Sushila Devi Bansal College Of Technology

Department Of Computer Science & Engineering

Software Design Specification Document for

Augmented Reality in E-commerce

1. Introduction

Augmented reality[1] has been a hot topic in software development circles for a number of years, but it’s getting renewed focus and attention with the release of products like Google Glass. Augmented reality is a technology that works on computer vision-based recognition algorithms to augment sound, video, graphics and other sensor-based inputs on real world objects using the camera of your device. It is a good way to render real world information and present it in an interactive way so that virtual elements become part of the real world. Augmented reality displays superimpose information in your field of view and can take you into a new world where the real and virtual worlds are tightly coupled. It is not just limited to desktop or mobile devices.

A simple augmented reality use case is: a user captures the image of a real-world object, and the underlying platform detects a marker, which triggers it to add a virtual object on top of the real-world image and displays on your camera screen.

• Problem Definition

As the customer purchases various types of furniture through online, but in online it shows only photo and cannot be determined size in room. Even though there are certain applications present which are based on augmented reality they are not suitable for live processing and takes more time to process the area and some are fixed to a particular image plane. So, to overcome that he can use this application to check whether the furniture is adjustable or not which can be placed in the customer living area like home or office using augmented reality images.

Our application is a step in this direction, allowing users to view a 3D rendered model - a virtual resemblance of the physical furniture without any interruption of the markers - which can be viewed and configured in real time using our Augmented reality application.

This study proposes a new method for applying Augmented Reality [1] technology to furniture, where a user can view virtual furniture and communicate with 3D virtual furniture data using a dynamic and flexible user interface.

- **Existing System**

Traditional methods of designing include advising and assisting customers who have relied upon a combination of verbal explanations and 2D drawings through online shopping application. However, this medium of approach clearly restricted to the limit of explanations provided to customer for the particular placement of a furniture and makes him less efficient and confused to buy the furniture.

The main drawbacks in the mediums of existing system are:

- Static view of design which is unable to convey
- Cannot determine the furniture will fix to our needs.
- Information like height and breadth can't be known.

- **Proposed System**

With the approach of augmented reality application, this can be easily achieved. Interior designing is a field where augmented reality has not been able to get its grip to it fullest. People today are well versed with the technology and are operating smartphones which support AR. Thus, the concept of creating a furniture layout-based application brings the designer step closer to being technologically advanced.

With the recent emergence of better cameras and more accurate sensors in soon-to-be mainstream devices. In our current implementations of application, we use Google AR Core[7] to accurately detect the real- world environment, such as the locations of walls and points of intersection, allowing users to place virtual objects into a real context.

The proposed system uses Marker-less Augmented Reality as a basis for enhancing user experience and for a better perception of things. Marker less tracking is a method of positional tracking – the determination of position and orientation of an object within its environment. This is a very important feature in augmented reality (AR), making it possible to know the field-ofview and perspective of the user - allowing for the environment to react accordingly or the placement of augmented reality content in accordance with real world. While marker-based methods of motion tracking use specific optical markers, marker-less positional tracking does not require them, making it a more flexible method. It also avoids the need for a prepared environment in which fiducial markers are placed.

The basic premise of the proposed system is to overlay digital 3D models on top of real things using a camera.

- This Application will use AR supported mobile phone to scan the living area and display the augmented furniture object to check whether it adjusts or not and that helps in better choosing of the right furniture for our need.
- Augmented objects are the virtual objects (3D Model) which are similar to furniture tool developed using Auto desk Maya[8] and Substance painter.
- Autodesk Maya is a software which offers a comprehensive creative feature set for 3D computer animation, modelling , simulation, rendering, and compositing.
- The next step involves setting up light, shadow, and camera positioning of these models using various components of Unity 3D.
- Next, the furniture model is selected and the selected model is rendered and processed to be loaded on the scanned surface by Google AR Core.
- Mapping of 3D model onto the smartphone screen takes place which decides the dimensions of the model which is then rendered and displayed onto the screen.

1.1 Purpose

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1.2 Document Conventions

While writing for SRS document we have made the following conventions and adopted the IEEE standards :

- Font used – Times New Roman

- For main headings font size – 14

- For subheadings font size – 11

- For normal text – 11

- Headings are highlighted in bold.
- Document text is single spaced and maintains the 1” margin.

1.3 Intended Audience and Reading Suggestions

The document is intended for project guide , class coordinator and professor . The SRS document contains overall descriptions , specific requirements , and other non- functional requirements of the project.

1.4 References

[1] Ronald T. Azuma(March 13, 2006),”A Survey of Augmented Reality” Example,[Online]Available :

https://doi.org/10.1162/pres.1997.6.4.355

[2] Current status, opportunities and challenges of augmented reality in education,[Online]Available : https://www.sciencedirect.com/science/article/pii/S0360131512002527

[3] L. Ziquan, “Augmented Reality: Virtual fitting room using Kinect”, Comp.nus.edu.sg, 2012. [Online]. Available: https://www.comp.nus.edu.sg/~ziquan/archieve/FYP/FYP%20Report_ZIQUAN.pdf. [Accessed: 26- Feb- 2019].

[4]Ş. Genes, O. Şanlı and Ö. Öztürk Ergün, “Augmented Reality Tool for Markerless Virtual Try-on around Human Arm”, Ieeexplore.ieee.org, 2015.

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[5] Er. Revati Mukesh Raspayle1, Prof. Kavita Kelkar," Towards a Development of Augmented Reality for Jewellery App",2016

[online] Available at: https://www.ijcsmc.com/docs/papers/June2016/V5I6201629.pdf [Accessed 02 March.2019]

[6] M. Andriluka, S. Roth, and B. Schiele, "Monocular 3D Pose Estimation and Tracking by Detection," in 2010 IEEE Conference on Computer Vision and Pattern Recognition (CVPR). San Francisco, California. Pp. 623-630, 2010.

2. Analysis Model

2.1 Methodology used

The purpose of the web application is to provide a dashboard for the e-commerce businesses to interact with the system. And the mobile application is created for the customers of the ecommerce business to experience the Augmented Reality feature.

The solution proposed for the AR platform mainly consists of a web appt separately, it contains the following as, Web application .

- E-commerce business details management portal.
- 3D models related details management portal and hosting of them.
- QR code generation for the mobile application to download the model from cloud storage.
- Generation of a dynamic link for each specific product of the respective e-commerce website, in order to connect the ecommerce website with the AR platform.

Mobile application

- Marker less tracking using ML.
- Augmentation of the 3D models.
- Live streaming of the augmentation.

2.2 UML Diagrams

2.2.1 Use case Diagram

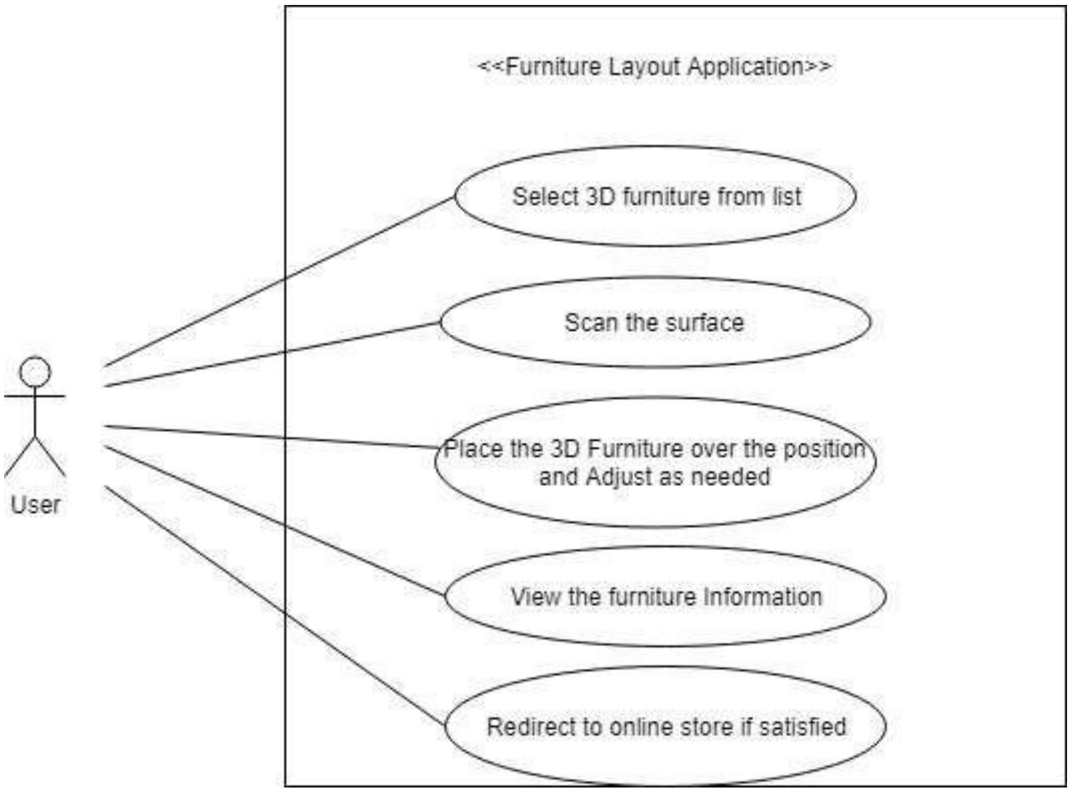


Figure 3.4: Use case diagram

As shown from the above figure 3.4, it describes the use case diagram of the application where the user interacts with application using Android device that supports AR camera. Initial we select the model in which we are interested then scan the surroundings using camera of device and place the model to verify whether it fulfill our needs, if satisfied we can move to online store. The actor here is the user and uses cases select 3D furniture, scan the surface, place the 3D furniture, view the information and redirect to online store if satisfied.

2.2.2 Class Diagram

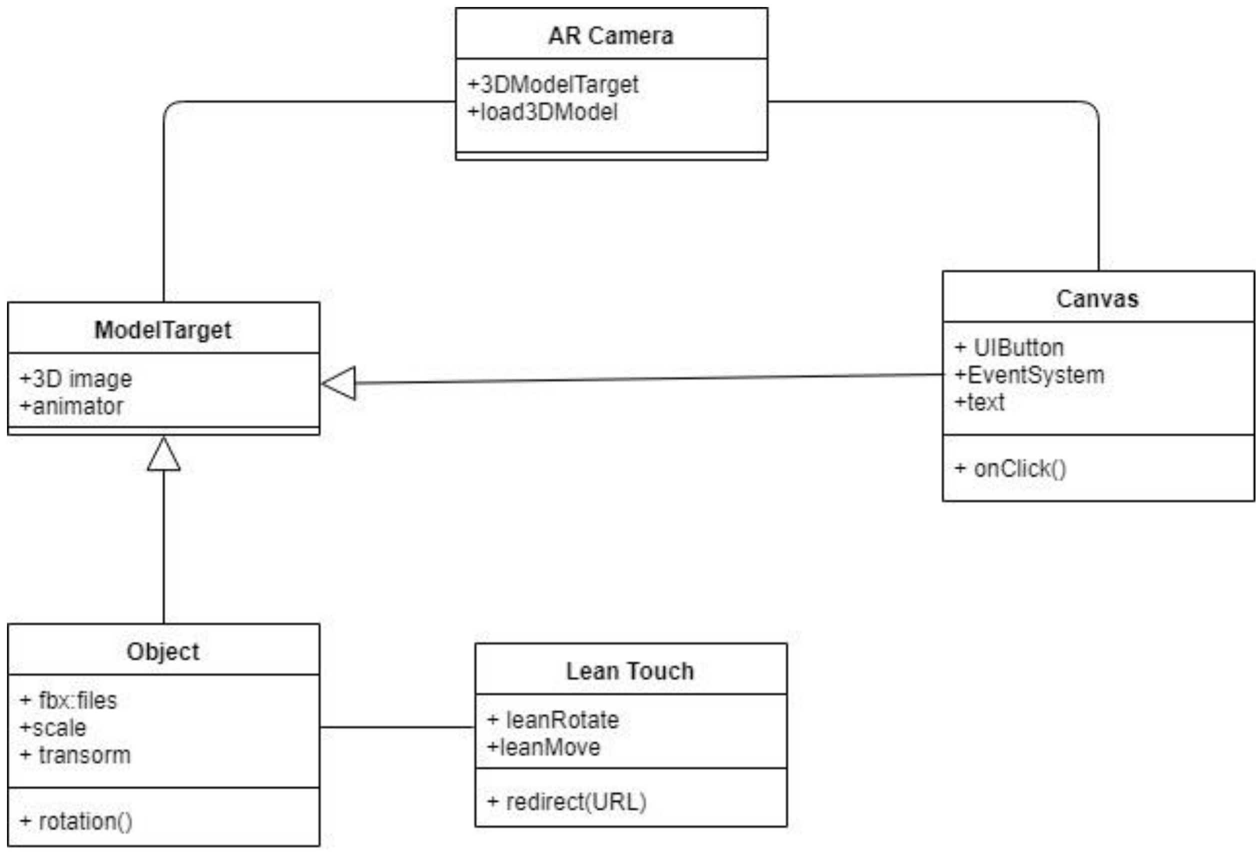


Figure 3.5: Class diagram

As shown from the above figure 3.5, it describes the class diagram of the application where the main classes include AR Camera, Model Target, Object, Lean touch, Canvas. AR Camera consists of the main configuration to be set to get the 3D model when model target is given by user. Canvas class consists of the buttons and texts that are used in the application interface. Object is the 3D model and consists of the information of scaling, transform. Lean touch class consists of how to rotate application i.e. portrait or landscape and all user interactions with the device using lean touch scripts.

2.2.3 Sequence Diagram

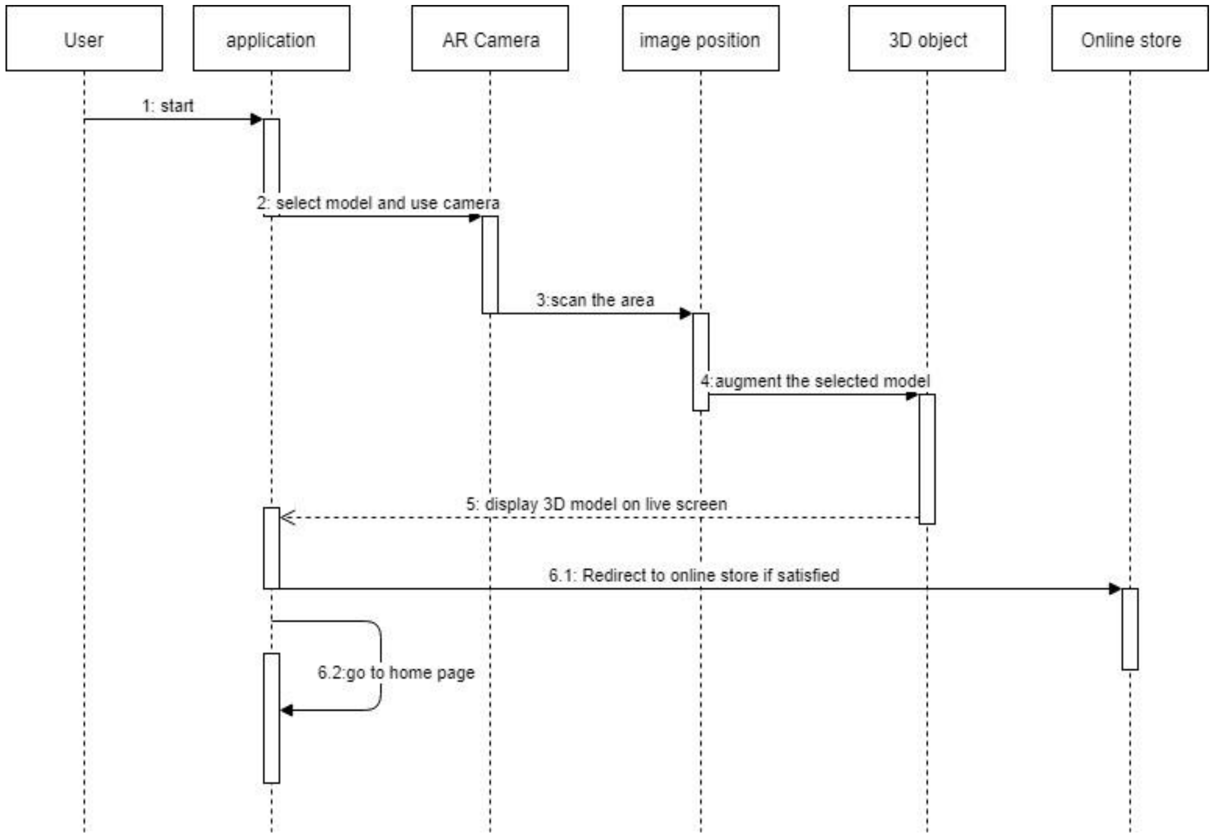


Figure 3.6: Sequence diagram

As shown in the above figure 3.6, it describes the sequence diagram of the application, i.e. how the application is started and to the end of the resultant augmented display in a sequence of interactions. User, application, AR Camera, image position, 3D object, Online store are the main objects of this diagram. First user starts the application and holds the living area by scanning surface. As soon as the area is scanned the 3D model selected is placed over the area. After that if user satisfy then he can move to online store else return to home page of this application.

2.2.4 Activity Diagram

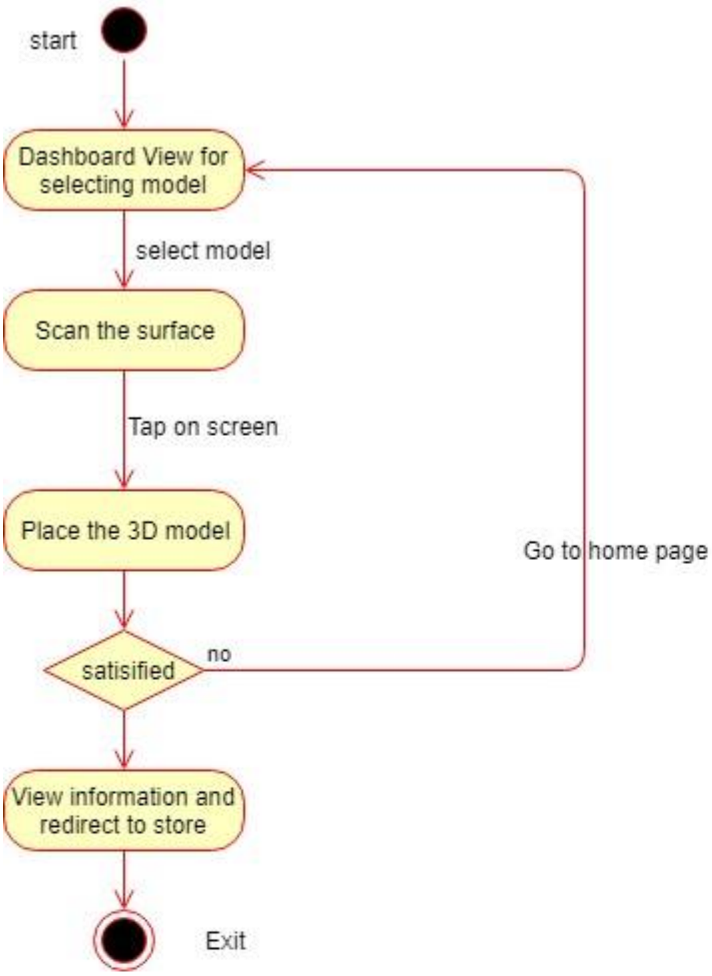


Figure 3.7: Activity diagram

As shown from the above figure 3.7, it describes the activity diagram of the application that consists of flow of the application which has the actions Dashboard view for selecting the model i.e. home page. Next scan the surface, place 3D model and finally if satisfied move to online store.

3. Design Model

3.1 Architecture design

The system basically uses mobile phone built-in camera which supports Augmented reality to collect view as the real scene view observed by human eye and stacks the 3D furniture models on the screen displayed. First of all, we need to setup the scenes in Unity 3D[6] for User Interface of application like buttons, text areas, background image and virtual object selection. Later we build 3D furniture models by Autodesk Maya and import the models into Unity 3D. Through identifying and tracing the surface area, the camera obtains pointers using Google AR Core and establishes projection models, at last stacks the imported 3D virtual model in the Real-world view. Because Android smart phone has touch-screen interface function, we can place the furniture by sliding screen.

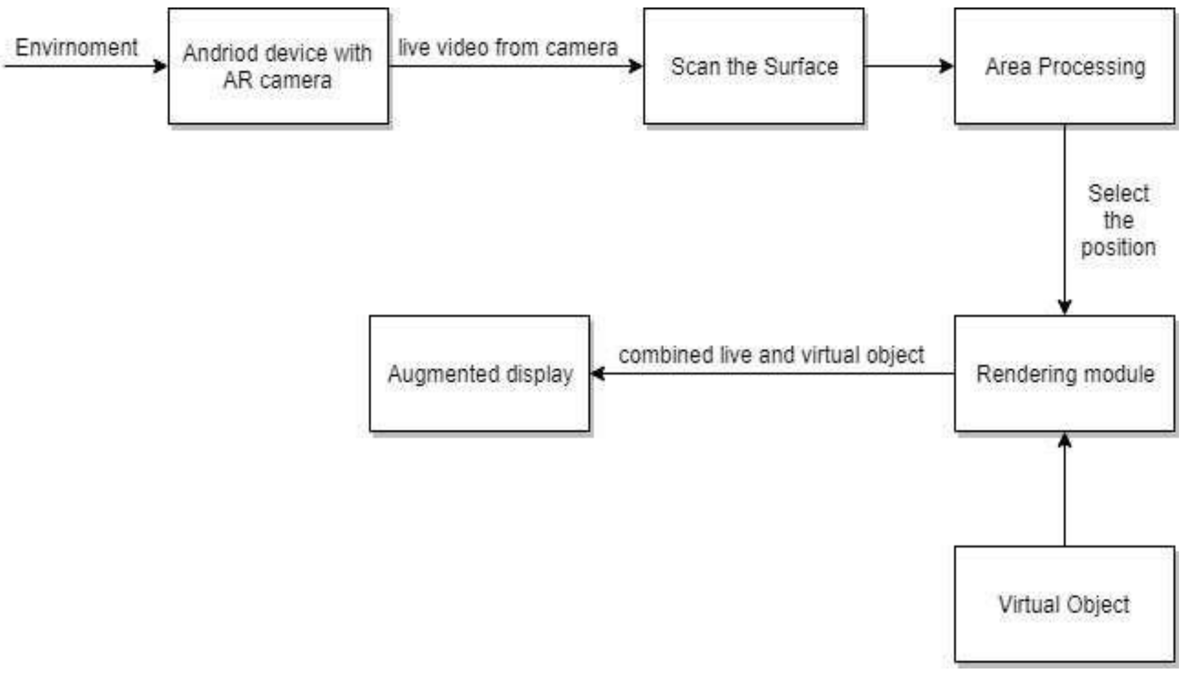
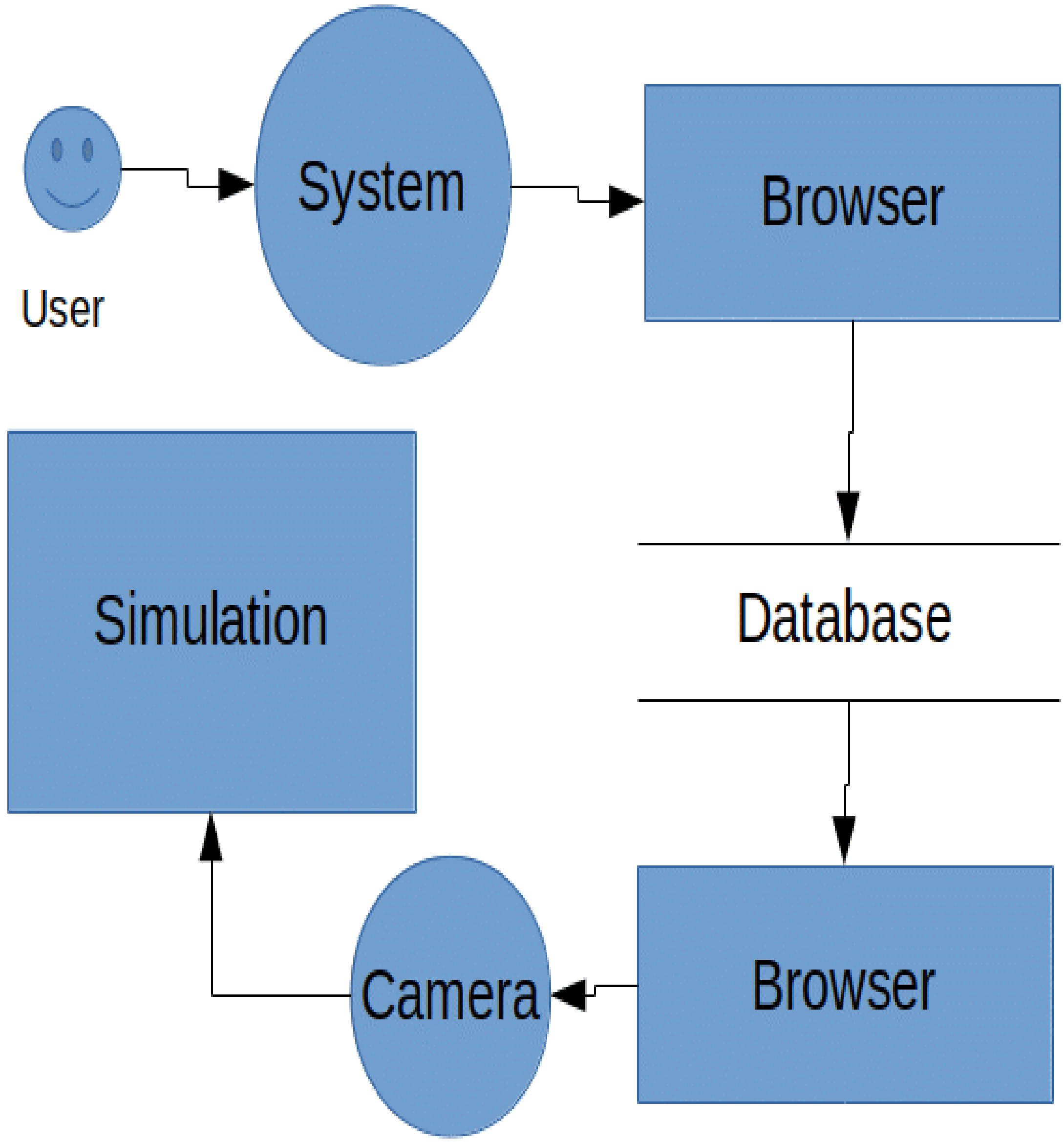


Figure 3.1: System Architecture of Application

As shown from the above figure 3.1, it describes the architecture of the application that take the real view as input with the help of AR camera then process it with virtual object to get the resultant output as augmented display.

3.1.1 Data Flow Diagram



3.1.2 Modules

The application implementation consists of four modules.

- Creating Augmented Reality Objects.
- Developing Scenes for User Interface.
- Place the Object on the Surface Area.
- Verification of placed objects.

Creating Augmented Reality Objects

First, we should establish virtual models with the help of Autodesk Maya[8] software to create 3D furniture models, the models mainly use Polygon and NURBS modeling methods, the animation mainly uses key frame and expression animation technology. After establishing models in Autodesk Maya, four important information of the model will be stored in the file of each model, they are the model's vertex coordinate, texture coordinate, normal coordinate and the total number of polygons, these data are the main data when rendering model. Application will store them in memory and read them to render models when calling rendering function. The data quantity of the model is very huge, so we need a loading module of the model to make it loaded into program conveniently. Later we export the model data, the file exported by Autodesk Maya is .obj file, which stores above information, next convert the information to file which is available in program by model loader and obtain the model data by calling head file. After loading model data, we can render and display it in the scene through Unity 3D[6].

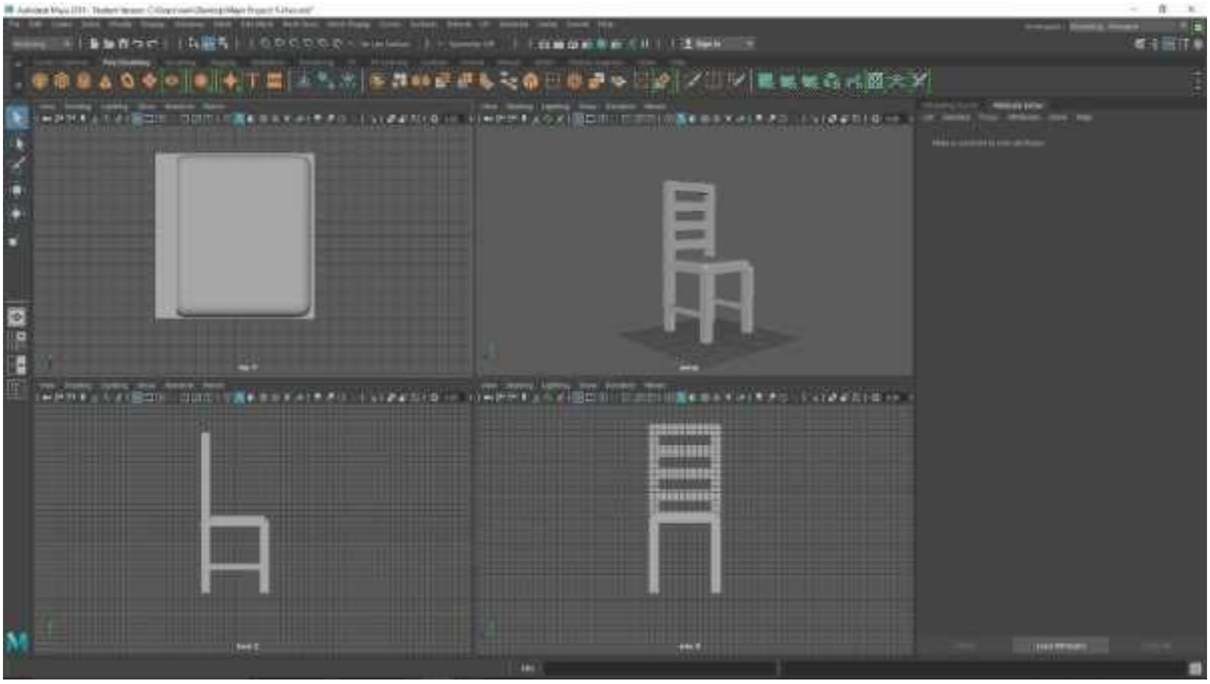


Figure 3.2: Developing Augmented Reality objects

As shown from the above figure 3.2 it shows how the 3D objects are developed for this application using the Autodesk Maya. In the figure it shows the front view, side view, top view, 3D view of the object that is been created.

Developing Scenes for User Interface

In this module we create scenes for every slide of application using Unity 3D. The main interface interacts by sliding browsing and selecting the key. The main interface contains furniture model, buttons that helps to move to next model, to scan the surface area of living room, description of model such as length, width, height and for buying the model in online store. The furniture column stores the key of all furniture, display one furniture at a time and which also supports sliding browsing. In order to implement these functions, we make the scene display to ratio of Android display and add the buttons to the scene that helps in moving to next scene. Later we import the 3D model developed using Autodesk Maya[8] and functionalities like rotating the chair while displayed using C# code for that object and add functionalities to move to next scene.

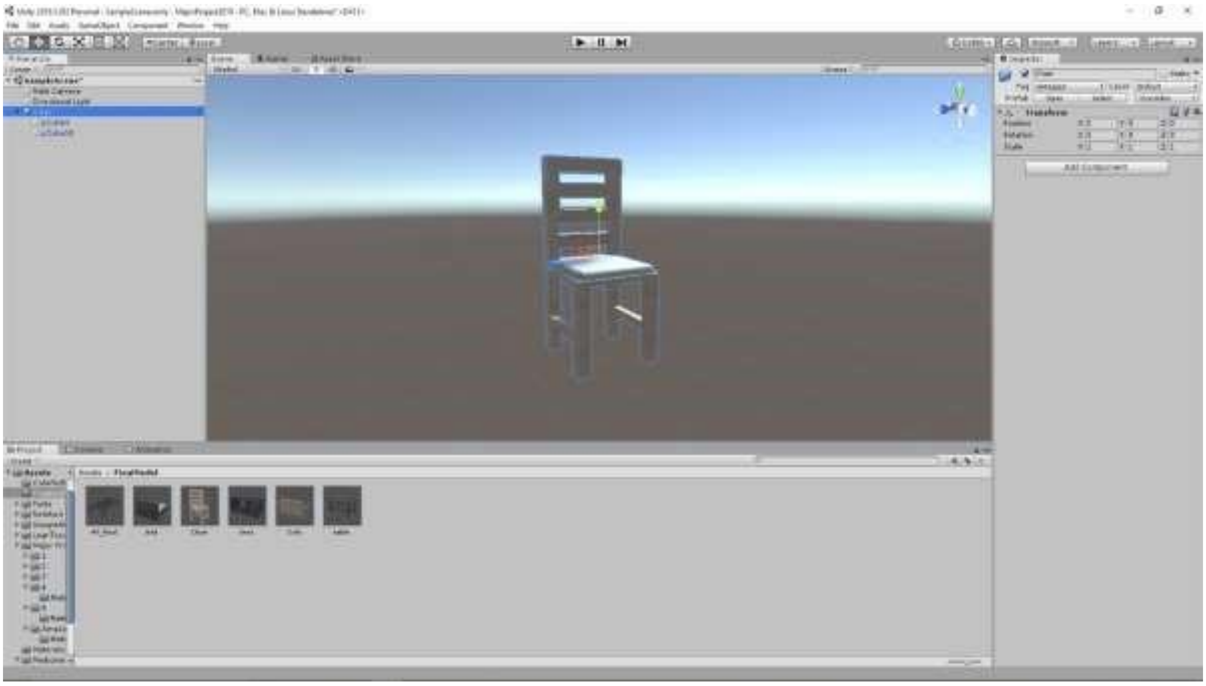


Figure 3.3: Unity 3D scene of the chair model

As shown in the above figure 3.3, it shows the Unity 3D platform that is used to create scene for the chair model that is used as furniture which is imported from Autodesk Maya. For every model of the furniture we will create an individual scenes and at final we combine all scenes.

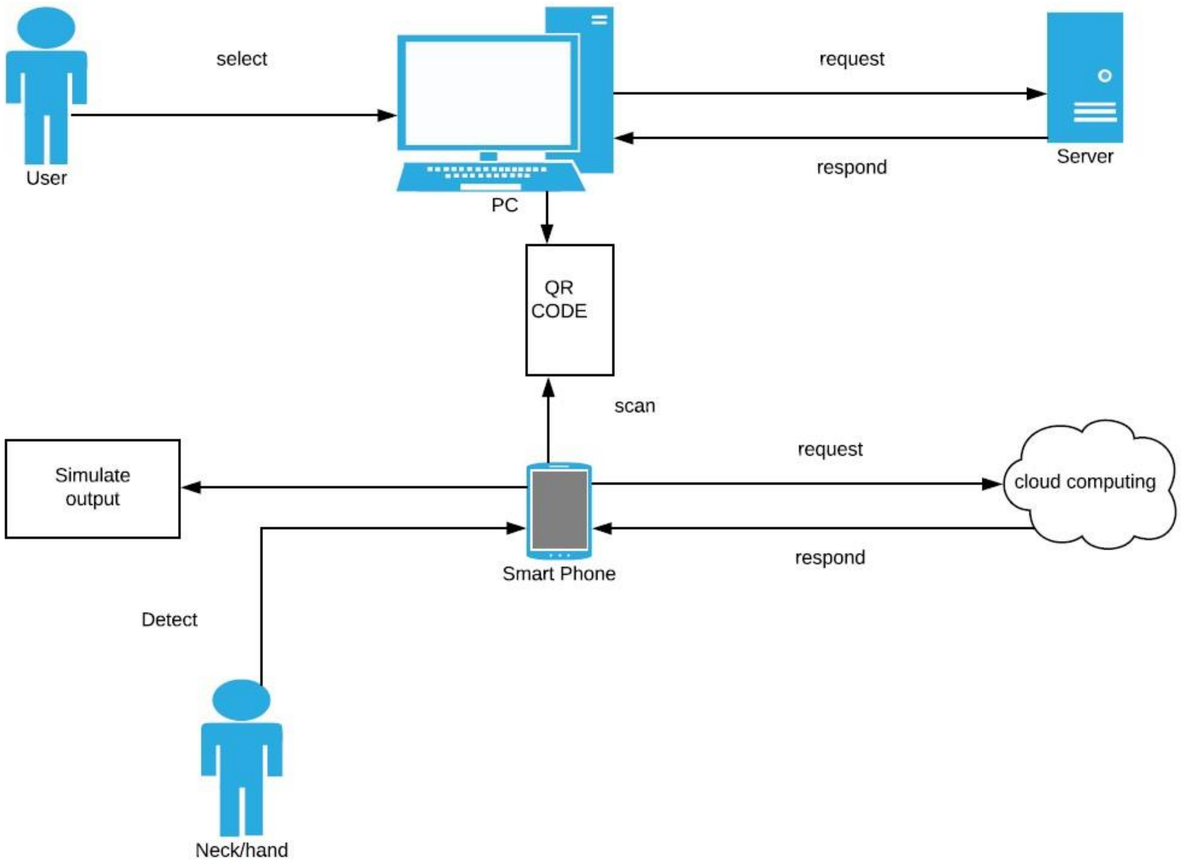
Place the Virtual Object on the Surface Area

In this scenario, we use the help of Google AR core[7] package which will be imported in Unity 3D and modify the package that will help us to scan the surface of living area where we need to place the virtual object in in the real world. Once the modifications to Google AR core has done, we will create scene such that after the surface area is scanned and when the user tap on the touch screen then the virtual 3D model will be rendered or integrated with the living area so that user can verify the object furniture model suits to our needs. The user can drag-anddrop virtual furniture model according to his desired in the real scene via user interface provided at this stage.

Verification of placed objects

Once the user thinks that the object is well suited to his need, he can check the description by selecting the information button that helps in describing the width, height and length of object. In order to view this description, we create another scene that helps in displaying all the required information. We add another button that helps in redirecting to online store where the furniture is available to purchase. We add one more button that helps in rotating object by an angle of 30°.

3.1.2 Description of Architectural Diagram



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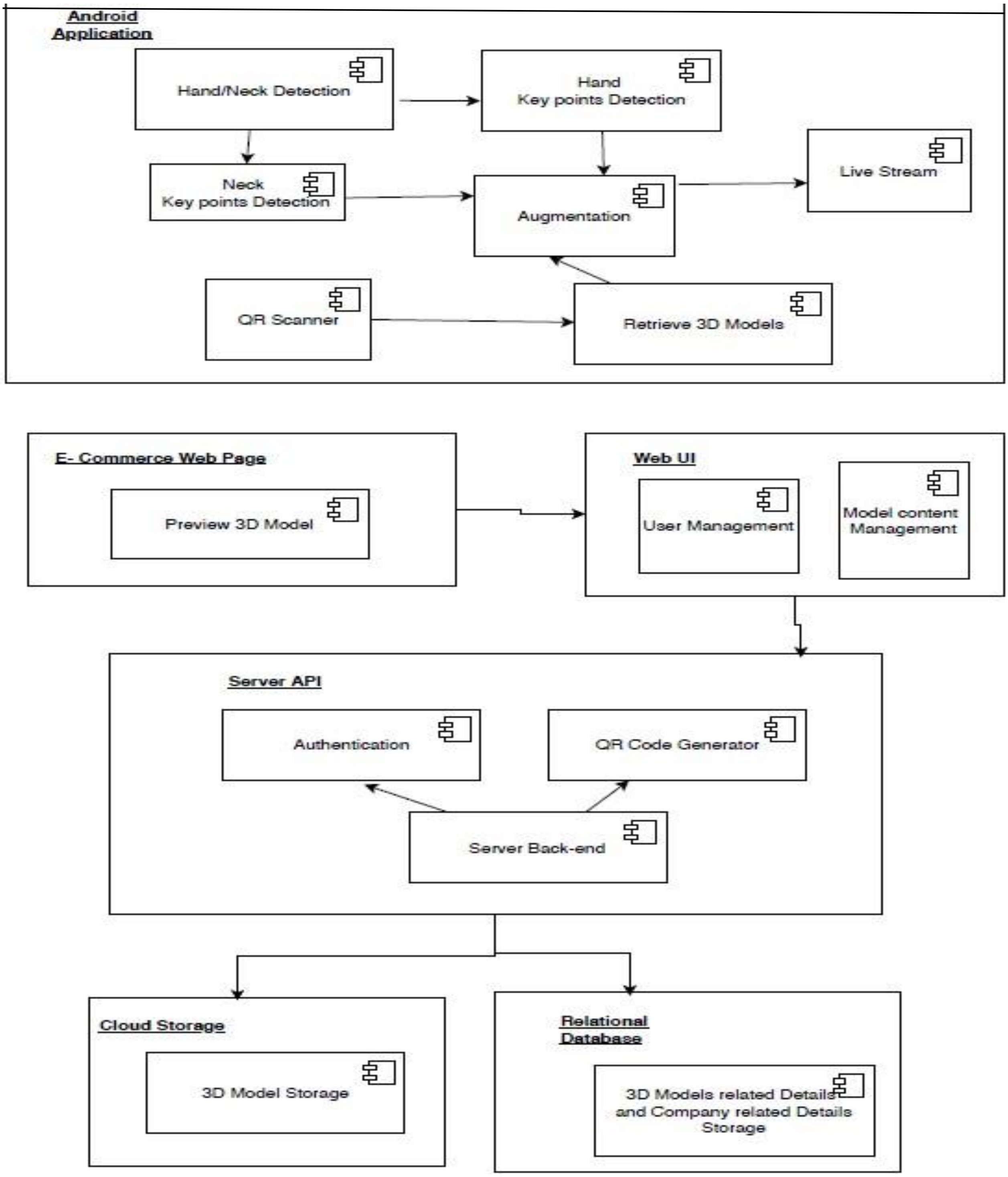

Fig:- Software component diagram

3.2 Database Design

DATABASE

No	Table	Columns	KEYS	Comments
1	category	2	1 PK	To classify items
2	item	6	1 PK, 1FK	Store item details
3	login	4	1 PK	Store user credentials
4	Order_master	6	1 PK, 1FK	Store details of order placed by users
5	Order_slave	4	1 PK, 2FK	Order table split into 2, to reduce data redundancy and for Normalization Purpose.
6	review	6	1 PK, 2FK	Store Reviews
7	User_details	10	1 PK, 1FK	Store User details
Total	7 Tables	38		

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3.2.1 Data Dictionary

The Data Dictionary is an organized listing of all data elements that are pertinent to the system, with precise rigorous definitions so that user and system analyst will have common understanding of inputs, outputs and components of stores. A data dictionary should contain the following information :

- Name- the primary name of data and control item, the data store or an external entity.

- Alias- other names used for the first entry.

- Where used / how used – a listing of processes that uses the data or control item and how it is used.

- Content description – a notation for representing content.

- Supplementary information – other information about data types, preset values, restriction or limitations, etc.

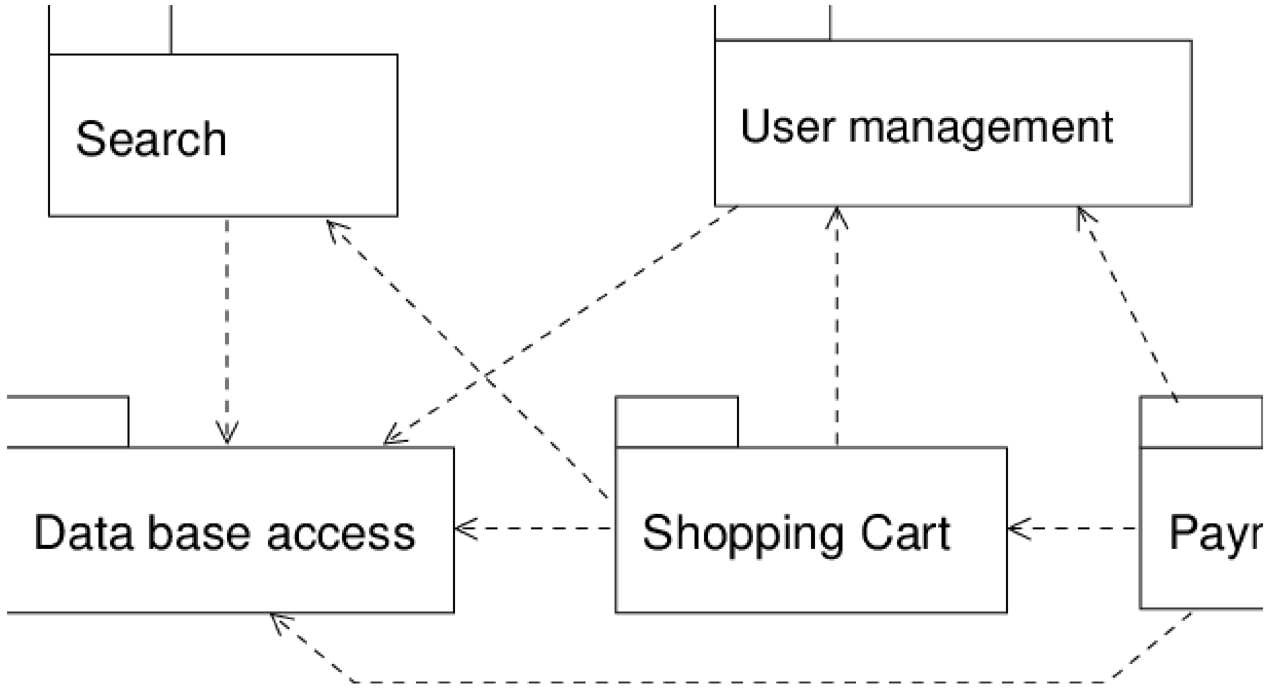
3.2.1 Normalization

Database normalization is the process of organizing the fields and tables of a relational database to minimize redundancy and dependency. Normalization usually involves dividing large tables into smaller (and less redundant) tables and defining relationships between them. The objective is to isolate data so that additions, deletions, and modifications of a field can be made in just one table and then propagated through the rest of the database via the defined relationships.

3.3 Component Design

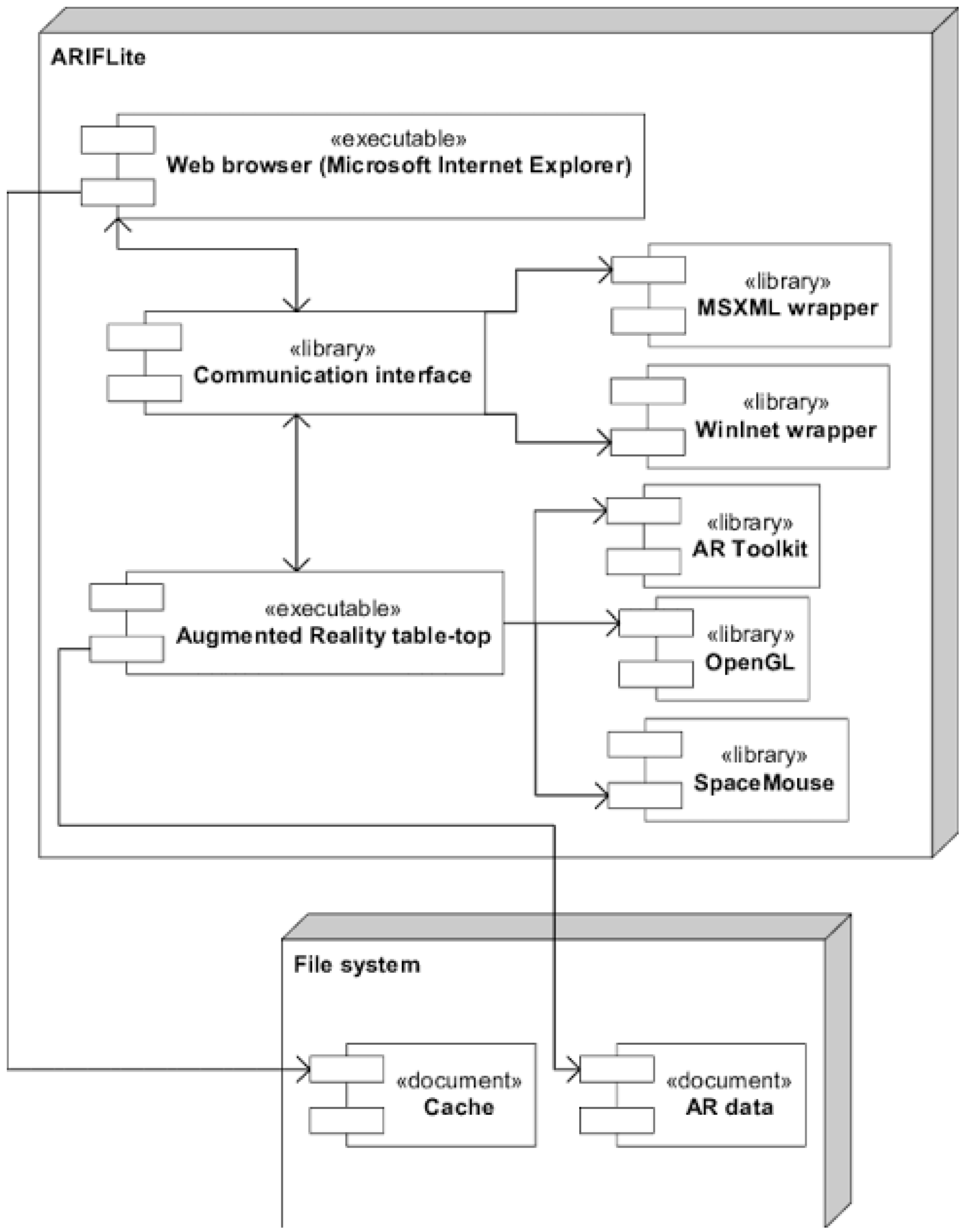
3.3.1 Package Diagram

A package diagram in the Unified Modeling Language depicts the dependencies between the packages that make up a model.



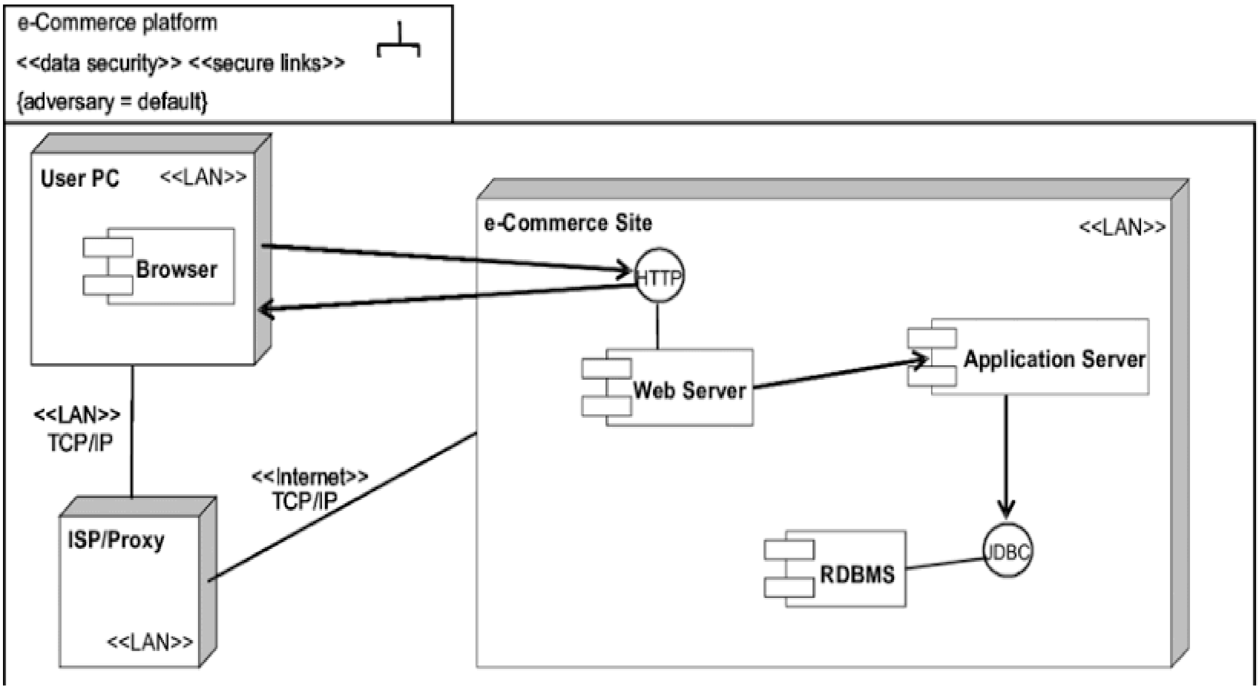
3.3.2 Component Diagram

In the Unified Modeling Language, a component diagram depicts how components are wired together to form larger components and or software systems. They are used to illustrate the structure of arbitrarily complex systems.



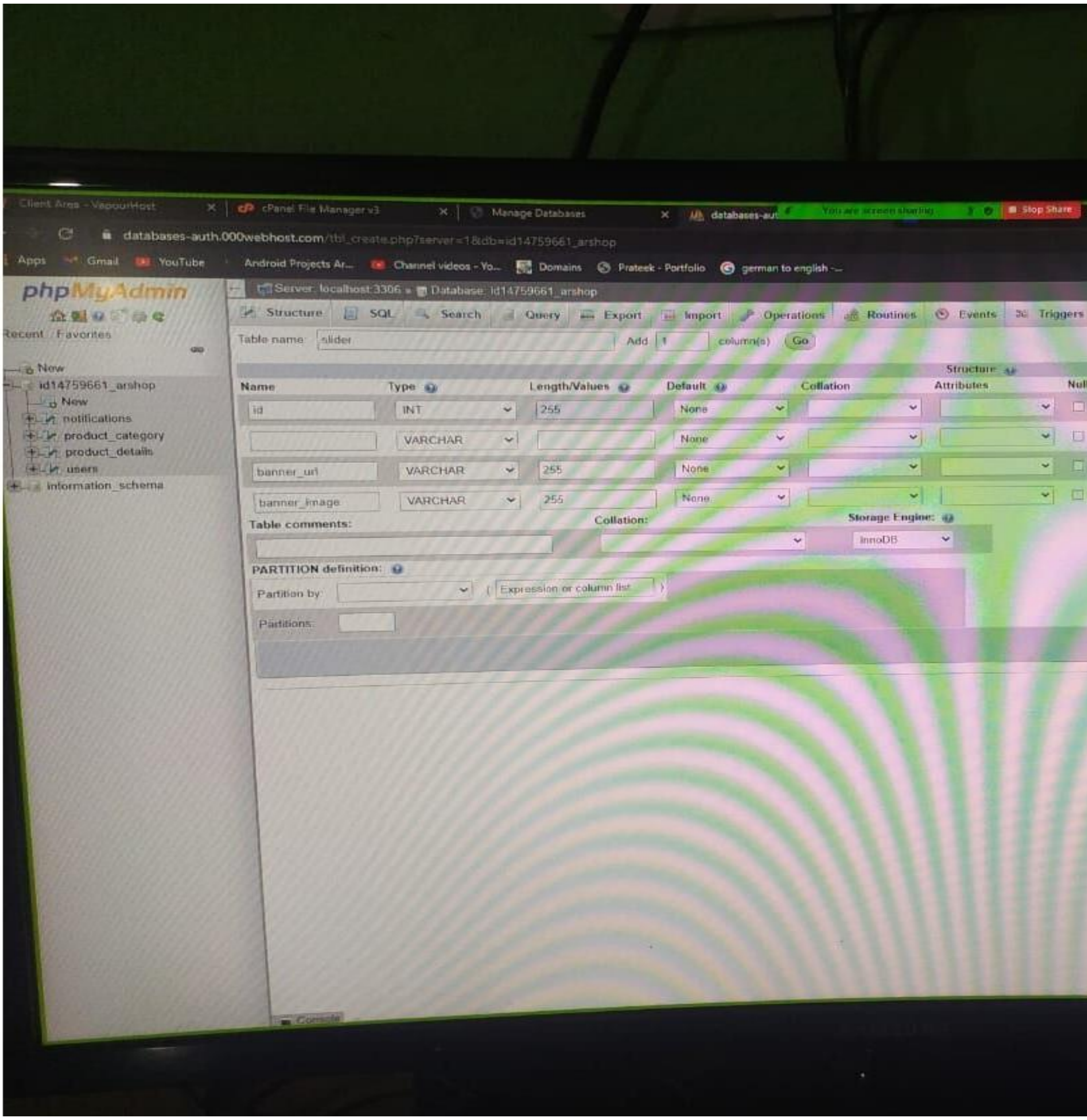
3.3.2 Deployment Diagram

A deployment diagram in the Unified Modeling Language models the physical deployment of artifacts on nodes.[1] To describe a web site, for example, a deployment diagram would show what hardware components ("nodes") exist (e.g., a web server, an application server, and a database server), what software components ("artifacts") run on each node (e.g., web application, database), and how the different pieces are connected (e.g. JDBC, REST, RMI).



3.4 Interface Design

3.4.1 Screen Shots



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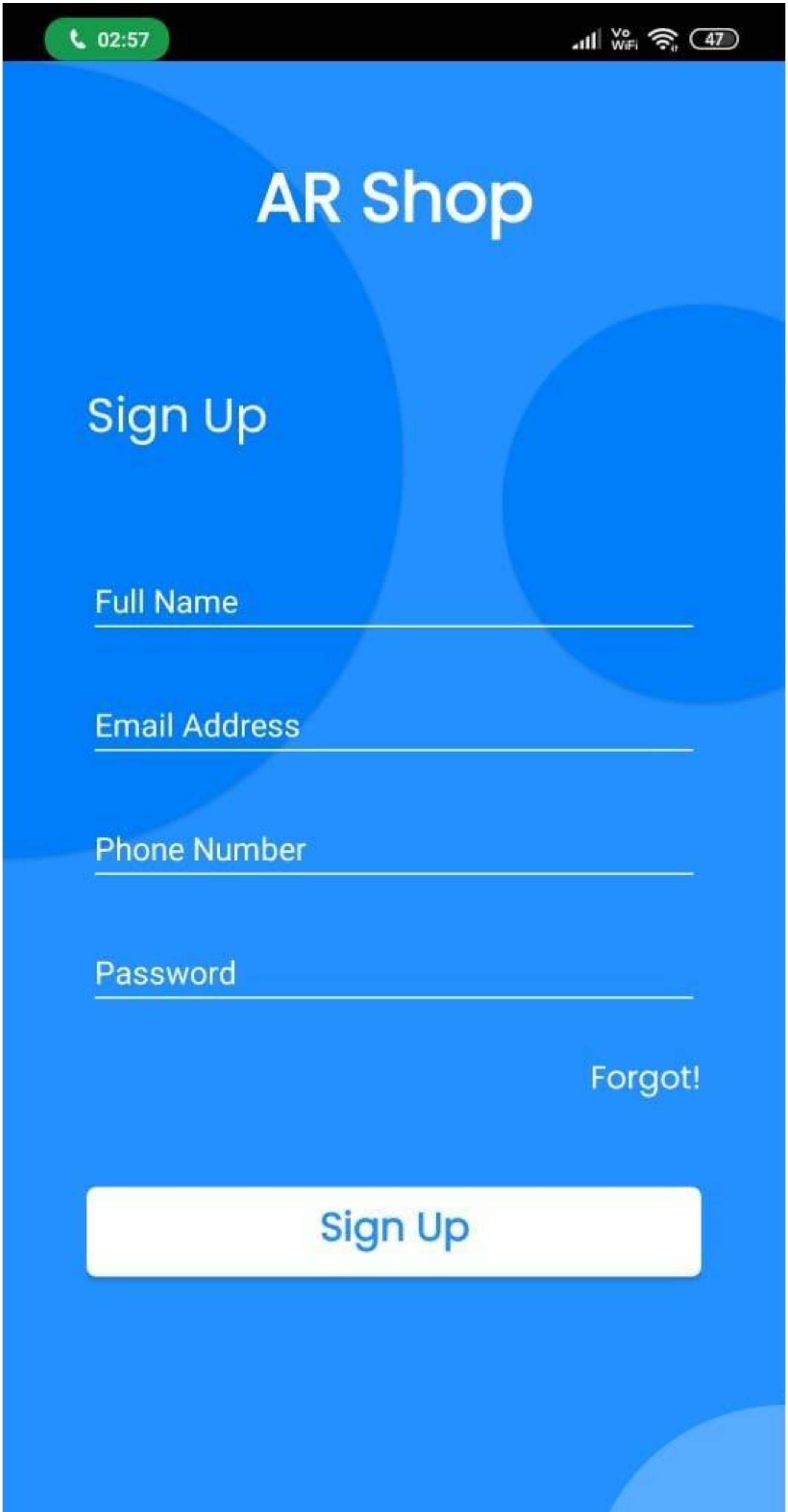
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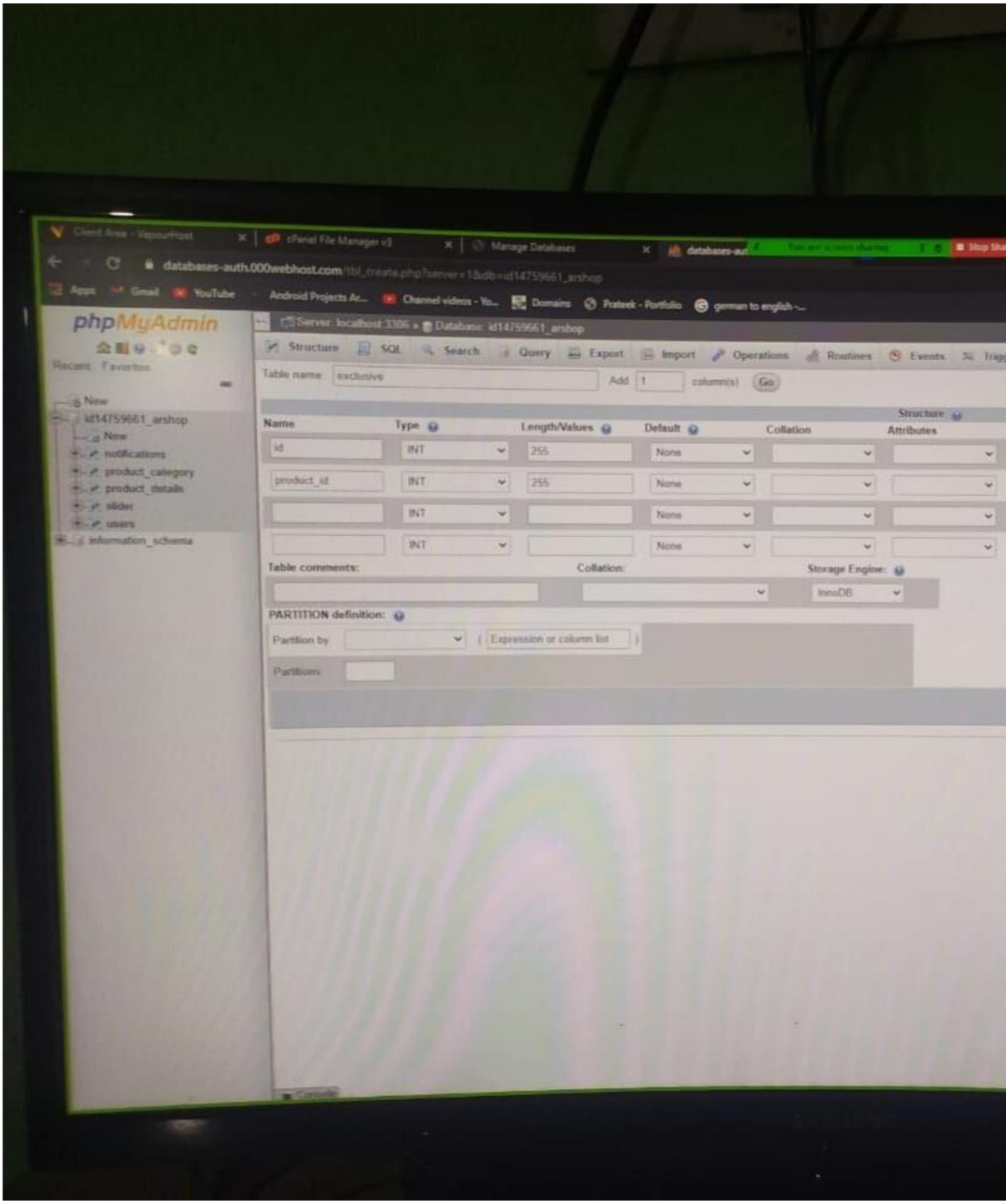

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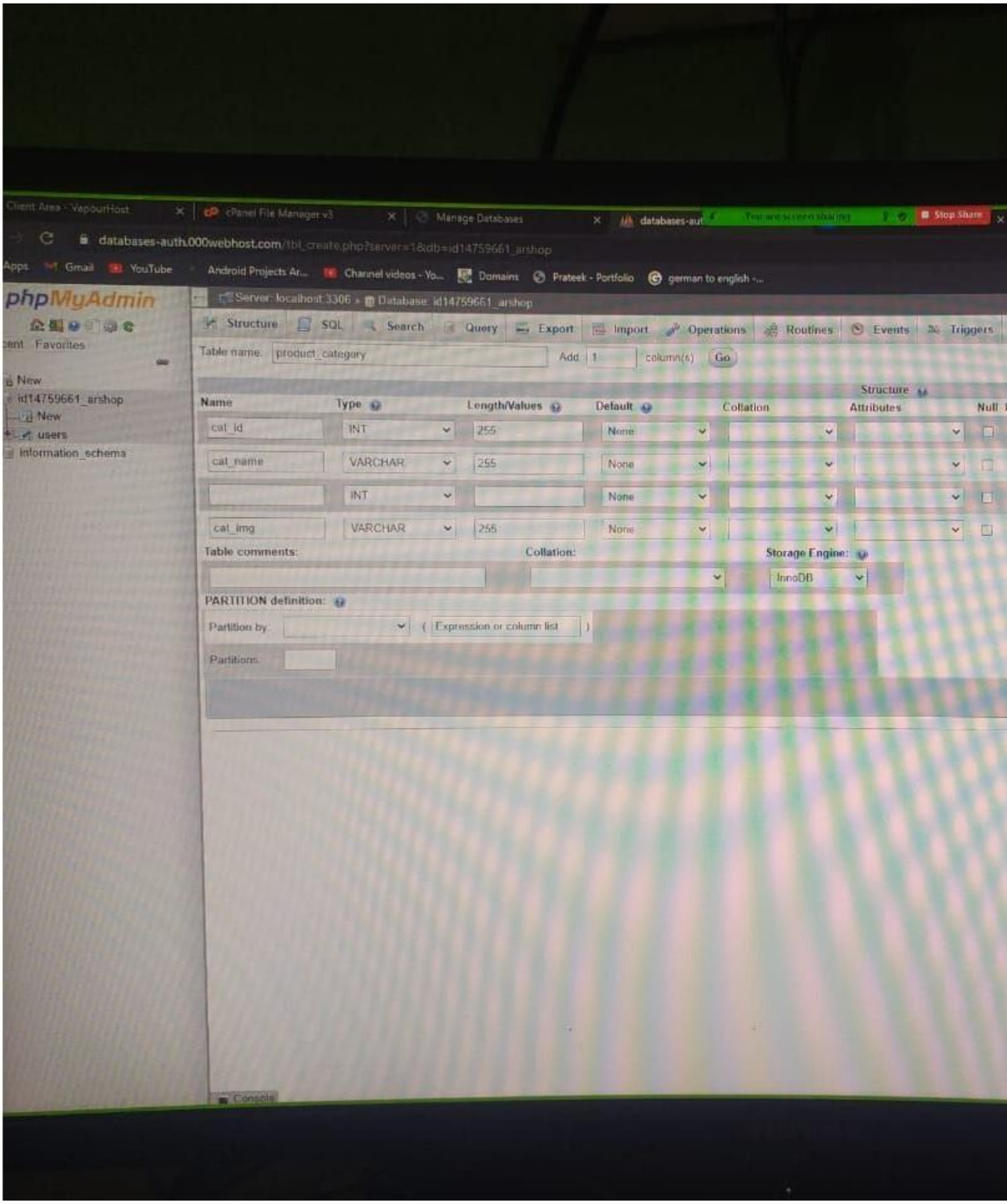
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Table comments:
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PARTITION definition:
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Expression or column list
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Appendix C1: Glossary

Augmented Reality (AR): A technique in computer graphics that superimposes (places) a computer generated object into a devices camera view to alter the perception of the real world.

Application Program Interface (API): Functions or methods for accessing software services or libraries.

Framework: One of the software deliverables from Augmented Reality for Hydrology (Version 1) that provides components to assist in the development of the AR objects in the application.

Hydrology: A study of the properties of earth's water, focusing on the movement of the water in relevance to the land.

Point of Interest (POI): A place in the real world that is represented by a computer generated object in the AR view of the program.

REST API: An API practice that uses HTTP or HTTPS request to GET, PUT, POST, and DELETE data from a database.

Watertrek: A database provided by JPL that stores Hydrology data and is accessible using a REST API.

Appendix B: To Be Determined List

Appendix C2: To Be Determined List

<Collect a numbered list of the TBD (to be determined) references that remain in the SRS so they can be tracked to closure.>