A PROJECT REPORT

ON

"AUTO GENERATION OF 3D MODEL USING MULTIPLE 3D GRAPHICS AND MANIFEST THROUGH AUGMENTED REALITY"

Submitted to
UNIVERSITY OF MUMBAI
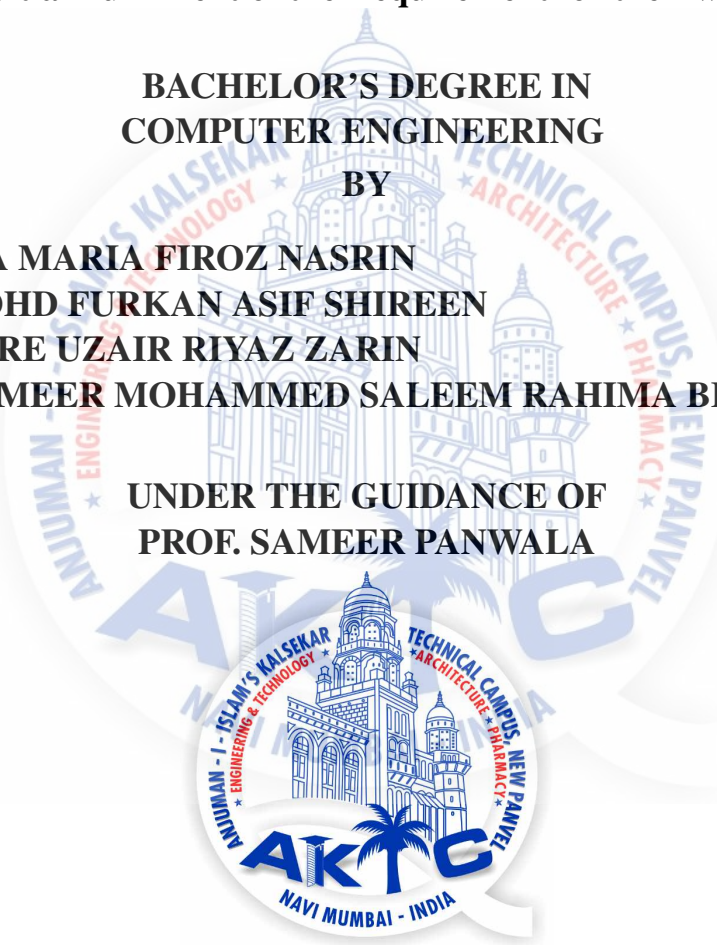
In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
COMPUTER ENGINEERING
BY

KHEDWALA MARIA FIROZ NASRIN	**14CO03**
MOMIN MOHD FURKAN ASIF SHIREEN	**15DCO55**
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UNDER THE GUIDANCE OF
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Plot No. 2 3, Sector - 16, Near Thana Naka,
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2017-2018

AFFILIATED TO

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A PROJECT II REPORT
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CERTIFICATE

This is certify that the project entitled

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submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Engineering) at *Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai* under the University of MUMBAI. This work is done during year 2017-2018, under our guidance.

Date: /   /

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Acknowledgements

Project II Approval for Bachelor of Engineering

This project entitled *"Auto generation of 3D model using multiple 2D graphics and manifest through Augmented Reality"* by *Khedwala Maria Firoz Nasrin, Momin Mohd Furkan Asif Shireen, Pachhapure Uzair Riyaz Zarin, Shaikh Sameer Mohammed Saleem Rahima bi* is approved for the degree of *Bachelor of Engineering in Department of Computer Engineering.*
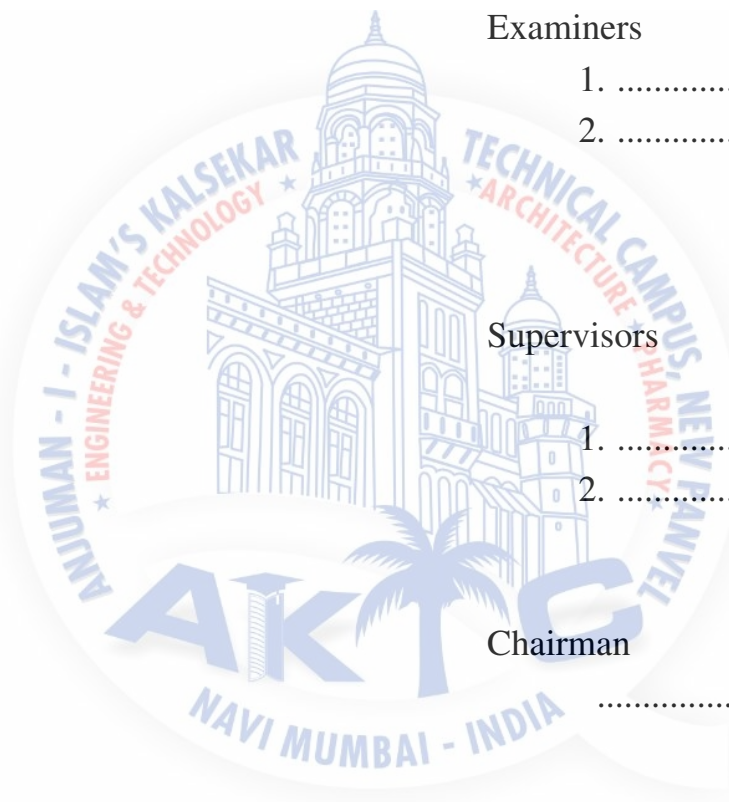
Examiners

1. ....
2. ....

Supervisors

1. ....
2. ....

Chairman

....

Declaration

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

Images are more ambient than words similarly the 3D models are more descriptive than 2D pictures. 3D model of any product will give the enhanced information about it. The main objective of generating the 3D model is to reduce the amount of time by automating the process of generating the 3D model. Augmented Reality (AR) technologies have been recognized as offering great benefit to almost every field and organizations, although they are not easy to implement. AR provides enhanced information of the product by overlaying the 3D model into the real world. 3D models can express the shape and dimensions of the products with greater precision and they are being extensively used these days.

In this project, we have implemented a 3D Modeling application which will take only a few 2D images as input from any image capturing device taken from different angles and it will automatically convert it into a 3D model. The first step towards generating the 3D model from the images is to establish point correspondence which includes feature extraction and feature matching. Then refining correspondence is done followed by de-calibration of 3D structure and camera pose. The final step is texture mapping and rendering.

We are using an e-commerce portal as an example to display the 3D models generated by our 3D Modeling application. Most often customers shopping on e-commerce websites do not get complete information about the product by only viewing the 2D images. They can get a better understanding of the product by using AR View. The adaptation of Augmented Reality (AR) will take e-commerce to the next level.
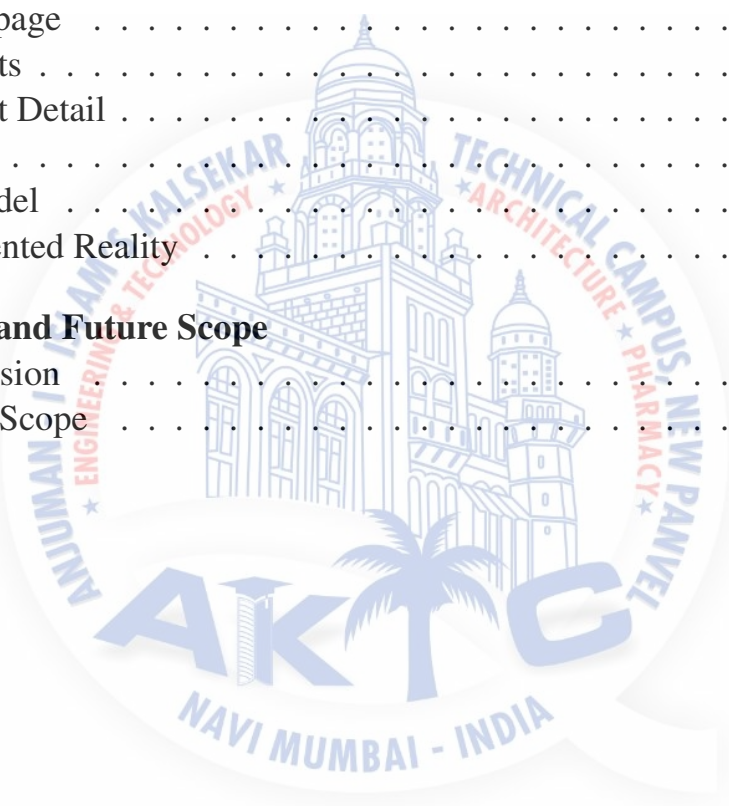
Keywords: Augmented Reality, 3D-Model, e-commerce

Contents

List of Figures

List of Tables

Chapter 1

Introduction

A vast use of 3D technology is increasing day by day, as new 3D enable gadgets are being introduced in the current market. One of the reasons behind the growth in 3D technology is entertainment which includes and supports basic contents necessary for sports, movies, games, mobile phones, etc. In computers, 3D (3 Dimensions or 3-Dimensional) describes an image that provides the perception of depth. 3D models are made interactive so that users feel involved with the scene, the experience is known as virtual reality. During the development of 3D models, designers and developers have to handle a lot of input dimensions of the object, a lot of interaction techniques, and a lot of ways to present content. 3D models can express the shape and dimensions of the products with greater accuracy and they are being extensively used these days. By overlaying the 3D model into the real world, Augmented Reality provides enhanced information of the product. Augmented reality (AR) is a direct or indirect view of a physical, real-world environment where elements are "augmented" automatically or manually.

Figure 1.1: 2D to 3D conversion

It is related to a more general concept i.e. computer-mediated reality, which modifies a view of the reality by a computer. Virtual reality replaces the real world with

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a simulated one, whereas Augmented Reality is the one which enhances the current perception of reality. AR systems overlay the "Virtual" objects onto the real world to increase users' visual experience, expand their visual system, and help them achieve their tasks in more natural way. So it has many applications inhuman-computer interaction, industry maintenance, multimedia computing, medical and military training. The paper we are proposing is an application, in which, it will take few 2D images and that 2D images will than automatically get converted into the 3D model. The 2D images can be taken from any image capturing devices from every angle. After the generation of the 3D model, that 3D model can be displayed through augmented reality. The main use of this application is that we can get an enhanced view of the object, and it can be examined perfectly.

The generated 3D model has application in many fields such as in medical, gaming, e-commerce, etc. We are using an e-commerce as an example to display the 3D models generated by our 3D-Modeling application. Most often customers shopping online do not get complete information about the product by only viewing the 2D images so to help them get a precise view of the product we are using AR. The adaptation of Augmented Reality (AR) will take e-commerce to the next higher level.

1.1 Purpose

Usually in every field like E-commerce user can only see the screen-shots of the product. The product can be better understood by the user if the detail view is displayed and the best thing would be the 3D view. Our main purpose is to provide the 3D view of the object/product to the user in the E-commerce website. The 3D model will be generated in an app and it will be overlayed into the real world using Augmented Reality. The application to convert the 2D graphics to 3D model can be used by anybody who needs a 3D model of any object. Further the 3D model of the object/product can be rendered and can be displayed into the real world via mobile camera using AR.

1.2 Project Scope

This project consist of creating an application for generating a 3D model of any object. The main objective include to make the process automatic and make it less time consuming. It was expected that time taken by the application would be 5-10 minutes. We accomplished few steps for conversion of 2D images to 3D model and they are-

1. Feature Matching

2. Segmentation

There is wide scope for AR in every field. The 3D model is then overlayed into the real world using Augmented Reality. The project is completed in April 2018.

1.3   Project Goals and Objectives

1.3.1   Goals

The goal of the project is to generate 3D model of the object/product automatically using multiple 2D images and the 3D model will hence be overlayed into the real world using Augmented Reality.

1.3.2   Objectives

The main objective is to give more informative view of the object by providing the 3D model of the object/product and the other is overlaying the 3D model of the product into the real world using Augmented Reality.

1.4   Organization of Report

In Chapter 1, we have considered Project overview under which we have explained various important terminologies like introduction of the project, motivation (what exactly motivates us to create 3D model of the object and view in AR), problem definition, about current system, problems in current systems, advantages over current system, goal objectives, scope applications.

In chapter 2, we have discussed about various papers that we have referred for our project, we have mentioned the description, pros and cons, and how to overcome the problems under every paper. Total 3 papers have been referred.

In chapter 3, we have done with the project planning in which every members' capabilities and responsibilities have been detailed. Assumptions and constraints have been discussed and project management approach has been given and also the ground rules for the project has been detailed. In this section we have also discussed about the project timeline in detail.

In Chapter 4, we have discussed about the requirement analysis, under which we have discussed about platform requirement(supporting OS for the software), Soft-

ware requirement and hardware requirement along with feasibility study.

In Chapter 5, we can see the system design and its architecture, various diagrams can be seen in this chapter which represent the software, diagrams included are System architecture, class diagram, sequence diagram, component diagram and deployment diagram.

In Chapter 6, we discussed about the implementation details of the system. This part contains details of the implementation of various modules. In short we describe how the system works.

In Chapter 7, we have shown the test cases and results along with analytical discussion. This part contains the results of the output of our project.

In Chapter 8, we have shown various screenshots of the project.

In Chapter 9, We have concluded the whole project and future scope along with the limitations. Followed by references and appendix.
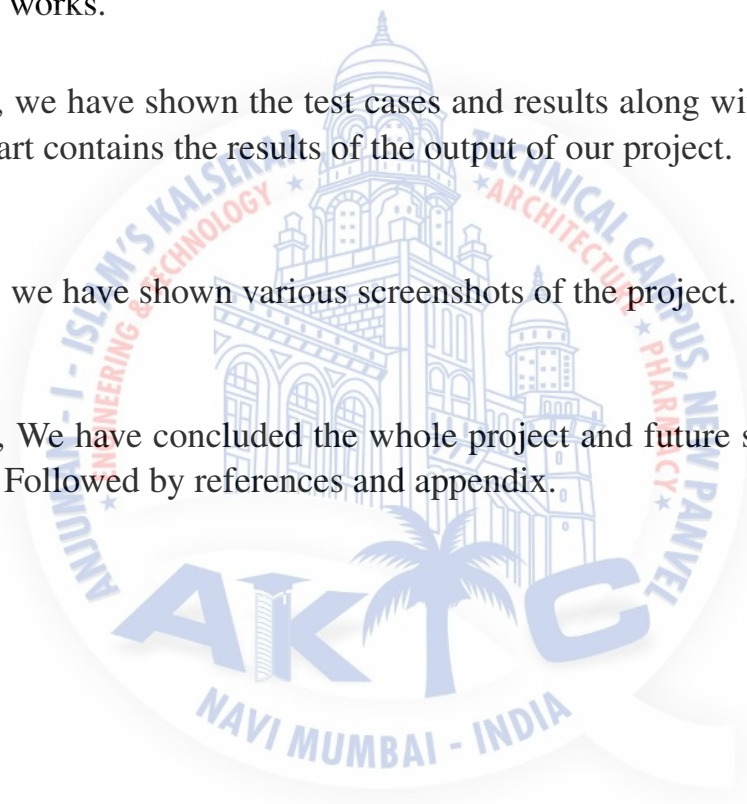
Chapter 2

Literature Survey

2.1 Augmented Reality E-Commerce: How the Technology Benefits People's Lives

Traditional e-commerce systems have reached a limitation that needs to be overcome, because they do not provide enough direct information for online shoppers, especially when they are shopping for products like furniture, clothing, shoes, jewelry, and other decorative products. In this study, they developed an AR e-commerce system and studied the effectiveness of AR for enhancing e-commerce.[1]

2.1.1 Advantages of Paper

a. This paper presents a new type of e-commerce system, AR e-commerce, which visually brings virtual products into real physical environments for user interaction.

b. The new approach gives customers a chance to "try" a product at home or in another use environment. The chapter presents development of a prototype AR e-commerce system and a user study of the developed prototype.

c. Overall results of the study show that the AR e-commerce system can help customers make better purchasing decisions.

2.1.2 Disadvantages of Paper

a. 3D model is generated manually and using marker to display in AR.

b. They are uploading static pictures with markers, or uploading pre-made videos so that users do not need to carry a laptop computer around for viewing each product.

c. Manually made videos of the product alters or degrades the efficiency of the project.

2.1.3   How to overcome the problems mentioned in Paper

a. 3D model can be generated automatically and displayed into AR.

b. Instead of just taking the video of every single product the actual 3D model will be made.

c. The product will be displayed in AR without marker.

2.2   E-commerce Direct Marketing using Augmented Reality

In this paper, we describe the development of a direct marketing system that uses augmented reality (AR) technology. A set of specially designed markers is used to calibrate the camera and track the motion of the markers for the augmentation of three dimensional product models. There is no special hardware required for this system except a PC camera (e.g., WebCam or ViCAM). [2]

2.2.1   Advantages of Paper

a. Turning Web customers from "window shoppers" into buyers demands an interactive sales model that informs them, gives them individualized attention, and helps to close the sale at the customer's request.

b. Ideally, sales agents should have in-person meetings with all prospective customers. However, this may not be desirable or feasible. The next best thing is for sales agents to send promotional e-mails to their prospective customers.

c. In this paper, they describe the development of a direct marketing system that uses augmented reality (AR) technology. A set of specially designed markers is used to calibrate the camera and track the motion of the markers for the augmentation of three dimensional product models.

2.2.2   Disadvantages of Paper

a. In this paper, they describe the development of a direct marketing system that uses Augmented Reality (AR) technology.

b. A set of specially designed markers is used to calibrate the camera and track the motion of the markers for the augmentation of 3D product models. They are using markers to track the model to display it in AR.

c. To generate 3D model they stream over the live video with the user and later that video is been emailed to the one who need the 3D model of the product.

2.2.3   How to overcome the problems mentioned in Paper

a. Prototype is only first or preliminary version of any product which can be overcome by making a real 3D model of the product automatically.

b. They are using markers to track the motion of the product which can be overcome by using marker-less tracking.

c. The concept of generating 3D model over here is being done by live streaming video. Meaning it does not actually generate 3D model it just shows the video and gives the prototype which can be overcome by generating actual 3D model that too automatically.

2.3   A survey of plasticity in 3D user interfaces

They present the state of the art about plastic 3D user interfaces. Moreover, they present well known methods in the field of 2D user interfaces that could become relevant for 3D user interfaces. With this survey, they show that current solutions do not meet all plasticity requirements. That is why they propose an action plan to meet these requirements. [5]

2.3.1   Advantages of Paper

a. Plasticity of 3D user interfaces refers to their capabilities to automatically t to a set of hardware and environmental constraints. This area of research has already been deeply explored in the domain of traditional 2D user interfaces. Besides, during the last decade, interest in 3D user-interfaces has grown.

b. An adaptation is performed in reaction to different criteria defining a system such as the targeted hardware platform, the user's context and the structure and the semantic of the manipulated data. This adaptation can then impact the system in different ways, especially content presentation, inter- action techniques modifications and eventually the current distribution of the system across a set of available devices.

c. We present the state of the art about plastic 3D user interfaces. Moreover, we present well known methods in the eld of 2D user interfaces that could become relevant for 3D user interfaces.

2.3.2   Disadvantages of Paper

a. During the development of 3D user interfaces, designers and developers have to handle alot of input and output devices, alot of interaction techniques, alot of possible kinds of target users, and a lot of ways to present content.

b. Developing manually a version of an application for each possible configuration is not a very flexible way toward adapting it to various features. Better solutions propose to adapt them automatically. In this case, it is referred to as plastic or adaptive 3D user interfaces.

c. The goal is to preserve usability in any condition while minimizing development and maintenance costs. This paper aims to generate only the plastic 3D user interfaces automatically of the object and not the actual 3D model.

2.3.3   How to overcome the problems mentioned in Paper

a. The plasticity property of an interactive system refers to its capacity to withstand variations of both the system physical characteristics and the environment while preserving its usability.

b. Plasticity give the plastic model of the object.

c. In this paper we are generating a real 3D model of the object that too automatically and displaying into the real world using AR.

2.4   Technical Review

Our system is basically taking multiple 2D images using camera and convert it into 3D model using an application. Further the 3D model will be over layed into the real world using Augmented Reality. The 3D model can be rendered in the real world and can also be displaced.

Some main technologies we have used are:

1. PHP :
   The PHP Hypertext Preprocessor (PHP) is a programming language that allows web developers to create dynamic content that interacts with databases. PHP is basically used for developing web based software applications. PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites. It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.

2. Wikitude :
   Wikitude's cross-platform Augmented Reality SDK combines 3D Marker-less Tracking technology (SLAM), Object Recognition and Tracking, Image Recognition and Tracking, support for AR-Kit and AR-Core (SMART), as well as Geo-location AR for apps.

2.4.1   Advantages of technology

a. HTML is a mark-up language and is used in front-end Web Development that is responsible to the web-page's layout together with CSS and Javascript.

b. PHP is a server-side programming language and is used in back-end Web Development usually with MySQL.

c. PHP as a server-side language is usually used to program the manipulation of web pages made with HTML.

d. PHP can be also used in creating HTML components and tags.

e. AR is used to display the object into the real world with rendering support.

2.4.2   Reasons to use this Technology

a. With PHP, it's a simple matter to embed dynamic activity in web pages. When you give pages the .php extension, they have instant access to the scripting language.

b. The point is that with PHP, web developers have a scripting language that, although not as fast as compiling your code in C or a similar language, is incredibly speedy and that also integrates seamlessly with HTML code.

c. With the emergence of the CSS3 standard in recent years, CSS now offers a level of dynamic interactivity previously supported only by JavaScript. For example, not only can you style any HTML element to change its dimensions, colors, borders, spacing, and so on, but now you can also add animated transitions and transformations to your web pages, using only a few lines of CSS.

d. 3D model needs to be displayed into the real world so we have used wikitude library for AR.

Chapter 3

Project Planning

3.1   Members and Capabilities

Table 3.1: Table of Capabilities

SR. No	Name of Member	Capabilities
1	Khedwala Maria	HTML, CSS, PHP, UI Design
2	Momin Furkan	HTML, CSS, PHP, JS, Database, UI Design
3	Pachhapure Uzair	HTML, CSS, PHP, UI Design
4	Shaikh Sameer	Android, Unity 3D, Augmented Reality

3.2   Roles and Responsibilities

Table 3.2: Table of Responsibilities

SR. No	Name of Member	Role	Responsibilities
1	Khedwala Maria	Team Member	Web Development
2	Momin Furkan	Team Member	Web Development and Database
3	Pachhapure Uzair	Team Member	Web Development
4	Shaikh Sameer	Team Leader	Augmented Reality

3.3   Assumptions and Constraints

Assumptions :

1. The aim of the project was to take several 2D images of the object and convert it to 3D model using an application.

2. The 3D model would be then displayed into the real world using Augmented Reality.

3. The images are to be taken using the simple camera or DSLR.

4. The augment in the real world is movable in Augmented Reality.

Constraints :

1. While capturing images for 3D model generation, the background should be white.

2. The images has to be taken from different angles.

3.4   Project Management Approach

Spiral model has been used in the project. The spiral model is a risk-driven process model generator for software projects. Based on the unique risk patterns of a given project, the spiral model guides a team to adopt elements of one or more process models, such as incremental, waterfall, or evolutionary prototyping.
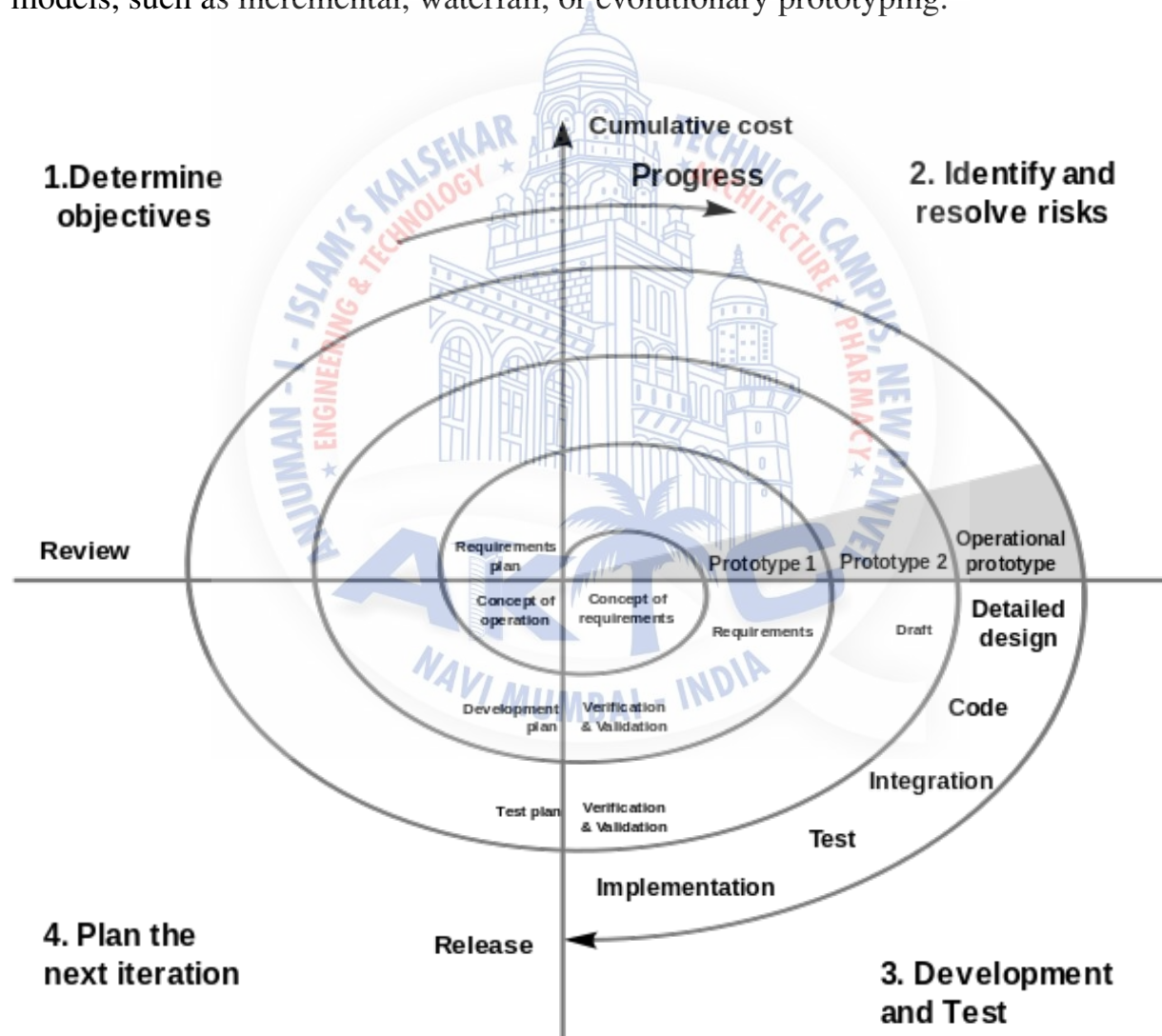
Figure 3.1: Spiral model

3.5 Ground Rules for the Project

1. Be on time for all team meetings.

2. Team leader must create and disseminate agendas for each team meeting.

3. Avoid informal/social talk during team meetings.

4. Be patient with alternative viewpoints, different kinds of learners, writers, speakers.

5. No responsibilities to be assigned unless the person who is being assigned the responsibility accepts it. If a person to be given a responsibility is not at the meeting, the team leader must review that assignment or action item with the person before the responsibility is designated.

6. Inform team project guide or leader if unable to complete work on time.

7. Confront issues directly and promptly.

8. Keep a positive attitude toward the team, individual members, projects and course.

9. Play an equal role in the team by contributing equally to every task.

10. Help one another with difficult or time consuming deliverables.

11. Ask for help from the team or other resources if "stuck" or falling behind.

12. Treat each other with respect.

13. Accept responsibility and accountability along with the authority given.

3.6 Project Budget

1. HTML, CSS, JS, PHP - open source

2. Wikitude library for Augmented Reality - open source

3. Personal laptops are used by the members of the project which costs more than 40,000/-

3.7   Project Timeline

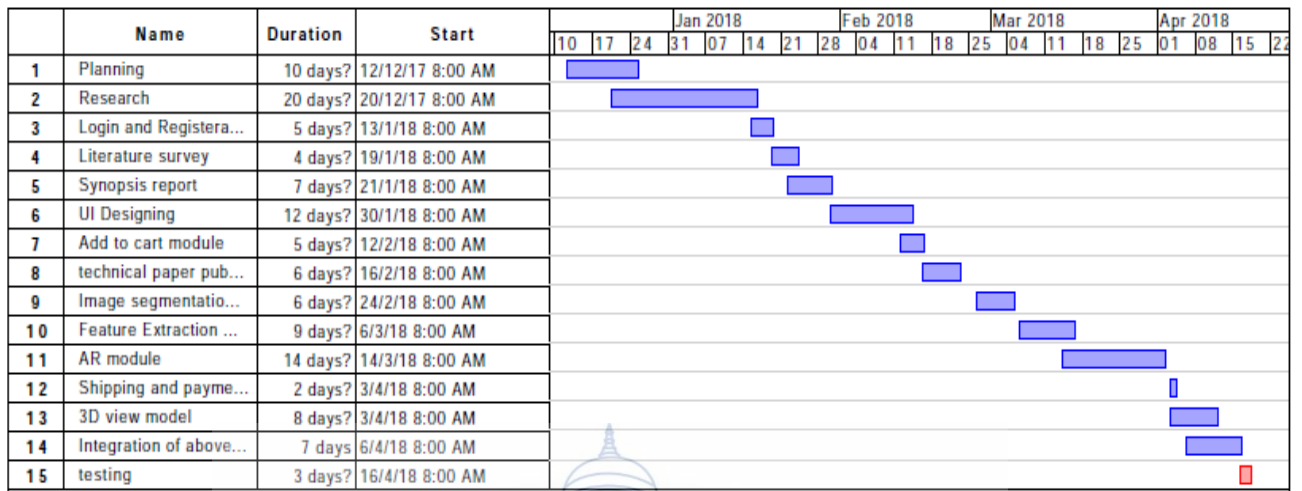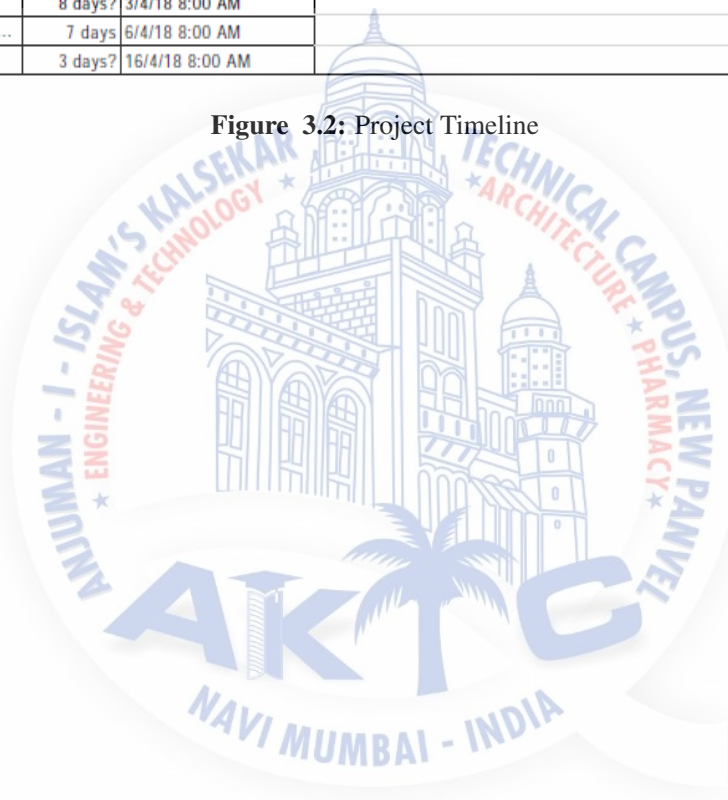|	Name	Duration	Start	Jan 2018	Feb 2018	Mar 2018	Apr 2018
1	Planning	10 days?	12/12/17 8:00 AM				
2	Research	20 days?	20/12/17 8:00 AM				
3	Login and Registera...	5 days?	13/1/18 8:00 AM				
4	Literature survey	4 days?	19/1/18 8:00 AM				
5	Synopsis report	7 days?	21/1/18 8:00 AM				
6	UI Designing	12 days?	30/1/18 8:00 AM				
7	Add to cart module	5 days?	12/2/18 8:00 AM				
8	technical paper pub...	6 days?	16/2/18 8:00 AM				
9	Image segmentatio...	6 days?	24/2/18 8:00 AM				
10	Feature Extraction ...	9 days?	6/3/18 8:00 AM				
11	AR module	14 days?	14/3/18 8:00 AM				
12	Shipping and payme...	2 days?	3/4/18 8:00 AM				
13	3D view model	8 days?	3/4/18 8:00 AM				
14	Integration of above...	7 days	6/4/18 8:00 AM				
15	testing	3 days?	16/4/18 8:00 AM				

Figure 3.2: Project Timeline

Chapter 4

Software Requirements Specification

4.1 Overall Description

4.1.1 Product Perspective

The e-commerce field in which we are demonstrating the 2D to 3D transforming application will have the following perspective.

a. Customer Details:
It involves getting details of the customer and verifying whether or not it is an authorized user. Since it is an e-commerce platform security comes first and fore-most.
The user of the e-commerce website will register itself as an authorized user and later he or she will be able to add products to cart and proceed towards billing process.
It also includes customer code, name, address and phone number. This information may be used for keeping the records of the customer for any emergency or for any other kind of information.

b. Product Details:
It includes details of the product like is the product verified as true, are the details provided for the product true, is the seller of the product verified and also other regular details of the product are included like brand, color, warranty and guarantee, specifications etc.

c. 3D model description:
The 3D model which is to be displayed into the real world has some constraints related to mobile. So this includes the description of the same.

4.1.2 Product Features

The features of the project include:

1. E-commerce website. In which user can view selected product, add it to cart and purchase it by proceeding to billing process.

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2. User can also see the 3D model of the product like no other e-commerce website. 3D model of the product can also be displayed into the real world using Augmented Reality, which is marker-less. In which product can also be rendered and move from one place to another.

4.1.3 User Classes and Characteristics

User of the e-commerce website will be able to view different products, add products to cart, and finally purchase the product. Usually in every e-commerce website or portal user can see only the screenshots of the product. But in this project user can also see the 3D model of the object he or she wishes to see. User can also overlay the 3D model or the product in AR using the mobile camera.
User can:

1. View several products.

2. View 3D model of the product.

3. Display the 3D model in AR.

4. Add product to cart.

5. Order the product.

6. Cancel an existing order.

4.1.4 Operating Environment

The environment in which the e-commerce app will operate should be Android and the hardware platform on which the software will run will be any android based smart phone. For Augmented Reality the users' mobile phone should include following features and specifications :

1. API 19+

2. High resolution devices (hdpi)

3. Camera

4. Devices with a quad-core CPU

5. Compass

6. Accelerometer

7. Gyroscope

4.1.5   Design and Implementation Constraints

The major challenge that will hurdle the development of the system is required mobile specifications. To view the object in AR, users' mobile phone should have the above mentioned specifications only then they would be able to the object in Augmented Reality. Another constraint would be the internet connectivity,if there is no internet connection available than all the services will not be provided to the user. Also if the server data connectivity is lost with the application than the system will fail to authenticate the user.

4.2   System Features

The major feature of our system is to provide flexible e-commerce website. Another main feature includes displaying 3D model of the object in the real world. The rendering and complete object tracking is done by using Augmented Reality.

4.2.1   System Feature

1. User Authentication

2. Make an order of the product

3. Generating the 3D model

4. Viewing the 3D model

Description and Priority

1. User Authentication :
   This feature will authenticate user for the further use of further facilities of e-commerce website.

2. Easy purchasing of product :
   This feature will help user to easily order the products online, add them to cart or remove the existing product from cart, finally proceed to payment.

3. Generating the 3D model :
   User can generate the 3D model by using multiple 2D graphics of the product.

4. Viewing the 3D model :
   User can view 3D model of the product. Also it can overlay that selected 3D model into the real world using Augmented Reality.

Stimulus/Response Sequences

1. The user need to login or register in to the system.

2. Seller who needs to add 3D model of its product can upload multiple 2D graphics of the object.

3. Further user can see the 3D model of the product on the app.

4. The 3D model can be overlayed into the real world using Augmented Reality.

Functional Requirements

1. The user should login in to the system.

2. The user should provide correct shipping address for the product to deliver at right place and at right time.

3. The seller can add multiple 2D images and then the application will convert it into 3D model.

4. The 3D model can be displayed into the real world using Augmented Reality.

5. The servers should response quickly.

4.3   External Interface Requirements

4.3.1   User Interfaces

1. The user should be able to login to the system.

2. The post login session should be maintained.

3. The seller who needs to convert its 2D images to 3D model should upload correct 2D images from various angles.

4. The user can display the 3D model of the selected product into the real world using Augmented Reality.

5. User can book or order the product.

6. User can proceed to payment by filling the shipping details.

4.3.2   Hardware Interfaces

Android enabled device: The android enabled device should have android version above 5.0, API level 15+, accelerometer, gyroscope, compass. In order for the smooth functioning of the application the android device must have atleast 2 GB RAM and atleast 500 MB free storage on device. The application can also function on a tablet device.

4.3.3   Software Interfaces

1. Operating System : Android 4.4+

2. Database : PHPmyadmin

3. Tools : Android Studio IDE, Unity 3D

4. Library : wikitude

4.3.4   Communications Interfaces

1. The website support all types of browser.

2. The AR app needs android devices with API level 15+.

3. The interface between the database and the system will be done by using http protocol.

4.4   Nonfunctional Requirements

4.4.1   Performance Requirements

1. Authentication :
   The login is the only constraint for the user to proceed to various facilities like purchasing product, viewing it in AR, viewing 3D model of the product.

2. Overlaying 3D model into the real world using AR :
   The 3D model will be overlayed into the real world using AR, and this application works only in Android mobile with API 15+ and several other features are required.

4.4.2   Safety Requirements

If there is extensive damage to a wide portion of the database due to catastrophic failure, such as a disk crash, the recovery method restores a past copy of the database

that was backed up to archival storage (typically tape) and reconstructs a more current state by reapplying or redoing the operations of committed transactions from the backed up log, up to the time of failure.

4.4.3 Security Requirements

The major security requirements for the system will be the safeguarding of the user data from any kind of exploit. In order to protect the user data the data is not stored in local databases we will be storing in the cloud for better security. Users' session will be secured.

Chapter 5

System Design

5.1   System Requirements Definition

There are two main modules of our system, module 1 consist of the 2D to 3D conversion application and module 2 consist of the Augmented Reality. According to the properties the requirements of module 1 is the simple 2D images that will be taken from the camera. The second module require that 3D model which is generated by the system to manifest it through Augmented Reality. The system consists of two types of requirement:

5.1.1   Functional requirements

1. The user should login in to the system.

2. The user should provide correct shipping address for the product to deliver at right place and at right time.

3. The seller can add multiple 2D images and then the application will convert it into 3D model.

4. The 3D model can be displayed into the real world using Augmented Reality.

5. The servers should response quickly.

Use-case Diagram

This is the Usecase diagram of the system. In general, a use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved.

A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.

While a use case itself might drill into a lot of detail about every possibility, a use-case diagram can help provide a higher-level view of the system.

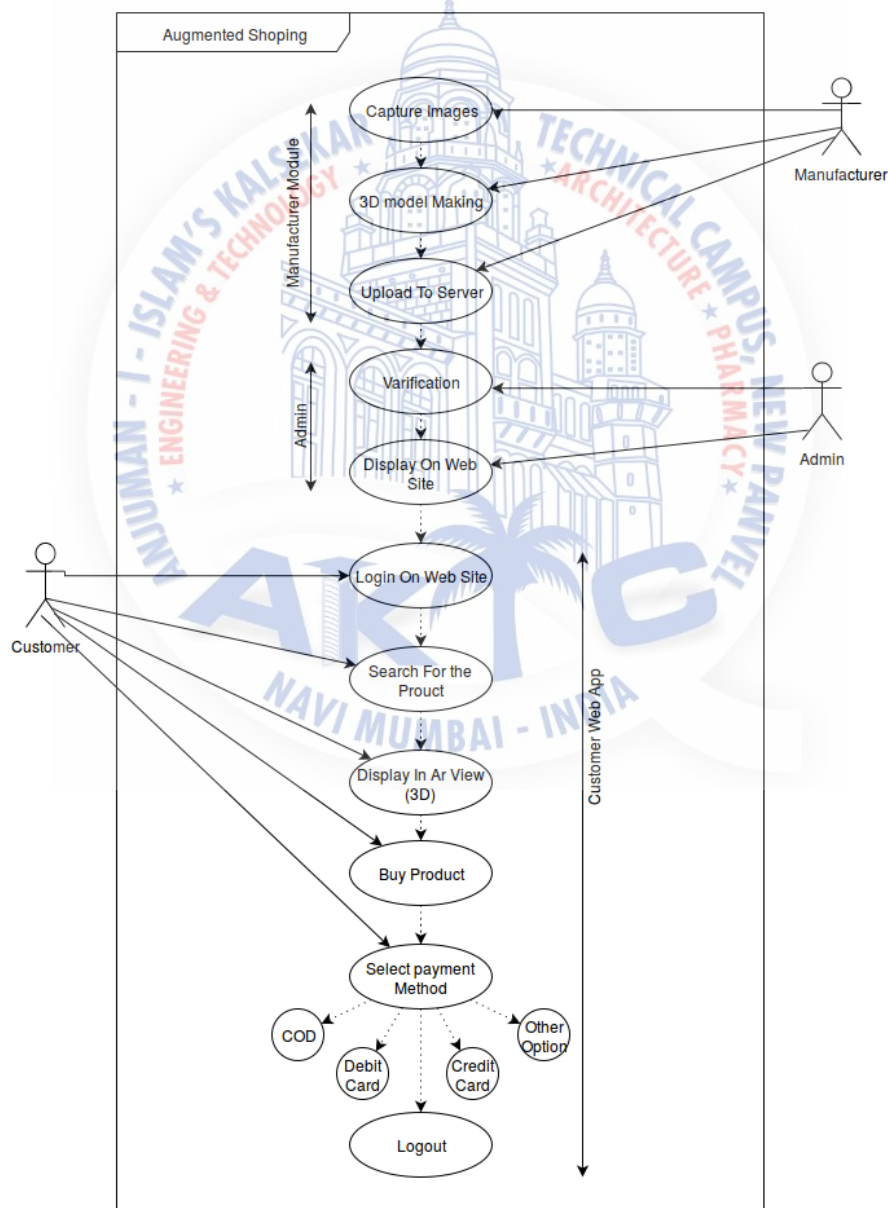Use case are the blue print of the system.

Figure 5.1: Use-case Diagram

Data-flow Diagram

This is the data-flow diagram of the system. A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. DFDs can also be used for the visualization of data processing.
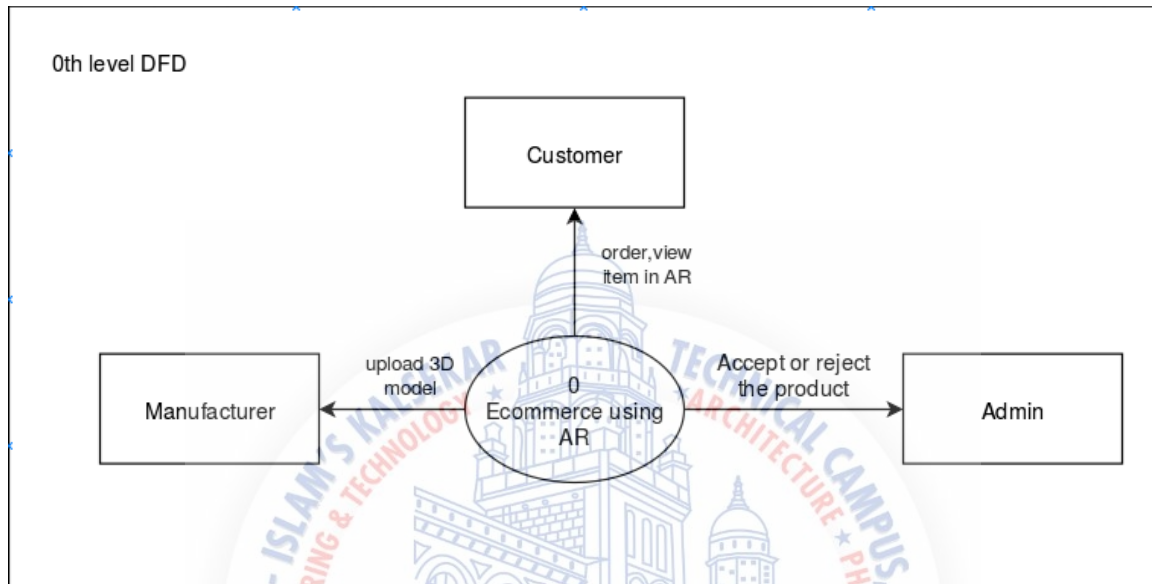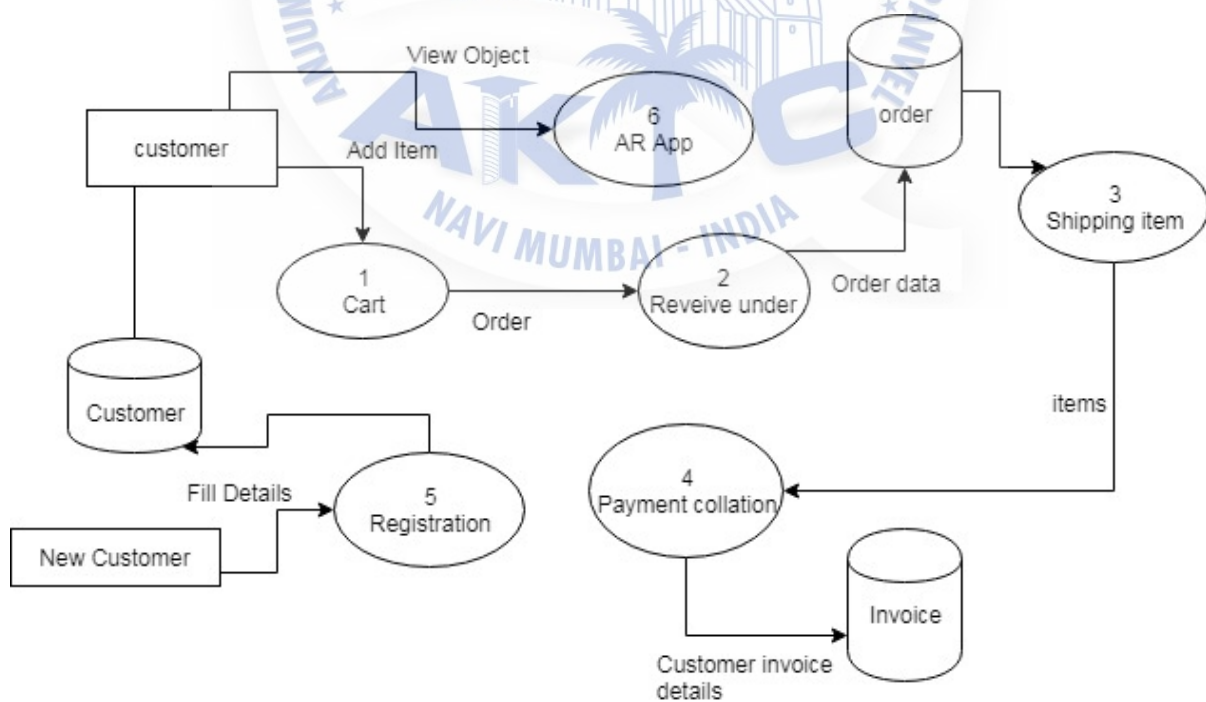

Figure 5.2: DFD level 0
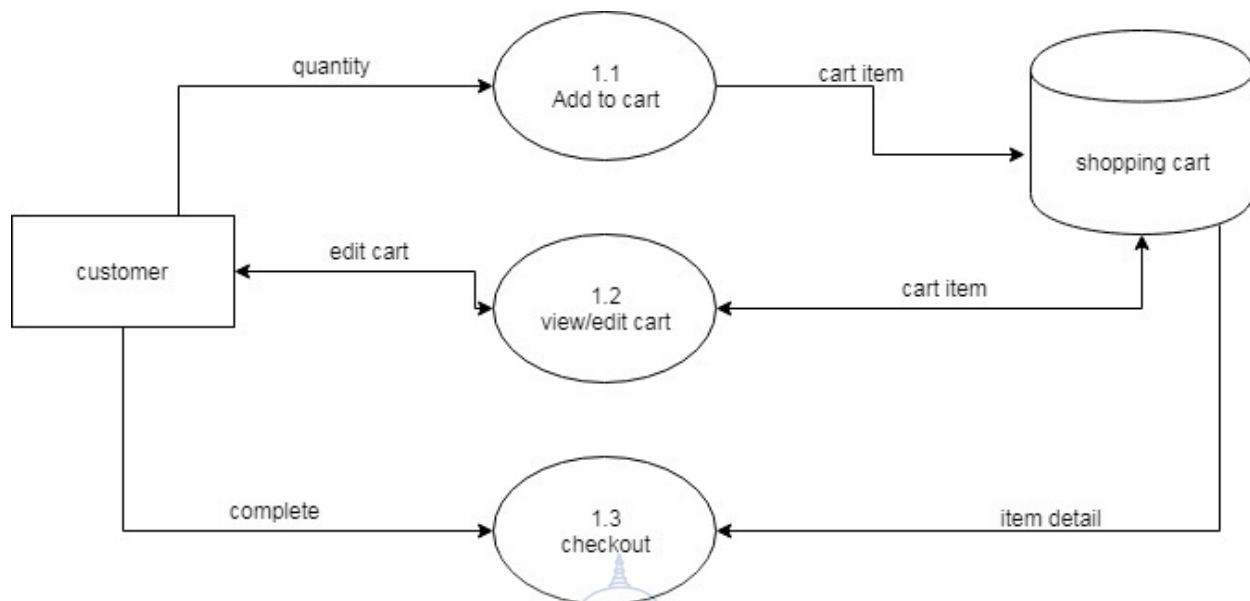

Figure 5.3: DFD level 1

Figure 5.4: DFD level 2

5.1.2 System requirements (non-functional requirements)

Performance Requirements

1. Authentication :
   The login is the only constraint for the user to proceed to various facilities like purchasing product, viewing it in AR, viewing 3D model of the product.

2. Overlaying 3D model into the real world using AR :
   The 3D model will be overlayed into the real world using AR, and this application works only in Android mobile with API 15+ and several other features are required.

Safety Requirements

If there is extensive damage to a wide portion of the database due to catastrophic failure, such as a disk crash, the recovery method restores a past copy of the database that was backed up to archival storage (typically tape) and reconstructs a more current state by reapplying or redoing the operations of committed transactions from the backed up log, up to the time of failure.

Security Requirements

The major security requirements for the system will be the safeguarding of the user data from any kind of exploit. In order to protect the user data the data is not stored in local databases we will be storing in the cloud for better security.

5.2   System Architecture Design

This is the System Architecture of the project. A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.
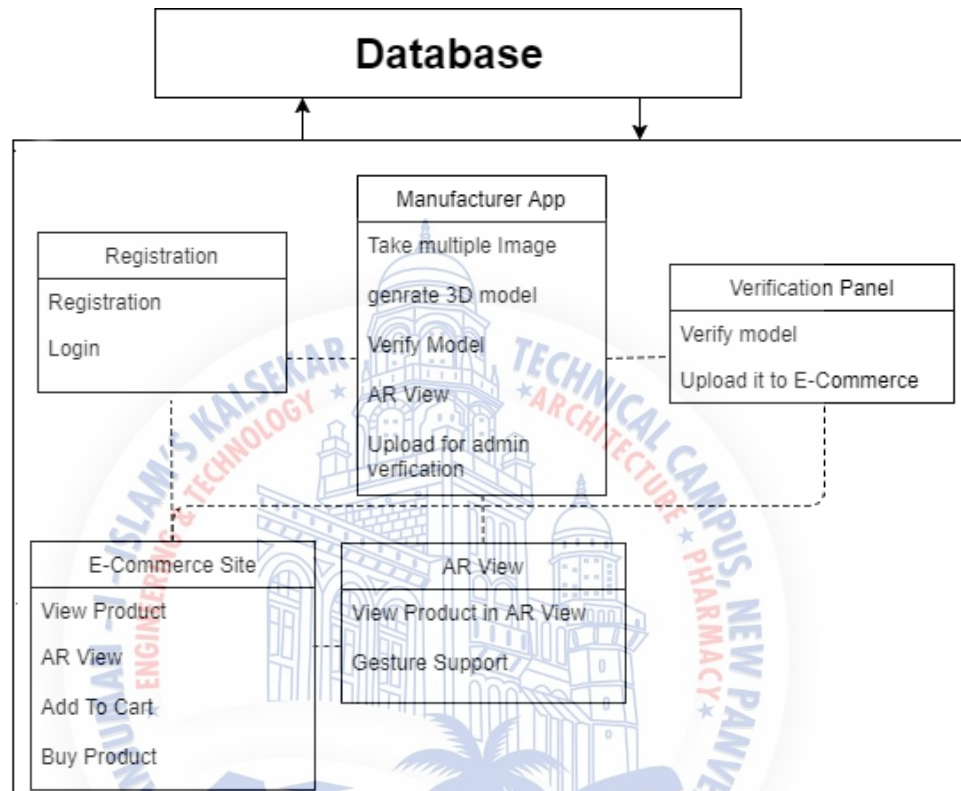

Figure 5.5: System Architecture

5.3   Sub-system Development

Customer Module:- In this module, customer will buy the item they want from the E-commerce site. Before buying, customer can view the item in Augmented Reality and select the product by their choce.

Manufacturer Module:- Manufacturer can login to an account and can upload the product and can preview it in AR view. If the manufacturer is satisfied then the product is uploaded.

Admin Module:- Admin will verify the product. The verification will done on the basis of the product information and valid manufacturer.

AR Module:- The 3D model will displayed on to the Screen by Augmented Reality in which the customer can get the precise view of the product.

5.3.1 Customer Module

In this module, customer can purchase the item or product they want from the e-commerce site. Before buying, customer can view the product in Augmented Reality and select the product by their choice.
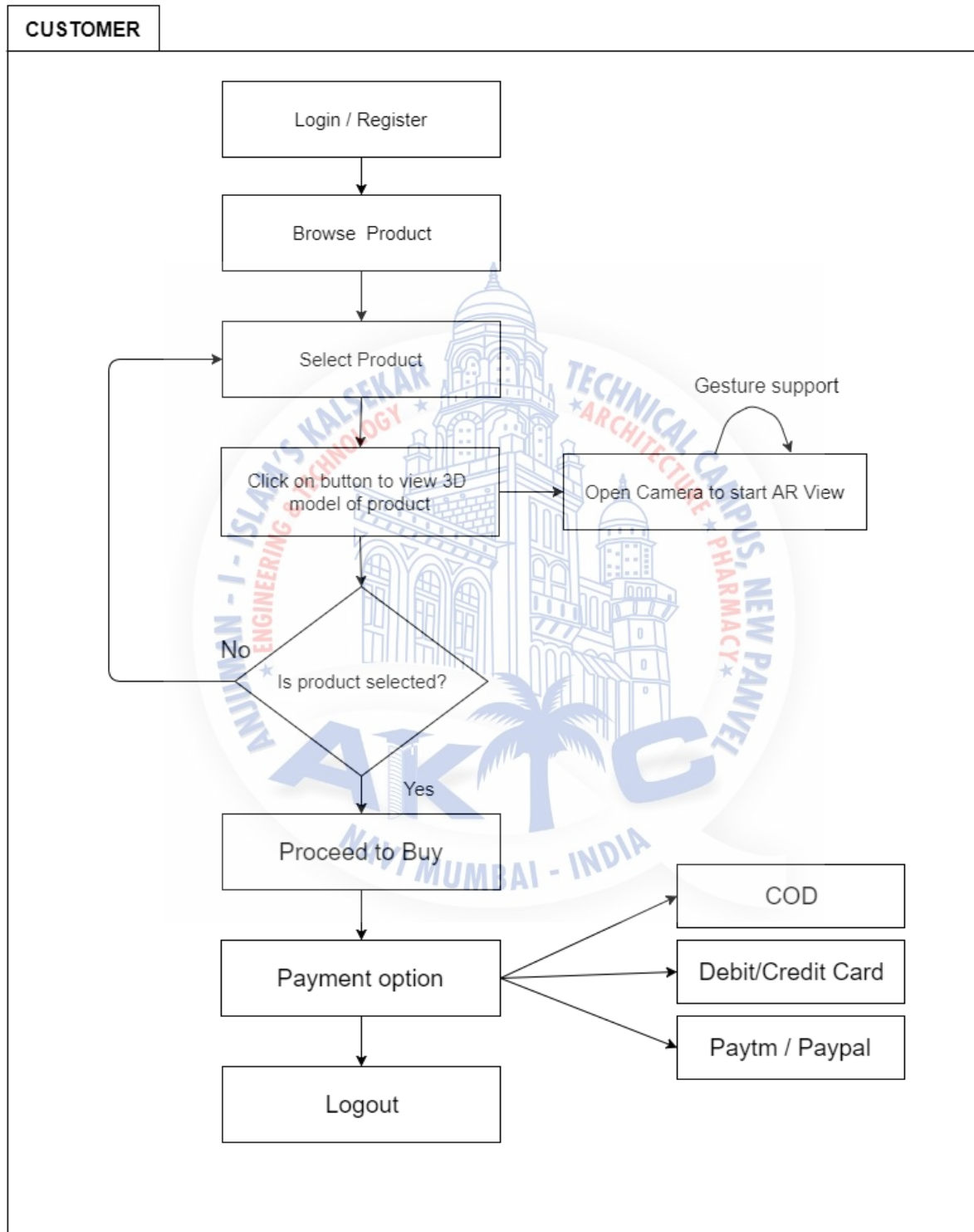

Figure 5.6: Customer Module

5.3.2   Manufacturer Module

Manufacturer Module:- This is the manufacturer module of our system. In this manufacturer can register or login to the account and can upload the product and can preview its 3D model. If the manufacturer is satisfied than the product will be uploaded.
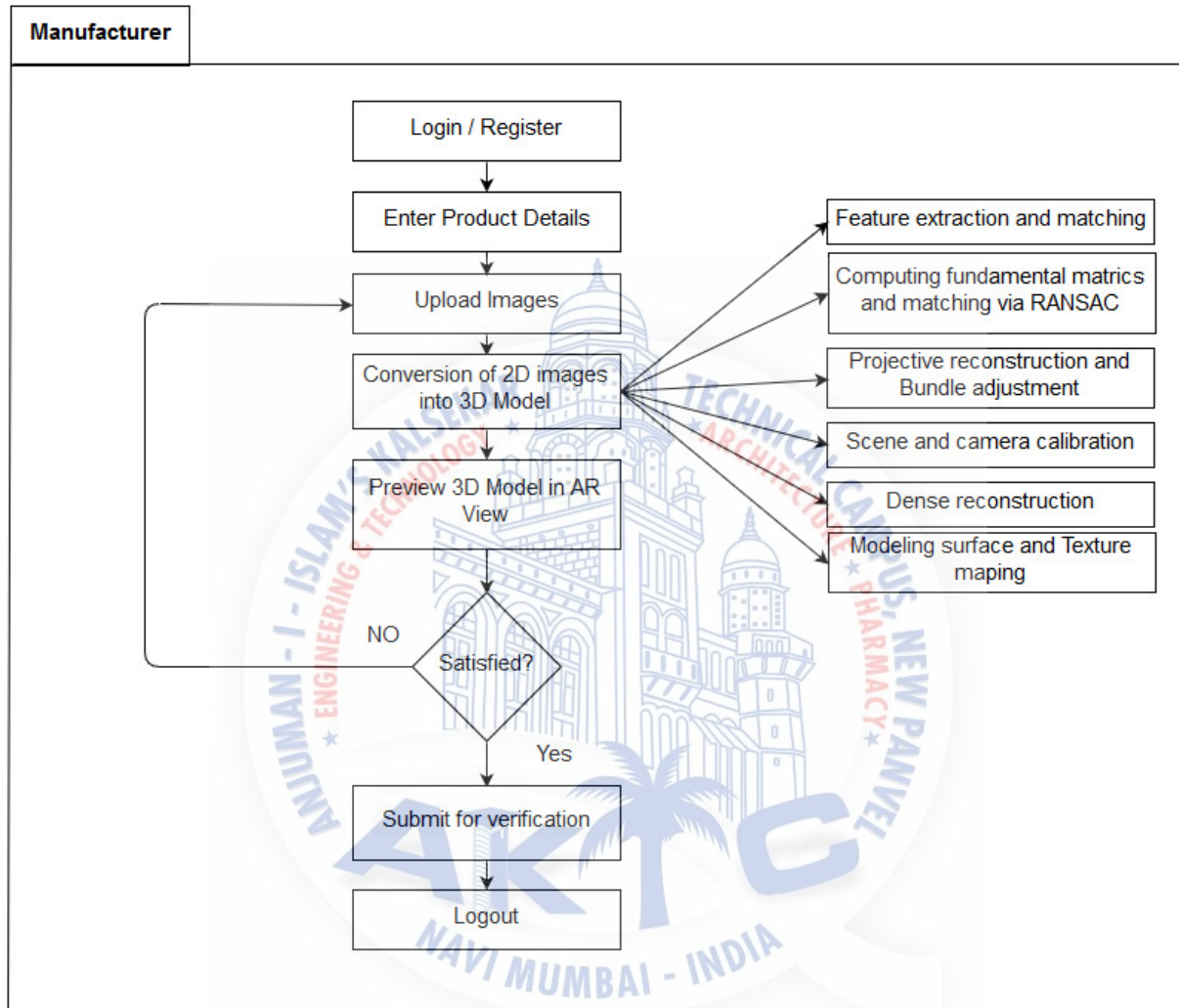
Figure 5.7: Manufacturer Module

5.3.3 Admin Module

Admin Module:- Admin will verify the product. The product which are to be displayed on the e-commerce website and the 3D model of the same needs to be verified by some authority. So here is the admin module which will verify the products and 3D model of the same before viewing them on the website. The verification will be done on the basis of the product information and valid manufacturer. If the admin verifies the product and its 3D model is not proper or the details provided by the manufacturer are not proper then the product will be rejected.
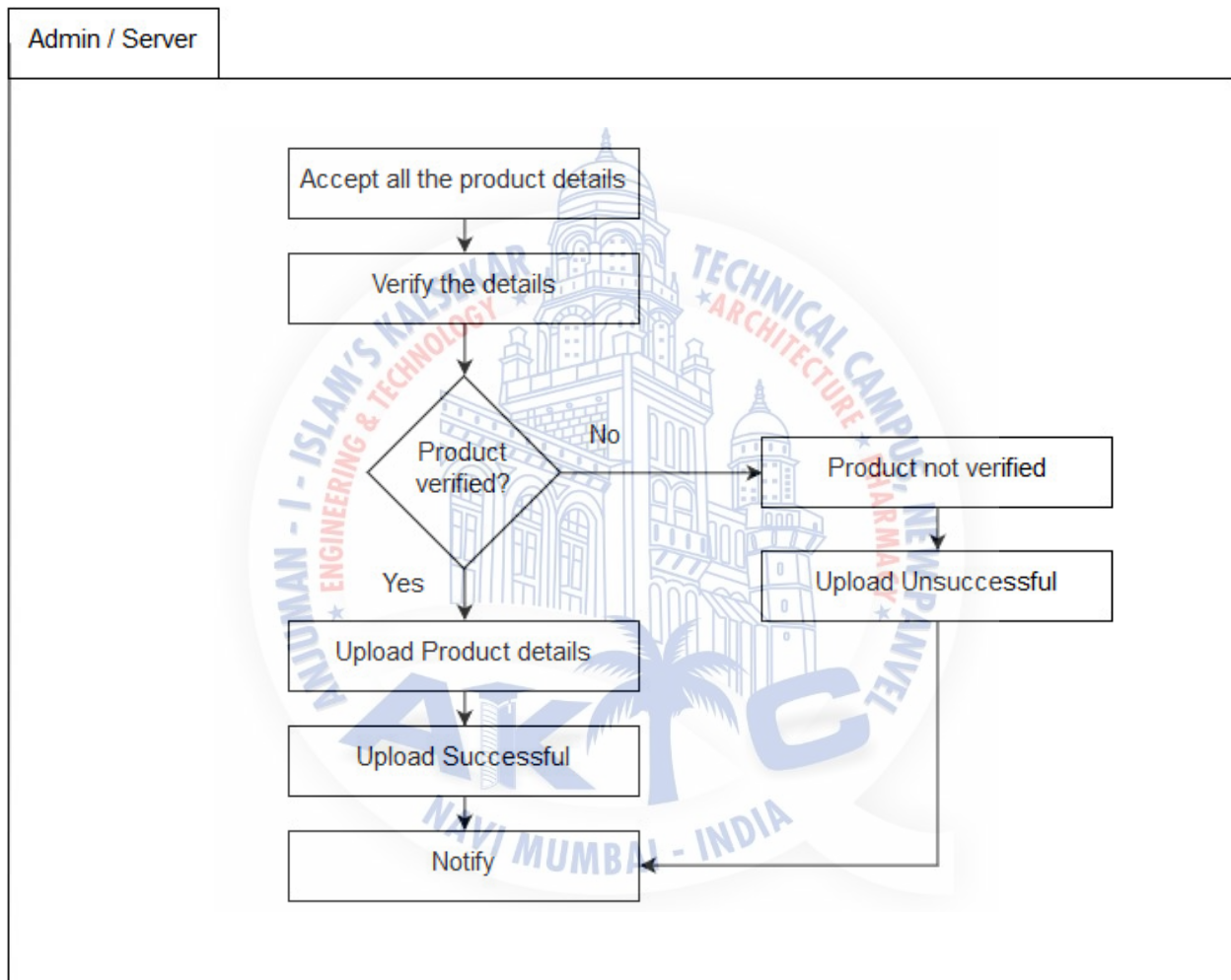
Figure 5.8: Admin Module

5.3.4   AR Module

The next module is AR module. In this module as soon as user clicks on the AR view button in e-commerce website, the 3D model of the product will be overlayed into the real world with the help of camera. This will be done by using Augmented Reality. With the help of AR, user will be able to see the product in real world and in which the customer can get the precise view of the product. User will have rendering options in this module.

Figure 5.9: AR Module

5.4   Systems Integration

First module is customer module in which the customer will buy the products, before buying, customer can see the product in to the AR view. The second module is of Manufacturer module, in this module the manufacturer will provide the 2D images to the system that will get converted into 3D model. The third Module is the Adm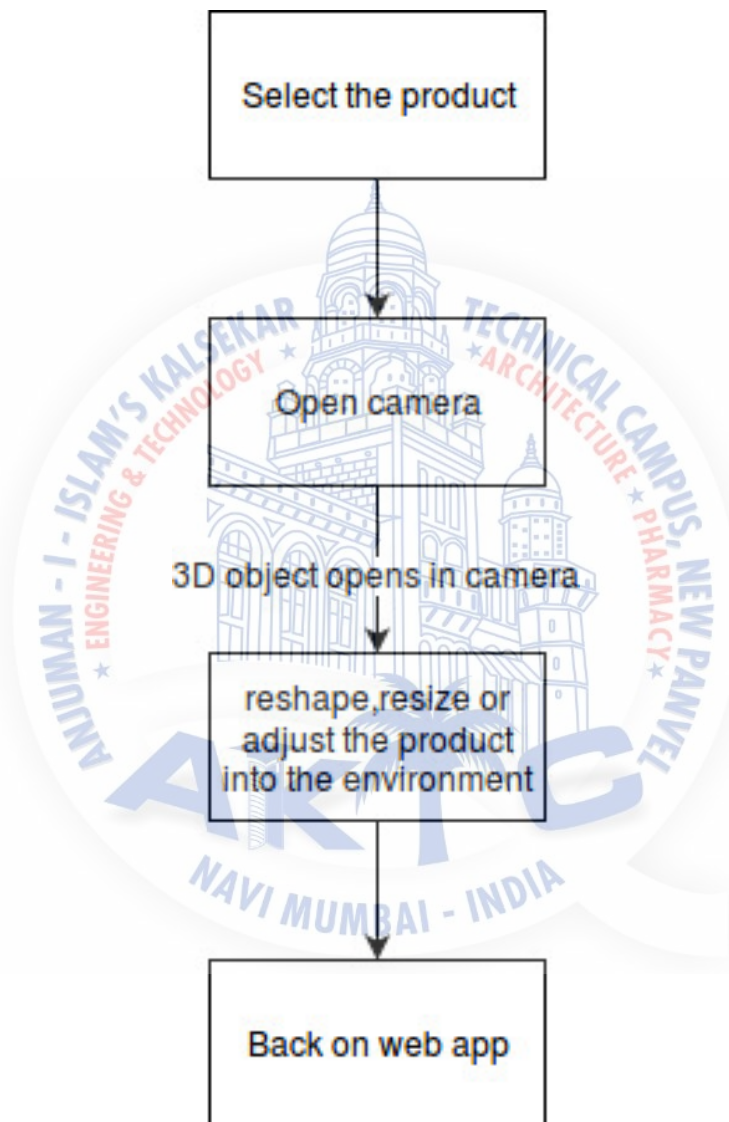in module in which all the products will get verified by the admin. The verification will be done by using product information. The fourth module is AR module in which the customer can see the products in AR view. All the modules are integrated into one e-commerce website and mobile site. The separate application is made for conversion of 2D images into 3D model and displaying it in Augmented Reality.

5.4.1   Class Diagram

This is the Class diagram of the system. The class diagram is the main building block of object-oriented modelling. It is used for general conceptual modelling of the systematic of the application, and for detailed modelling translating the models into programming code. Class diagrams can also be used for data modeling.
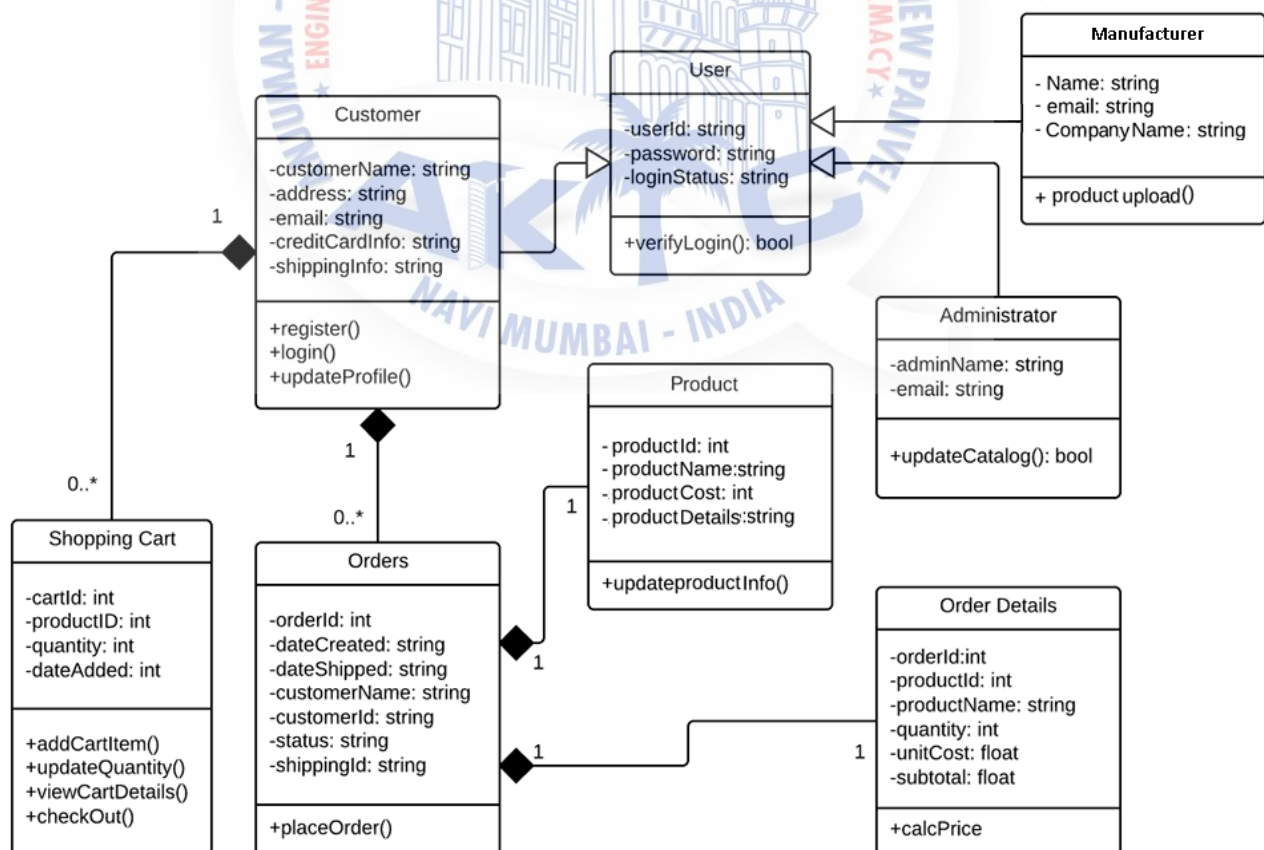
Figure 5.10: Class Diagram

5.4.2   Sequence Diagram

This is the Sequence diagram of the system. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams or event scenarios.

A sequence diagram shows, as parallel vertical lines (lifelines), different processes or objects that live simultaneously, and, as horizontal arrows, the messages exchanged between them, in the order in which they occur. This allows the specification of simple runtime scenarios in a graphical manner.
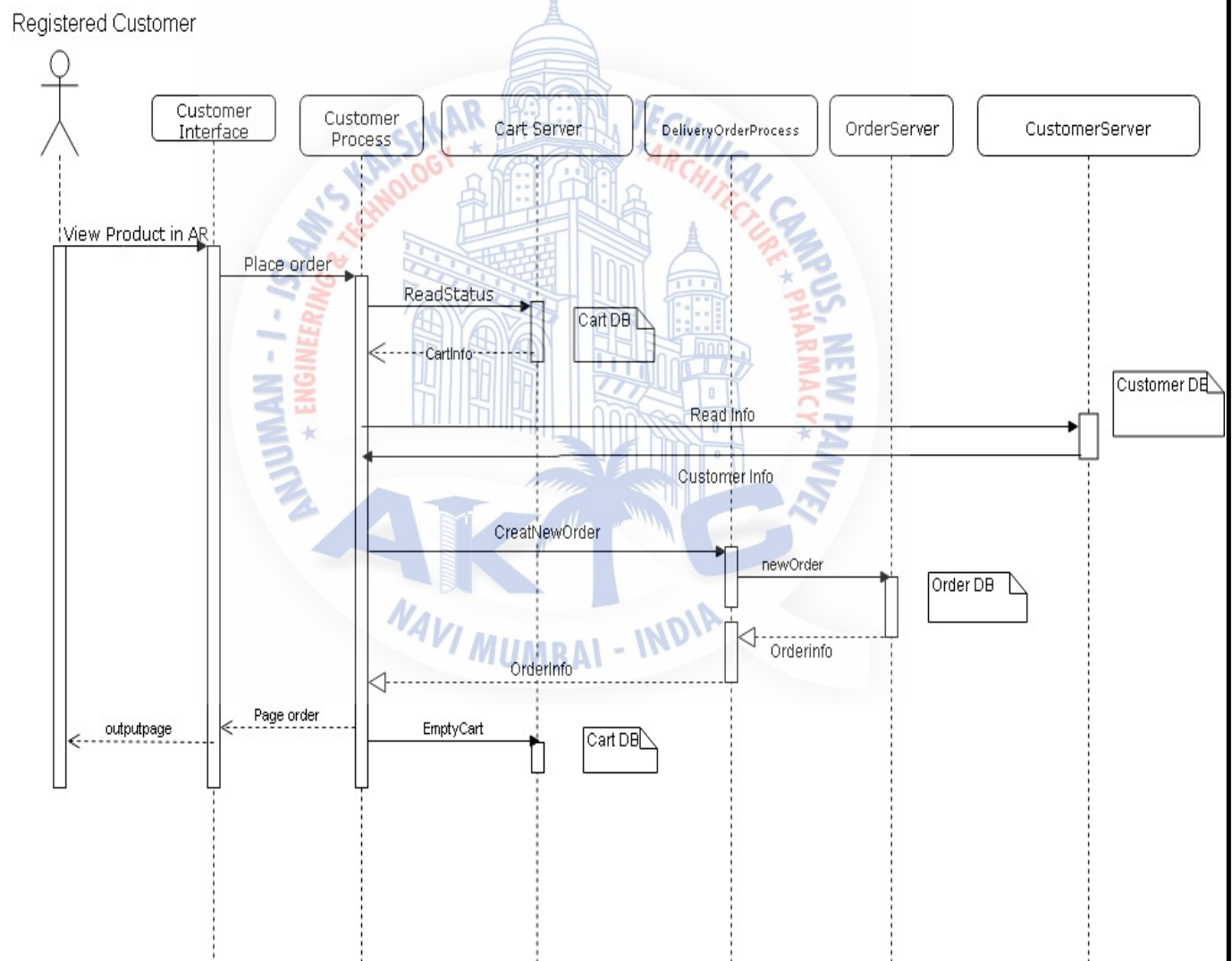
Figure 5.11: Sequence Diagram

5.4.3 Component Diagram

This is the Component diagram of the system. A component diagram depicts how components are wired together to form larger components or software systems. They are used to illustrate the structure of arbitrarily complex systems.
Components are wired together by using an assembly connector to connect the required interface of one component with the provided interface of another component. This illustrates the service consumer - service provider relationship between the two components.
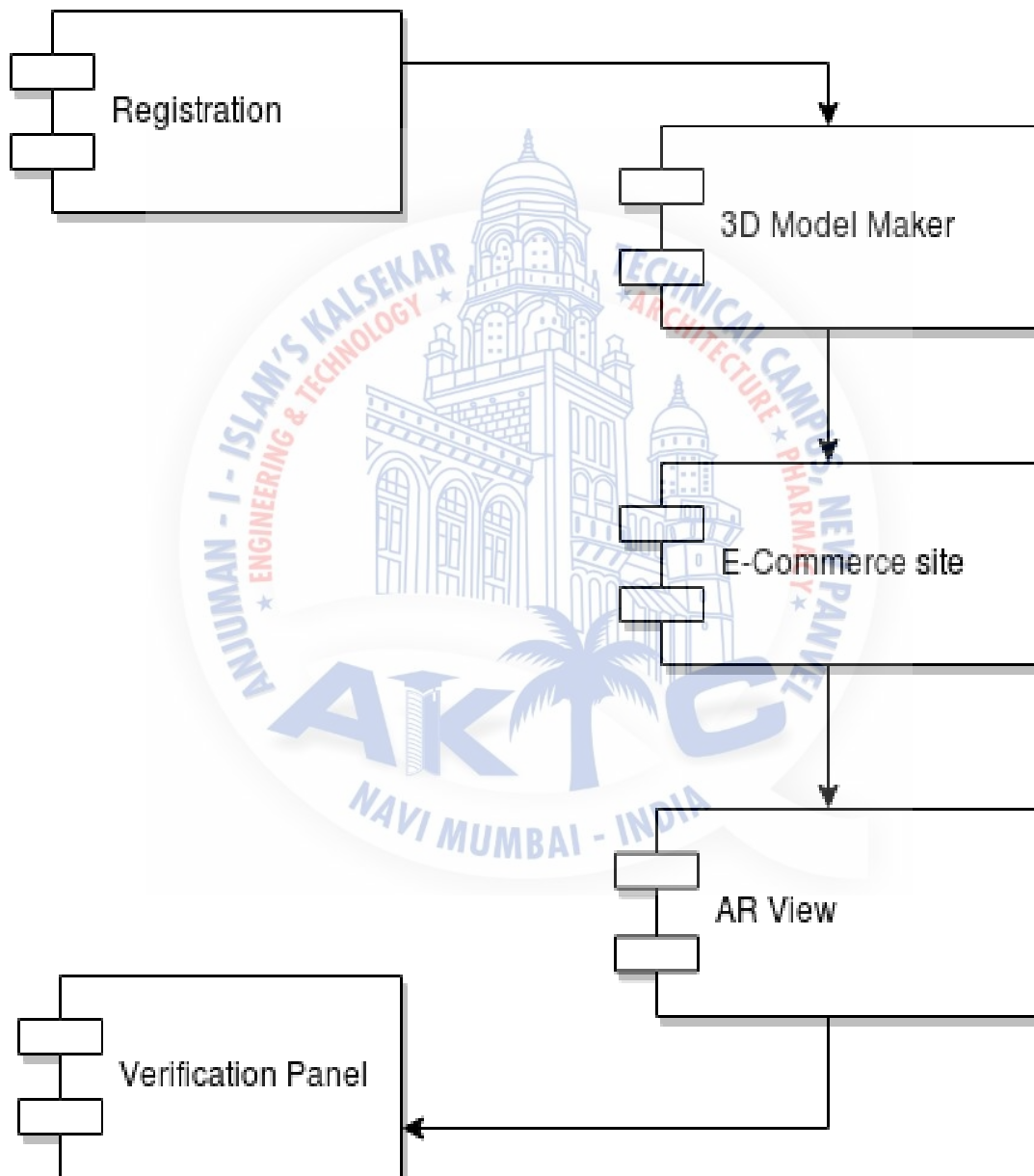
Figure 5.12: Component Diagram

AUTO GENERATION OF 3D MODEL USING MULTIPLE 2D GRAPHICS AND MANIFEST
THROUGH AUGMENTED REALITY

5.4.4   Deployment Diagram

This is the Deployment diagram of the system. Deployment diagram is a structure diagram which shows architecture of the system as deployment (distribution) of software artifacts to deployment targets. Deployment diagrams could describe architecture at specification level (also called type level) or at instance level (similar to class diagrams and object diagrams).

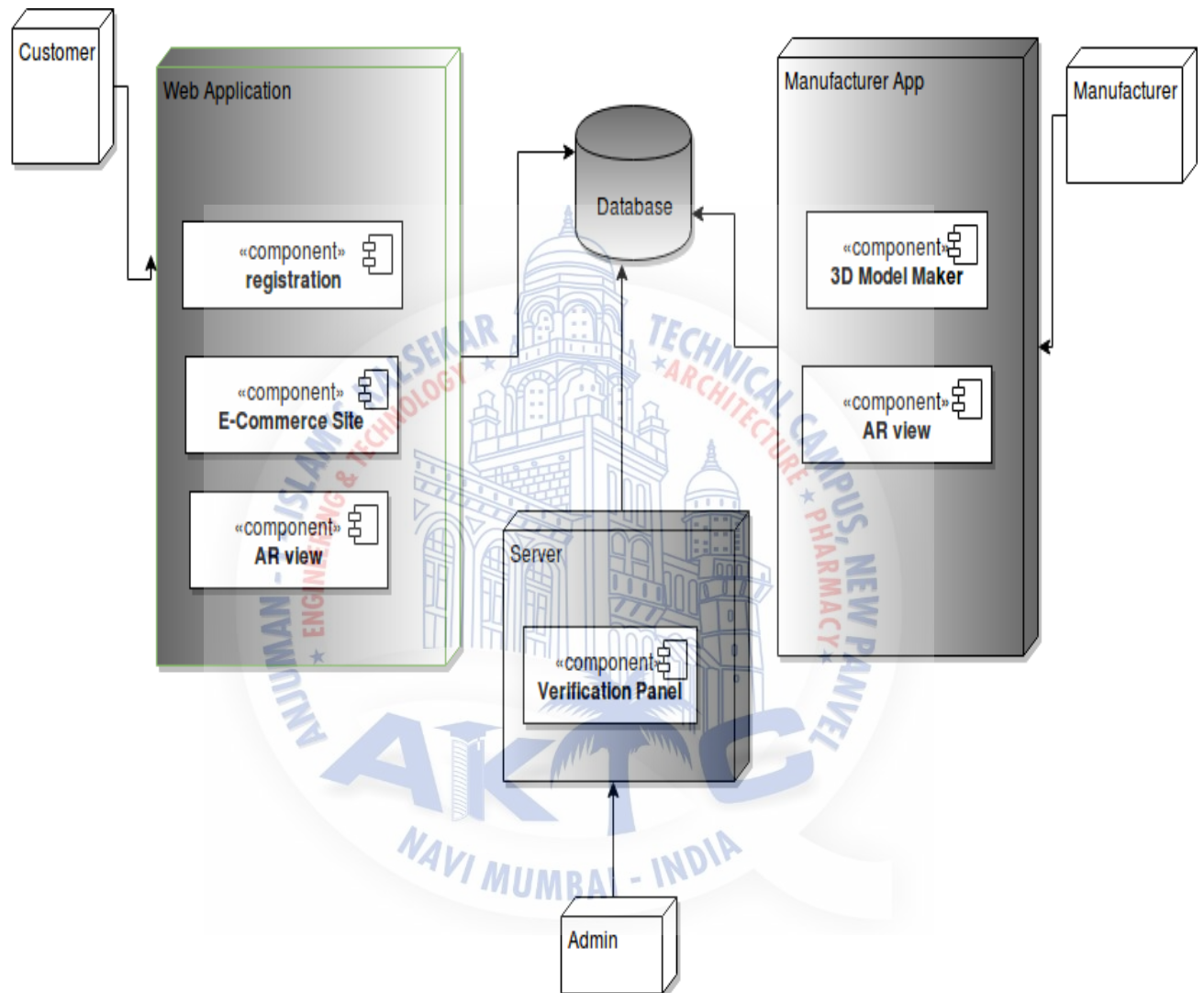**Figure 5.13:** Deployment Diagram

Chapter 6

Implementation

6.1   Customer Module

Like every other e-commerce site the customer has to register/login. Customer can further see the list of the products. Later after selecting the desired product he/she can view the 3D model of any product in Augmented Reality. Customer can then buy the product. Before buying, customer can view the item in Augmented Reality and select the product by their choice. Multiple payment options will be provided. The customer module includes several different modules they are:

1. Login

2. Registration

3. Product Details

4. Add to cart

5. Shipping Details

6. Payment Details

LOGIN :-

```
if (!empty($_POST['c_email']) && !empty($_POST['c_password'])) {
    $email = mysqli_real_escape_string($conn, $_POST['c_email']);
    $password =mysqli_real_escape_string($conn, $_POST['c_password']);
    // echo "string";
    $sql = "select * from customer_register where c_email='".$email."' and
        c_password='".$password."'";
    $result = mysqli_query($conn,$sql);
    $count = mysqli_num_rows($result);
    $row = mysqli_fetch_array($result);
    $user_name = $row['user_name'];
    if($count){
        session_start();
        $msg = "Welcome ".$user_name;
        $_SESSION['user_name'] = $row['c_firstname'];
        $_SESSION['email'] = $row['c_email'];
        $_SESSION['user_id'] = $row['c_id'];
        header("location: index.php?msg=$msg");
    }else{
```

AUTO GENERATION OF 3D MODEL USING MULTIPLE 2D GRAPHICS AND MANIFEST
THROUGH AUGMENTED REALITY

```php
18        $mssg = "!!!!   Invalid Login    !!!!";
19        // header("location: index.php?msg=$msg");
20        // $msg = "";
21      }
22  }
```

REGISTER :-

```php
1  if(isset($_POST['submit'])){
2    $email = mysqli_real_escape_string($conn, $_POST['email']) ;
3    $f_name = mysqli_real_escape_string($conn,$_POST['c_firstname']);
4    $l_name = mysqli_real_escape_string($conn, $_POST['c_lastname']);
5    $password = mysqli_real_escape_string($conn,  $_POST['c_password']);
6    $c_password = mysqli_real_escape_string($conn, $_POST['c_confirmpassword']) ;
7    $query_insert = "INSERT INTO customer_register(c_firstname, c_lastname,
         c_email, c_password, c_confirmpassword) VALUES ('$f_name', '$l_name', '
         $email','$password', '$c_password')";
8    $result = mysqli_query($conn, $query_insert);
9    if(!$result){
10     echo 'server error';
11   }else{
12    header("location:index.php");
13   }
14 }
```

CART :-

```php
1  <?php for ($x = 0; $x < $counter; $x++) {
2        echo "<tr>";
3        echo "<td><img src=images/";if (isset($url[$x])) {
4            echo $url[$x];
5        }
6        echo "></td>";
7        echo "<td>"; if (isset($price[$x])) {
8            echo $price[$x];
9        }
10       echo "</td>";
11       echo "<td>"; if (isset($qty[$x])) {
12           echo $qty[$x];
13       }
14       echo "</td>";
15       echo "<td>"; if (isset($price[$x])) {
16           echo $price[$x] * $qty[$x];
17       }
18       echo "<a href=itemdelet.php?id=";echo $product_id[$x];
19       echo "><span class=close>&times;</span></a></td></tr>";
20   }
21 ?>
```

6.2 Manufacturer Module

Manufacturer Module:- This is the manufacturer module of our system. In this manufacturer can register or login to the account and can upload the product and can preview its 3D model. If the manufacturer is satisfied than the product will be uploaded.

```java
public void btnChoosePhotosClick(View v){

    ArrayList<String> selectedItems = imageAdapter.getCheckedItems();
    Toast.makeText(MultiPhotoSelectActivity.this, "Total photos selected: "+
        selectedItems.size(), Toast.LENGTH_SHORT).show();
    Log.d(MultiPhotoSelectActivity.class.getSimpleName(), "Selected Items: "
        + selectedItems.toString());
}
public class ImageAdapter extends BaseAdapter {

    ArrayList<String> mList;
    LayoutInflater mInflater;
    Context mContext;
    SparseBooleanArray mSparseBooleanArray;

    public ImageAdapter(Context context, ArrayList<String> imageList) {
        // TODO Auto-generated constructor stub
        mContext = context;
        mInflater = LayoutInflater.from(mContext);
        mSparseBooleanArray = new SparseBooleanArray();
        mList = new ArrayList<String>();
        this.mList = imageList;

    }

    public ArrayList<String> getCheckedItems() {
        ArrayList<String> mTempArry = new ArrayList<String>();

        for(int i=0;i<mList.size();i++) {
            if(mSparseBooleanArray.get(i)) {
                mTempArry.add(mList.get(i));
            }
        }

        return mTempArry;
    }
     @Override
    public int getCount() {
        return imageUrls.size();
    }

    @Override
    public Object getItem(int position) {
        return null;
    }

    @Override
    public long getItemId(int position) {
        return position;
    }
```

6.3   Admin Module

Admin Module:- Admin will verify the product. The product which are to be displayed on the e-commerce website and the 3D model of the same needs to be verified by some authority. So here is the admin module which will verify the products and 3D model of the same before viewing them on the website. The verification will be done on the basis of the product information and valid manufacturer. If the admin verifies the product and its 3D model is not proper or the details provided by the manufacturer are not proper then the product will be rejected.

```php
<?php
include_once("config.php");
$select_product = "select * from admin ";
$select_product_result = mysqli_query($connection, $select_product);
$counter = 0;
if($select_product_result){
    while ($rows = mysqli_fetch_array($select_product_result)) {
        $product_id[$counter] = $rows['product_id'];
        $product_name[$counter] = $rows['product_name'];
        $url[$counter] = $rows['screenshots'];
        $price[$counter] = $rows['price'];
        $Td_model[$counter] = $rows['3d_model'];
        $color[$counter] = $rows['color'];
        $brand_name[$counter] = $rows['brand'];
        $m_name[$counter] = $rows['manufacturer_name'];
        $description[$counter] = $rows['description'];
        $specification[$counter] = $rows['specification'];
        // echo $product_id[$counter];
        $counter++;
    }
}
?>
```

6.4   AR Module

The next module is AR module. In this module as soon as user clicks on the AR view button in e-commerce website, the 3D model of the product will be overlayed into the real world with the help of camera. This will be done by using Augmented Reality. With the help of AR, user will be able to see the product in real world and in which the customer can get the precise view of the product. User will have rendering options in this module.

Figure 6.1: Augmented Reality

```
1  #region Tracker Events
2    public void OnSceneRecognized(InstantTarget target) {
3      SetSceneActive(true);
4    }
5    public void OnSceneLost(InstantTarget target) {
6      SetSceneActive(false);
7    }
8    private void SetSceneActive(bool active) {
9      _gridRenderer.enabled = active;
10     foreach (var button in Buttons) {
```

```
11      button.interactable = active;
12    }
13    foreach (var model in _activeModels) {
14      model.SetActive(active);
15    }
16    ActivityIndicator.color = active ? EnabledColor : DisabledColor;
17    _isTracking = active;
18  }
19  public void OnStateChanged(InstantTrackingState newState) {
20    _currentState = newState;
21    if (newState == InstantTrackingState.Tracking) {
22      InitializationControls.SetActive(false);
23      ButtonDock.SetActive(true);
24    } else {
25      foreach (var model in _activeModels) {
26        Destroy(model);
27      }
28      _activeModels.Clear();
29      InitializationControls.SetActive(true);
30      ButtonDock.SetActive(false);
31    }
32    _gridRenderer.enabled = true;
33    UpdateTrackingMessage();
34  }
35  public void OnError(int errorCode, string errorMessage) {
36    Debug.Log("InstantTracker OnError with errorCode: " + errorCode + " and
          errorMessage: " + errorMessage);
37  }
38  #endregion
```

```
1  public void OnBeginDrag (int modelIndex) {
2    if (_isTracking) {
3      GameObject modelPrefab = Models[modelIndex];
4      Transform model = Instantiate(modelPrefab).transform;
5      _activeModels.Add(model.gameObject);
6      var cameraRay = Camera.main.ScreenPointToRay(Input.mousePosition);
7      Plane p = new Plane(Vector3.up, Vector3.zero);
8      float enter;
9      if (p.Raycast(cameraRay, out enter)) {
10         model.position = cameraRay.GetPoint(enter);
11     }
12       Quaternion modelRotation = Quaternion.LookRotation(Vector3.ProjectOnPlane
            (-Camera.main.transform.forward, Vector3.up), Vector3.up);
13     model.rotation = modelRotation;
14     _moveController.SetMoveObject(model);
15   }
16 }
```

Chapter 7

System Testing

7.1   Test Cases and Test Results

Test ID	Test Case Title	Test Condition	System Behavior	Expected Result
T01	Login	User should be registered	Will connect to database	Should login into system
T02	Add to cart	User should be registered	Connect to database	Product will be added to cart
T03	Augmented Reality	User must be on mobile view and is device supported	Camera will launch	Product will be displayed in AR

7.2   Sample of a Test Case

Title: Login Page – Authenticate Successfully
Description: A registered user should be able to successfully login to the site.

Precondition: The user must already be registered with an email address and password.

Assumption: A supported browser is being used.

Test Steps:

1. Navigate to the website

2. In the 'email' field, enter the email of the registered user.

3. Click the 'Next' button.

4. Enter the password of the registered user

5. Click 'Log in'

Expected Result: User will be directed again to the website, users' session will start and welcome message will appear, after login the user will have access to cart and further shipping and payment options.

Actual Result: User will be directed again to the website, users' session will start and welcome message will appear, after login the user will have access to cart and further shipping and payment options.
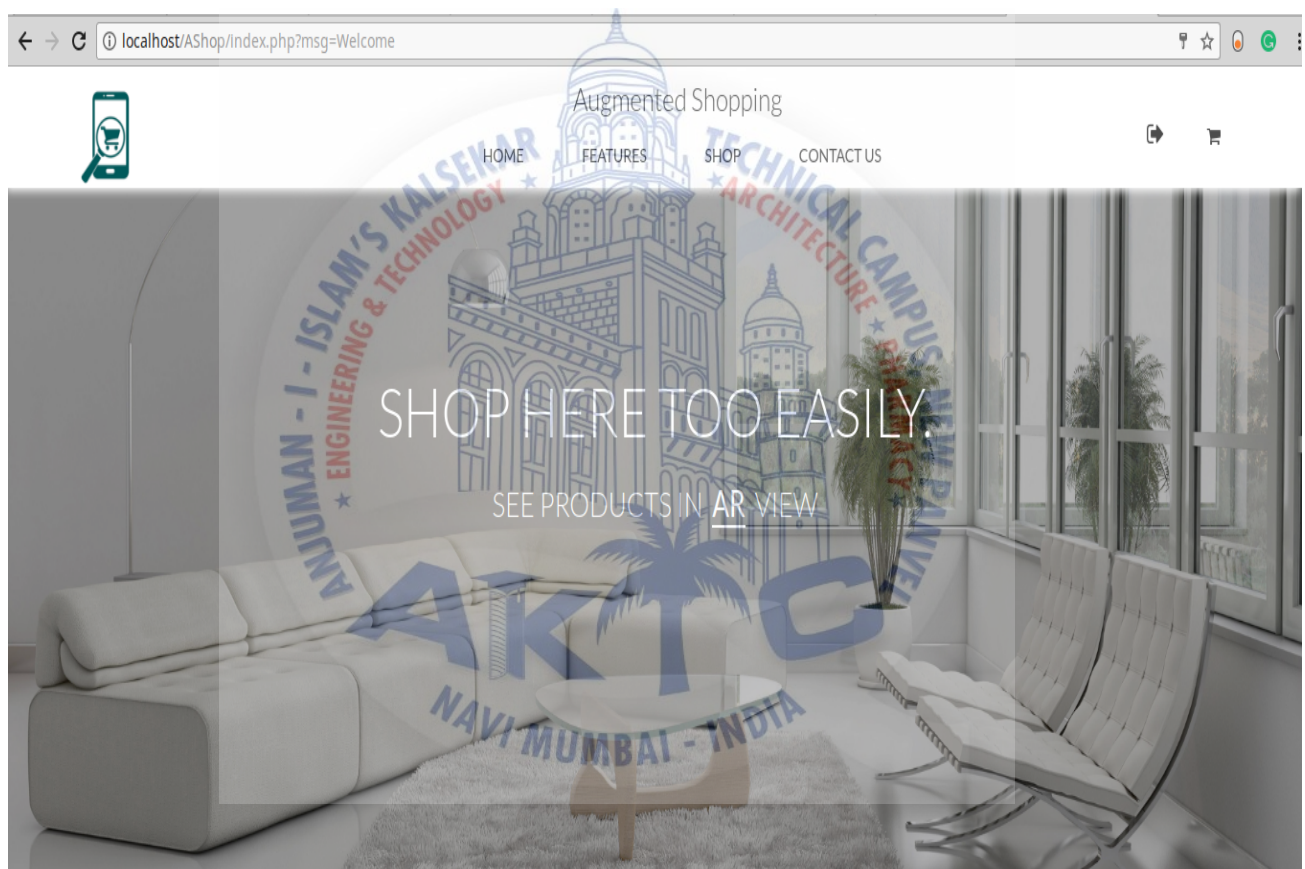

Figure 7.1: User logged in

7.2.1   Software Quality Attributes

1. AVAILABILITY: The system should not be down,whenever the user use the system the specific data should be available to the user.

2. CORRECTNESS: As per the user search the correct data should

be shown to the user like at time for searching the near by place the system should show only the places around the user.

3. MAINTAINABILITY: The administrators of the system will maintain the system with effective updates though on air update if needed.

4. EXTENSIBILITY: The system is capable to be modified by changing some modules or by adding some features to the existing system

Chapter 8

Screenshots of Project

8.1   Home page

Figure 8.1: Home page
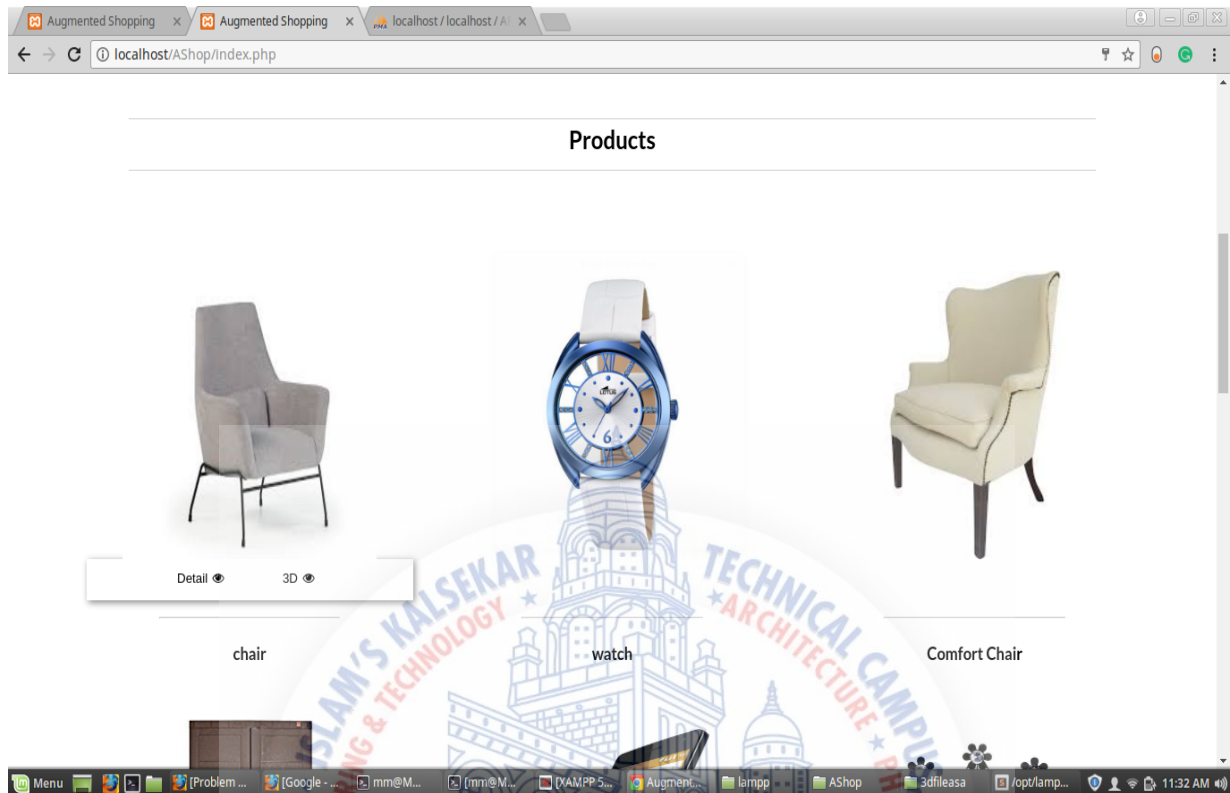
8.2 Products

Figure 8.2: Products

8.3 Product Detail
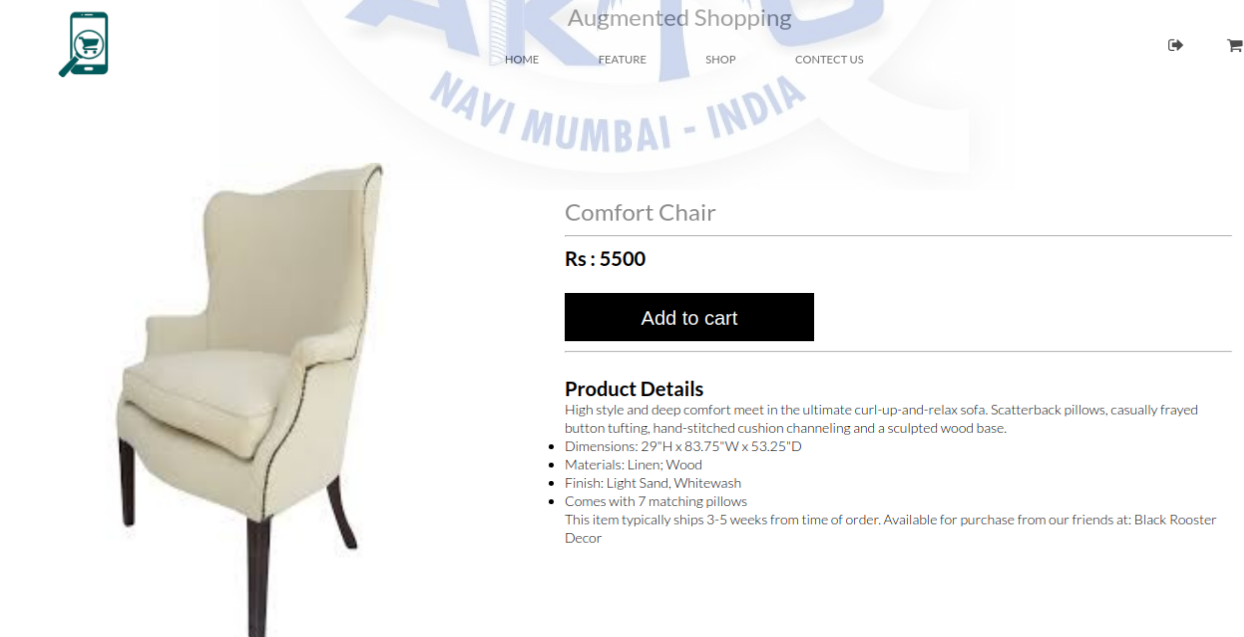

Figure 8.3: Product Detail

8.4 Cart

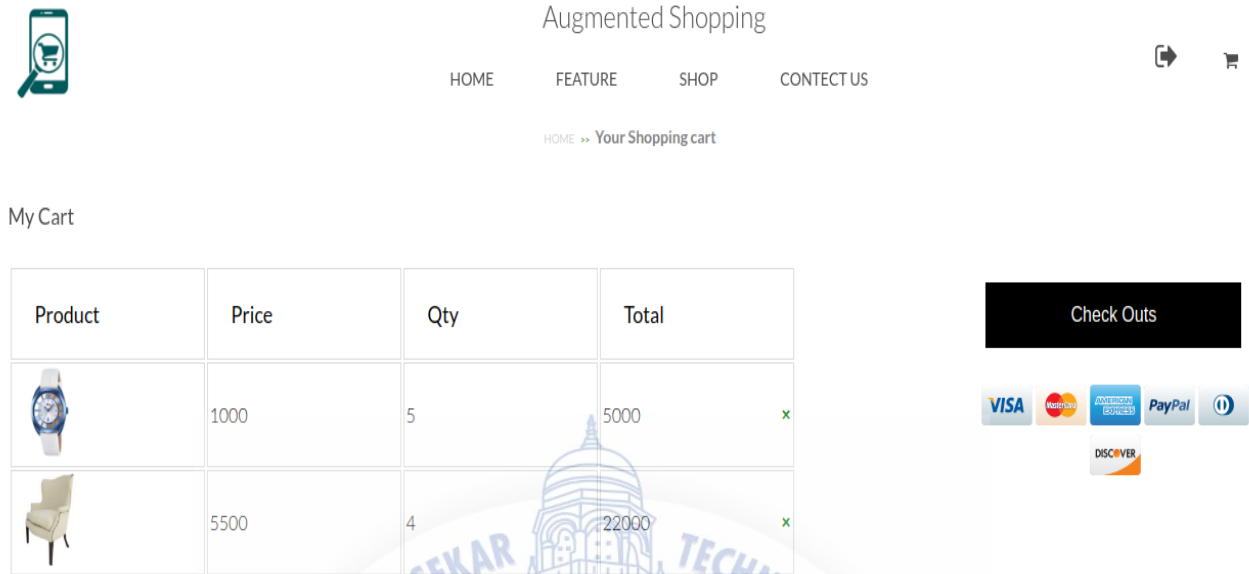**Figure 8.4:** Cart

8.5 3D model
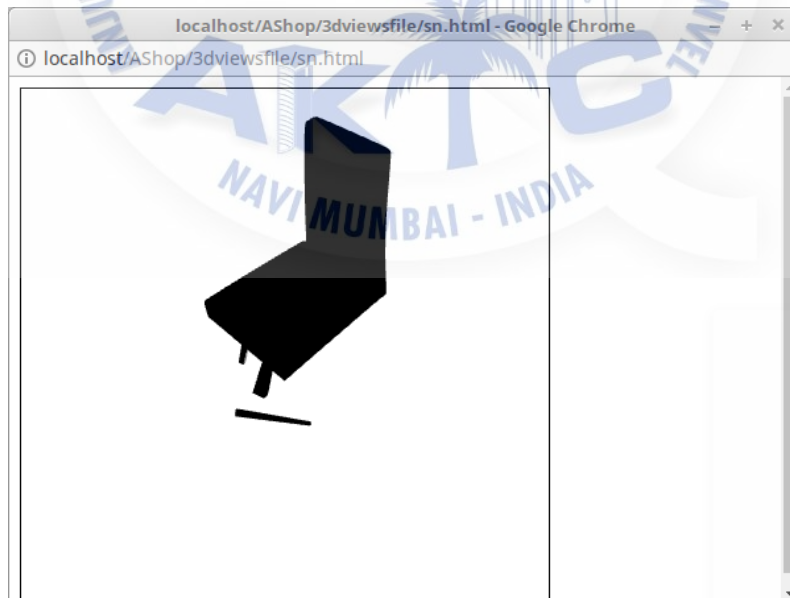

Figure 8.5: 3D model

8.6   Augmented Reality

Figure 8.6: Augmented Reality

Chapter 9

Conclusion and Future Scope

9.1   Conclusion

By generating 3D model from 2D images of the product or any object, one can observe that object more precisely. The proposed application can be implemented in many fields like gaming, machine modeling, architectural modeling, medical, e-commerce etc. The conversion of 2D images to 3D model makes the object look more realistic. During the development of 3D models, designers and developers have to handle a lot of input dimensions of the object, a lot of interaction techniques, and a lot of ways to present content. So our module helps to reduce these problems. The aim of this project is to automate the process of converting 2D images to 3D model and to eliminate the manual process for the same. The proposed model will be demonstrated using e-commerce field. The 3D model instead of 2D images will help customer get more precise and clear understanding of the product they wish to buy. This adaptation of 3D model generating application in E-commerce will take it to a more high level.

9.2   Future Scope

1. System will be able to generate 3D model of the product automatically.

2. The 3D model of the object will be displayed in AR seamlessly.

3. The 2D to 3D converting application can be used in several fields like medical, civil engineering, machine design etc.

AUTO GENERATION OF 3D MODEL USING MULTIPLE 2D GRAPHICS AND MANIFEST
THROUGH AUGMENTED REALITY

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Achievements

1. Publications

    (a) *ANALYSIS OF AUTO GENERATION OF 3D MODEL US-ING MULTIPLE 2D GRAPHICS TO MANIFEST THROUGH AUGMENTED REALITY*; Maria Khedwala, Furkan Momin, Pachhapure Uzair, Shaikh Sameer, Universal IEEE, Jan 2018
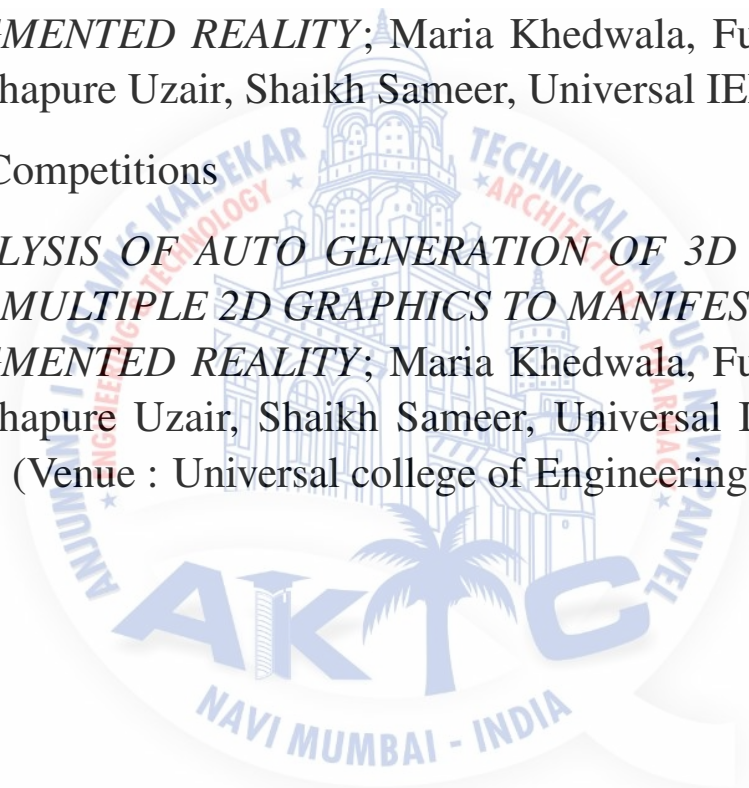
2. Project Competitions

    (a) *ANALYSIS OF AUTO GENERATION OF 3D MODEL US-ING MULTIPLE 2D GRAPHICS TO MANIFEST THROUGH AUGMENTED REALITY*; Maria Khedwala, Furkan Momin, Pachhapure Uzair, Shaikh Sameer, Universal IEEE , March 2018 (Venue : Universal college of Engineering, Vasai)

AUTO GENERATION OF 3D MODEL USING MULTIPLE 2D GRAPHICS AND MANIFEST
THROUGH AUGMENTED REALITY

IEEE

International Conference on
Smart City and Emerging Technologies (ICSCET)

organized by

Universal College of Engineering

Near Bhajansons Dairy & Punyadham, Kaman Bhiwandi Road, Vasai East, Mumbai – 401212, Maharashtra, India.

(Approved by AICTE, DTE & Affiliated to University of Mumbai)

(Gujarati Linguistic Minority Institution)

in association with

Institute of Electrical and Electronics Engineers (IEEE)

This is to certify that Dr./Ms./Mr. _**KHEDWALA MARIA**_

has presented a paper on

Analysis Of Auto Generation Of 3D Model Using Multiple 2D Graphics To Manifest Through Augmented Reality

in the *"International Conference on Smart City and Emerging Technologies"* (ICSCET-2018)

organized on 5ᵗʰ January 2018 at Universal College of Engineering

in association with IEEE Bombay Section.

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Conference Chair

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Presentation" 2018.

Date: *9ᵗʰ March 2018*

Dr. Ajoy Kumar
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