrees	In all degrees	Pass
4.	Login with right credentials	Login Successful	Login Successful	Pass
5.	Login with wrong credentials	Login Unsuccessful	Login Unsuccessful	Pass
7.	Add object to cart	Object added	Object added	Pass

8.

Results

8.1 Outcomes

The objective is to place the object in the available space. The available space is calculated using QCAR algorithm. The objects are detected and their distance from the users position is calculated based on the edges of the objects that are detected. The ground plane of the environment is the available space where the object will be placed. This space is calculated by the following formula.

$$FreeSpace = TotalSpace - OccupiedSpace$$

For example : Consider the following scenario.

Total space 1000 sq.ft
Space occupied by objects in the environment is as follows :

1. Chair : 30 sq. ft.
2. Shelf : 200 sq. ft.
3. Pouf : 20 sq. ft.

Free Space = Total Space (1000) - Occupied Space (30 + 200 + 20)
Free Space = 750 sq. ft.
If the user wants to fit a bed, then according to the calculations the available space is enough.
Size of bed : 300 sq. ft.
By placing the product in various places in the available environment, the user will get an idea of ow much free space will remain to walk through.

8.2 Screenshots

Figure 8.1: Model-Sofa

Figure 8.2: Model-pouf

9.

Conclusions

9.1 Conclusions

The application working on Marker-based tracking uses QR code for tracking an object.The QR code is placed in the environment where the user wishes to view the model. The application recognizes the code and then place the object on the code only. Carrying the code every time is not possible for the user. Hence, this application uses Marker-less Tracking for tracking of virtual objects.As in Marker-based Tracking the system recognizes the code to track the module, in the Marker-less Tracking the objects are tracked using QCAR algorithm of Tracker module. In this case, no such QR ode is required.

9.2 Future Works

1. The application can be extended for shopping of other kind of products too. For example, Clothing, Accessories, etc.
2. The application works for rendering of one virtual object at a time. This can be extended to render and view multiple objects in one frame.
3. The application fetches already created 3D models from the cloud database. The system can be extended to convert 2D images to 3D models and then render them to the environment.

9.3 Applications

1. This application will help to enhance online shopping experience and will definitely help to provide a better and fun way of shopping to the users.
2. The users can view the products before buying using camera or AR headset. This will help them to decide their preferences in a better way.
3. This application uses Markerless Tracking to track the virtual objects which does not require a marker. Rather it tracks the objects and locates them in accordance with users current location.
4. It will help overcome the disadvantages on how current way of online shopping works, thus providing benefit to online retailers.

10.

Appendix - A

1. **Technical Feasibility :** The application can be made available for both Android as well as IOS devices. For modelling and visualization purpose, we will use Unity, Maya Studio and Vuforia toolkit which are open source.

2. **Economic Feasibility :** As the application is developed keeping in mind the difficulties faced by users during online shopping, it will approach the problem of rejection and return of product and thus, increasing the net sale of the Organization.

3. **Ethical Feasibility :** The application is being developed to solve problems in online shopping and also provides a fun way of shopping,thus leading to benefit of the organization and is ethical in either of the perspective.

4. **Operational Feasibility :** The applications innovativeness attracts new customers and provides better way of shopping to the users, solving the problem of rejections and bad shopping experience.

11.

Appendix - B

[1] Cheng Xiao, Zhang Lifeng, "Implementation of Mobile Augmented Reality Based on Vuforia and Rawajali" in the 2014 IEEE 5th International Conference on Software Engineering and Service Science.
This paper proposes an application framework, the function of system core class and application workflow. This paper illustrates the use of Vuforia SDK for image recognition, to trace and register image markers and the working and Architecture of Vuforia.

[2] Xinyu Li,Dongyi Chen, "Augmented Reality in E-commerce with Markerless Tracking" in the , 2010 2nd IEEE International Conference on Information Management and Engineering.
This paper proposes an approach to feature point correspondence of image sequence based on transient chaotic neural networks. Through this approach a new markerless visual tracking technology with image feature can be used in AR E-commerce applications.

[3] Young-geun Kim, Won-jung Kim,"Implementation of Augmented Reality System for Smartphone Advertisements" in the 2017 International Conference on Computer Science and Engineering (UBMK).
This paper has used the markerless augmented reality system on smartphones to design and implement the smartphone application service aimed at efficiently conveying information on advertisements to users. This paper has also elaborated a few examples of Markers and Non-markers in Augmented Reality.

[4] Dennise Adrianto, Monica Hidajat,Violitta Yesmaya, "Augmented Reality Using Vuforia for Marketing Residence" in the 2016 1st International Conference on Game, Game Art, and Gamification (ICGGAG).
This study paper was made to produce an application by applying Augmented Reality on the Android platform that is intended for marketing promotions of residence. This paper uses a software named Vuforia (QCAR) to implement augmented reality in mobile applications for marketing residence.

12.

Appendix - C

PLAGIARISM SCAN REPORT

7%	93%	17	156
Plagiarism	Unique	Plagiarized Sentences	Unique Sentences

Content Checked For Plagiarism

Augmented reality brings components of the digital world into a person's perception of the real world. Mcommerce is constantly changing and those wanting to get ahead in the market need to have their finger on the pulse. More than half number of shoppers abandon their carts before completing a purchase or return a particular product saying that it was not as expected. This indicates that retailers need to do a lot more to convince customers to follow through with their choice and purchase items online. Augmented reality has the potential to reshape the world of retail. The Augmented Reality Application for Home Shopping will help users to get a better view of the product by providing its virtual representation. It gives the user a mocked-up version of how their home could look when fitted out with various items or products. The major problems that Mcommerce sites face is users feedback that the product was not as expected. The entire scene that users see is a virtually generated version of a home, and the immersive experience allows them to become spatially aware of how various products would appear. The current market works on Marker-based Tracking which hampers the true value of Augmented Reality. The proposed methodology provides an idea of using Markerless Tracking which is more efficient and requires less effort from

13.

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[3] Mustafa Atalar and Mahmut zcan, New Augmented Reality Application in E-Commerce and M-Commerce in 2017 International Conference on Computer Science and Engineering (UBMK).

[4] Shivnarayan Rajappa and Gaurav Raj, Application and Scope Analysis of Augmented Reality in Marketing using Image Processing Technique 2016 6th International Conference - Cloud System and Big Data Engineering (Confluence).

[5] Cheng Xiao and Zhang Lifeng, Implementation of Mobile Augmented Reality Based on Vuforia and Rawajali 2014 IEEE 5th International Conference on Software Engineering and Service Science.

[6] Dennise Adrianto , Monica Hidajat and Violitta Yesmaya, Augmented Reality Using Vuforia for Marketing Residence, 2016 1st International Conference on Game, Game Art, and Gamification (ICG-GAG).

[7] Sang-Woong Lee, Seong-Whaan Lee, Sand-Cheol Park, Superimposing 3D Virtual Objects using Markerless Tracking, 18th International Conference on Pattern Recognition, Hong Kong, China, 20-24 Aug. 2006.

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