3D VISUALIZER OF GRAPHICAL SHAPES USING AR

Major project Phase-1 report submitted to CUSAT in partial fulfillment of the requirements for the award of degree of

BACHELOR OF TECHNOLOGY
IN
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BONAFIDE CERTIFICATE

This is to certify that the major project certified **3D Visualizer of Graphical Shapes using AR** is a bonafide report of major project phase 1 is done by **Aadithya Sankar Suresh (20219502), Anjali Jayaprakash (20219545), Mohammed Yaseen M (20219525), Riya Zulphiker Ali (20219533), Sudev T (20219539)** towards the partial fulfillment of the requirements of the degree of B.Tech in COMPUTER SCIENCE AND ENGINEERING of COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY.

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ABSTRACT

Education has benefited greatly from technological advances and consequently increased access to information over the past decades. However, this abundance of available data does not necessarily correlate with educational quality. Traditional teaching methods often imply a passive role for students, so academic performance is often correlated with their ability to retain information. That's why leading educational institutions are now developing e-learning software and innovative technologies to transform the learning experience. One of these technologies is augmented reality, which is currently at the forefront of the educational technology revolution. We are developing an application for the three-dimensional visualization of graphical shapes using Augmented Reality. Augmented reality is a powerful educational tool that can significantly improve the learning experience by supplementing the real world with virtual objects in real-time. Words are read and detected using OCR and a virtual object appears in this application. By introducing innovative teaching methods into the classroom, education professionals are able to spark student interest and enthusiasm in many subjects. Importantly, the majority of today's smartphones can support AR applications, so adopting augmented reality does not require a large investment.

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INTRODUCTION

1.INTRODUCTION

Augmented reality is more popular than ever in schools around the world. Educators improve how they learn by increasing interactivity and engagement. Improve a variety of skills, such as problem-solving and preparing students for future collaborations. Augmented Reality replaces traditional methods and introduces creative learning methods. AR improves students' ability to learn curriculum topics, engages, interacts, and motivates students to improve their abilities. Encourage students to spend more time on curriculum topics and minimize time spent on social media platforms. The android app we created can visualize graphical shapes and objects three-dimensionally. We have three options: search for a shape, use the OCR tool to scan the shape's name, or choose from the syllabus choice. Additionally, it tries to increase students' interest in learning and spatial awareness.

1.1 Category

Android App

1.2 Purpose

The main purpose of this app is to make learning easier. It gives students extra digital information about Engineering Graphics subject. This can make complex information easier to understand. And it increases remote learning opportunities. In the classroom, where lecture time is limited, it is hard for the instructors to illustrate clearly the relationship between the 3D geometry and their 2D projection using only one kind of presenting technique. This app is the solution for that and it uses Augmented Reality (AR) in Engineering Graphics Education.

1.3 Scope

Each student learns in unique ways, but each one is equally capable of learning. The categories of visual, auditory, and kinaesthetic learning require differentiated instruction. This responsibility falls onto the educator or teacher guiding the student. The customization of AR enables diverse approaches that benefit learners of all sorts by encouraging exploration. Whether inside or outside of a classroom setting, it is hard to earn an individual's attention. One of AR's strong qualities is its ability to capture and keep the audience's attention. Because AR is interactive, it requires user participation to initiate. This active learning approach better communicates the message within a lesson or learning moment.

1.4 Existing System

The basic existing system is the traditional teaching method. In traditional teaching, students should listen to their teachers. Sometimes the students do not make an effort to listen to the teachers. They lack interest in the lectures and become passive listeners. Traditional teaching follows a rigid schedule which is challenging to study. The students have difficulties coping with it. Teachers and books are the main sources of information. The students are unable to learn new things, and their knowledge is restricted to the knowledge provided by the books and lecturers.

Existing system mentioned in IEEE reference paper is the influence of learning style on Biology teaching in AR learning environment which was published on 5th December 2021 discusses the improvement in learning, when Augmented Reality is implemented.This research has developed an exploratory AR software related to biological experiments and explored different Felder-Silverman learning styles students' improvement of the knowledge

level in AR learning environment. We carry out teaching demonstration with the AR software, then conducts questionnaires on sixty-two participated high school students. The research finds that the balanced students have the highest level of improvement in the information processing dimension, and visual students in the information input dimension. It is shown that AR learning environments pay attention to both teamwork ability and independent thinking ability; and compared to verbal, AR learning environments are more conducive to visual students. Combining the advantages and disadvantages reflected in the data results and the suggestions by the teachers in the interviews, this research proposes four suggestions: " Don't be virtual if it can be real", "Hands-on to explore", "Multiple combination" and "Explore flexibly and not afraid of mistakes".

1.5 Intended Audience and Reading Suggestion

This document is intended for all individuals participating in and/or supervising the 3D visualizer of graphical shapes using AR project. Readers interested in a brief overview of the product should focus on the rest of Part 1 (Introduction), as well as Part 2 of the document (Overall Description), which provide a brief overview of each aspect of the project as a whole.

Readers who wish to explore the features of 3D visualizer in more detail should read on to Part 3 (Functional Requirements), which expands upon the information laid out in the main overview. Part 3.2(Non Functional Requirements) offers further technical details, including information on the user interface as well as the hardware and software platforms on which the application will run.

Readers interested in the non-technical aspects of the project should read Part 3.3, which covers performance, safety, security, and various other attributes that will be important to users.

OVERALL DESCRIPTION

2.OVERALL DESCRIPTION

2.1 Product Perspective

3D visualizer using Augmented Reality is a new self-contained product intended for use on the Android platform. While the 3D visualizer mobile application is the main focus of the project, there is also a server-side component called Firestore which will be responsible for database and synchronization services. The scope of the project encompasses both server- and client-side functionalities, so both aspects are covered in detail within this document. Below is a diagram of the 3D visualizer system which illustrates the interactions between the server and client applications.

2.2 Product Features

The following list offers a brief outline and description of the main features and functionalities of the 3D visualizer system. The features are split into two major categories: core features and additional features. Core features are essential to the application's operation, whereas additional features simply add new functionalities. The latter features will only be implemented as time permits.

2.2.1 Core Features

1. Visualizing a Graphical Shape or object

- Search for a shape or object.
- Select a shape or object from the syllabus

2.2.2 Additional Feature

1. Search for the model using OCR (Optical Character Recognition).

2.3 User Classes and Characteristics

The 3D visualizer project is meant to offer a real time visual experience of graphical shapes and objects. Consequently, the application will have little or no learning curve, and the user interface will be as intuitive as possible. Thus, technical expertise and Android experience should not be an issue. Instead, anticipated users can be defined by how they will use the product in a particular situation. The following list categorizes the scenarios in which 3D visualizer is expected to be utilized:

1.When it is difficult for a user to perceive the shape and dimensions of a 3D object or different projections.

2.For more involved and interactive learning.

These are not meant to separate or categorize users, just the different situations in which 3D visualizer is likely to be used. In fact, a user may utilize the application for all of these scenarios simultaneously.

2.4 Operating Environment

The main component of the 3D visualizer project is the software application, which will be limited to the Android operating system (specifically Android 8 and above). The application uses mobile camera to 3D dimensionally visualize graphical model in real world, So camera

is a practical hardware constraint for this app And ARCore is a software constraint for this app, it enables an individual's phone to sense its environment and understand its surroundings to interact with information). The app will rely on several functionalities built into Android's Application Programming Interface (API), so ensuring appropriate usage of the API will be a

major concern. Beyond that, the application is a self-contained unit and will not rely on any other Android-related software components. The application will, however, frequently interact with the Firestore which is a flexible, scalable database for mobile, web, and server development from Firebase and Google Cloud. Like Firebase Realtime Database, it keeps your data in sync across client apps through real-time listeners and offers offline support for mobile and web so you can build responsive apps that work regardless of network latency or Internet connectivity. Cloud Firestore also offers seamless integration with other Firebase and Google Cloud products, including Cloud Functions.

2.5 Design and Implementation Constraints

The primary design constraint is the mobile platform. Since the application is designated for mobile handsets, limited screen size and resolution will be a major design consideration.

Creating a user interface that is both effective and easily navigable will pose a difficult challenge. Other constraints such as ARCore compatibility and camera quality.

2.6 Assumptions and Dependencies

2.6.1 Time Dependency

As mentioned previously, the features of 3D visualizer are divided into two groups: core features and additional features. Core features are crucial to the basic functionality of the 3D visualizer application. These features must all be implemented in order for the application to be useful. Optional features, however, are not critical to the function of the application. They are usability improvements and convenience enhancements that may be added after the application has been developed. Thus, the implementation of these features is entirely dependent upon the time spent designing and implementing the core features. The final decision on whether or not to implement these features will be made during the later stages of the design phase.

2.6.2 Hardware Dependency

Main features and additional features rely on hardware components present in Android handsets. For instance, the camera will be used for three dimensionally visualize the 3D model, this feature is entirely reliant upon the ability to access the camera's functionalities. In addition, the handset should have motion sensors and gyroscope sensors for surface recognition and space recognition

REQUIREMENT ANALYSIS

3.REQUIREMENT ANALYSIS

3.1 Functional Requirements

3D visualizer system features are divided into two main categories: core features and additional features. Core features form the body of the application and include any features that are essential to the functionality of the 3D visualizer app. These features must be implemented in order to have a fully functioning application. Additional features, however, are not required for the app to function. They include any features which, if time permits, will be added to the application in order to provide extra functionality.

3.1.1 Core Feature

Visualizing 3D model

This function is used to search the 3D model by typing the name of the Graphical shape.

- **Search for model**

A graphical model or object can be searched using the search box.

Stimulus/Response sequence

Step 1: 3D visualizer app is launched from the Android home screen.

Step 2: User searches for a graphical shape or graphical model using the search box

Step 3: Application searches for the model asked by user in Firestore.

Step 4: If the model is found, the application turns on the camera and the model is displayed on device screen such that the model is integrated with surrounding.

User Requirement

The user cannot access the Firestore services without an active internet connection.

System Requirements

- A fully functioning camera.
- Gyroscope sensor
- Motion Sensors
- ARCore (Google's kit for Augmented Reality services)

- **Select from the syllabus**

This function is used to select the name of the 3D model from the given syllabus.

Stimulus/Response sequence

Step 1: 3D visualizer app is launched from the Android home screen.

Step 2: User selects a graphical shape or graphical model from the

syllabus/directory provided.

Step 3: Application searches for the model asked by user in Firestore.

Step 4: If the model is found, the application turns on the camera and the model is displayed on device screen such that the model is integrated with surrounding.

User Requirement

The user cannot access the Firestore services without an active internet connection.

System Requirements

- A fully functioning camera.
- Gyroscope sensor
- Motion Sensors
- ARCore (Google's kit for Augmented Reality services)

3.1.2 Additional Feature

Search for the model using OCR (Optical Character Recognition).

This function is used to scan the name of the graphical shape or graphical object using the camera. The name can be either handwritten or printed. Using the Optical Character Recognition tool it recognizes the word, the application searches for that word in Firestore, and the model is shown.

Stimulus/Response sequence

Step 1: 3D visualizer app is launched from the Android home screen.

Step 2: User selects the OCR scan option and the camera will be turned on for getting the name of the 3D model.

Step 3: Application recognizes the name of the shape using optical character recognition tool.

Step 4: Application searches for the model asked by user in Firestore.

Step 5: If the model is found, the application turns on the camera and the model is displayed on device screen such that the model is integrated with surrounding.

User Requirement

The user cannot access the Firestore services without an active internet connection.

System Requirements

- A fully functioning camera.
- Gyroscope sensor
- Motion Sensors
- ARCore (Google's kit for Augmented Reality services)

3.2 Non-functional Requirements

3D visualizer system non-functional requirements are divided into four main categories: Hardware specification, Software specification, User interface specification, Communication specification. A non-functional requirements includes any requirement which specifies how the system performs a certain function. In other words, a non-functional requirement will describe how a system should behave and what limits there are on its functionality. Non-functional requirements generally specify the system's quality attributes or characteristics.

3.2.1 Hardware Specification

3D visualizer is intended as a mobile application for the Android platform and hence is solely supported on Android-powered devices. Messages and data exchanged between Android devices are transmitted to and handled by Firestore.

We need separate Hardware specification for development and running the application.

For development of application

- Laptop or PC with RAM of 8 GB or more
- Nvidia GeForce GTX 1660 Super, AMD Radeon RX 5600 XT, or equivalent.
- CPU with a minimum clock speed of 3.5GHz.
- SSD with 512GB storage.

For running the application

- RAM of 4 GB and above.
- Processor with a minimum clock speed of 2.2GHz and above.
- Internal memory of minimum 1 GB
- A fully functioning camera.
- Gyroscope sensor
- Motion Sensor

3.2.2 Software Specification

The 3D visualizer app is to be developed under the Android operating systems using the ARCore (Augmented Reality development kit) and Android SDK (software development kit) tools.

For development of application

- Windows OS/Linux OS for developing environment.
- Visual Studio Code for development.
- Blender for creating 3D model
- React Native for frontend and backend development.

- Viro react for Augmented Reality related developments.

For running of application

- Smartphones with android version 8.0 and above.
- ARCore compatibility

3.2.3 Communication Specification

The developer first develops a 3D model and uploads it in the Firestore. Firestore is a flexible, scalable database for mobile, web, and server development from Firebase and Google Cloud. It keeps your data in sync across client apps through realtime listeners and offers offline support for mobile and web so you can build responsive apps that work regardless of network latency or Internet connectivity. Cloud Firestore also offers seamless integration with other Firebase and Google Cloud products, including Cloud Functions.

3.2.4 User Interface Specification

MAIN SCREEN

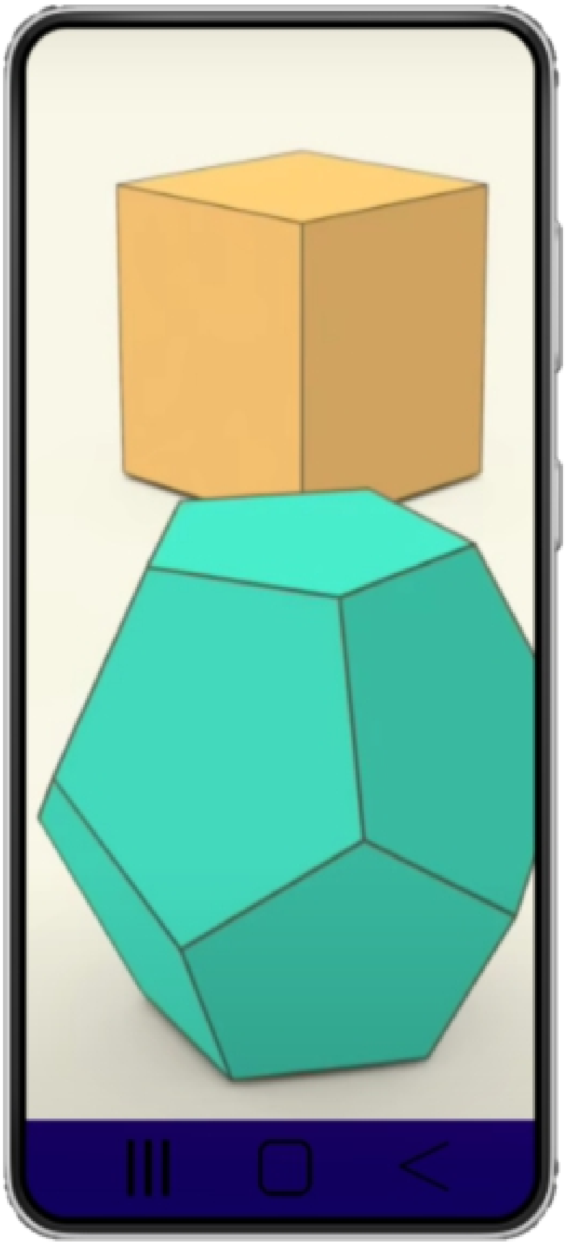
- Shows the search box which have two options for searching.

1. Searching by typing in the search box.

2. Searching using OCR.

3. .Selecting from directory (syllabus).

VISUALIZATION OF 3D MODEL



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- Application searches for the model or object in the Firestore asked by user.

- If the model is found, the application turns on the camera and the model is displayed on device screen such that the model is integrated with surrounding.

3.3 Other Non Functional requirements

3.3.1 Performance Requirements

Performance should not be an issue because all of our Firestore queries involve small pieces of data. Changing screens will require very little computation and thus will occur very quickly. Firestore updates should only take a few seconds as long as the phone can maintain a steady internet connectivity.

3.3.2 Safety Requirements

3D visualizer will not affect data stored outside of its servers nor will it affect any other applications installed on the user's phone. It cannot cause any damage to the phone or its internal components.

3.3.3 Security Requirements

There is no security concerns regarding the operation of this application.

3.3.4 Software Quality Attributes

The graphical user interface of 3D visualizer is to be designed with usability as the first priority. The app will be presented and organized in a manner that is both visually appealing and easy for the user to navigate.To ensure reliability and correctness, there will be zero tolerance for errors.To maintain flexibility and adaptability, the app will take into account situations in which a user loses internet connection or for whatever reason cannot establish a connection with the Firestore. Since Firestore keeps users data in sync across client apps through realtime listeners and offers offline support for mobile and web so you can build responsive apps that work regardless of network latency or Internet connectivity.

3.4 Proposed System

The proposed 3D visualizer of Graphical Shapes using AR system diminishes many of the demerits of traditional teaching. Graphical shapes can be viewed three-dimensionally on mobile phones. We can either search for a shape, scan the name of the shape using the OCR feature or select from the syllabus directly. This also aims at improving spatial awareness and interest in learning.

The key algorithms and the main functionalities used to develop this project are:

1.Marker-based AR: This generally involves tracking a camera against a planar texture pattern, but sometimes also a 3D object. It include interest point detection and matching, as well as RANSAC to filter out erroneous matches, plus a basic geometric model of the scene, such as a homography or essential/fundamental matrix.

2. Marker-less AR: Here you don’t have to put pre-specified markers in the scene, so the system can run in many environments right out of the box. It include visual odometry and visual-inertial odometry.

3. Marker-less AR with geometric environment understanding: In addition to localizing the camera, we aim for dense 3D reconstruction of the environment, even though we don’t attach labels to the surfaces we recover.

4. Marker-less AR with geometric and semantic environment understanding: In addition to having a dense 3D reconstruction, we also have labels for those surfaces. So, you know that a certain region of space in a chair or a table, and in even more mature systems even which surface is the “sittable” surface of the chair or what is the precise 3D pose of the hammer or bicycle in the scene.

3.4.1 3D Models or 3D Objects

A 3D model is a mathematical representation of something three-dimensional.3D models are used to portray real-world and conceptual visuals for art, entertainment, simulation and drafting and are integral to many different industries, including virtual reality, video games, 3D printing, marketing, TV and motion pictures, scientific and medical imaging and computer-aided design and manufacturing CAD/CAM.

When models are created for animation, they require careful construction because the polygon layout can create issues in unusual deformations. The models also require the construction of a skeleton and the painting of weights, which define the texture and polygon deformation of the model under movement. Some 3D models define surfaces through shaders, programs that mathematically define color, lightplay and other surface characteristics. Other models define color, specularity, surface texture, and light emission through a series of 2D image files called maps, especially those used in games where raster graphics are needed to deliver real-time frame rates

3.4.2 Blender Software

A free and open-source 3D modelling programme is called Blender. You've probably already read a few mentions of the software if you're just starting out making animated movies, visual effects, art, 3D printed models, motion graphics, interactive 3D apps, virtual reality, or computer games. You don't have to worry about how to pay for your learning period while you're learning how to use the software because it's free. Once you've used Blender enough to qualify as an advanced user, you can really use the Python scripting API to alter the programme and produce specialized tools. These are frequently included in updates for

Blender. It’s a powerful tool that can help you create professional renders—and it’s backed by a powerful and active community of supporters who work to constantly improve it.

Steps for preparing a 3D model with Blender:

Preparing a 3D model for mixed reality with Blender includes the following steps:

1. Import the model into Blender.
2. Decimate the model.
3. Unwrap the model (UV unwrapping).
4. Assign materials.
5. Bake the textures.
6. Export the model as a GLB file.

3.4.3 OCR

Text recognition is another name for optical character recognition (OCR). Data is extracted and reused from scanned documents, camera photos, and image-only PDFs by an OCR application. The original material can be accessed and edited by using OCR software, which isolates letters on the image, turns them into words, and then turns the words into sentences. Furthermore, it does away with the requirement for human data entry.

3.4.4 ARCore

ARCore is Google’s platform for building augmented reality experiences. Using different APIs, ARCore enables your phone to sense its environment, understand the world and interact with information. Some of the APIs are available across Android and iOS to enable shared AR experiences.

ARCore uses three key capabilities to integrate virtual content with the real world as seen through your phone's camera:

Motion tracking

ARCore uses a process called simultaneous localization and mapping, or SLAM, to understand where the phone is relative to the world around it. ARCore detects visually distinct features in the captured camera image called **feature points** and uses these points to compute its change in location. The visual information is combined with inertial measurements from the device's IMU to estimate the **pose** (position and orientation) of the camera relative to the world over time.

By aligning the pose of the virtual camera that renders your 3D content with the pose of the device's camera provided by ARCore, developers are able to render virtual content from the correct perspective. The rendered virtual image can be overlaid on top of the image obtained from the device's camera, making it appear as if the virtual content is part of the real world.

Environmental understanding

ARCore is constantly improving its understanding of the real world environment by detecting feature points and planes.

ARCore looks for clusters of feature points that appear to lie on common horizontal or vertical surfaces, like tables or walls, and makes these surfaces available to your app as geometric planes. ARCore can also determine the boundary of each geometric plane and make that information available to your app. You can use this information to place virtual objects resting on flat surfaces.Because ARCore uses feature points to detect planes, flat surfaces without texture, such as a white wall, may not be detected properly.

Depth estimation

ARCore can create depth maps, images that contain data about the distance between surfaces from a given point, using the main RGB camera from a supported device. You can use the information provided by a depth map to enable immersive and realistic user experiences, such as making virtual objects accurately collide with observed surfaces, or making them appear in front of or behind real world objects.

Light estimation.

ARCore can detect information about the lighting of its environment and provide you with the average intensity and color correction of a given camera image. This information lets you light your virtual objects under the same conditions as the environment around them, increasing the sense of realism.

User Interaction

ARCore uses hit testing to take an (x,y) coordinate corresponding to the phone's screen (provided by a tap or whatever other interaction you want your app to support) and projects a ray into the camera's view of the world, returning any geometric planes or feature points that the ray intersects, along with the pose of that intersection in world space. This allows users to select or otherwise interact with objects in the environment.

Oriented Points

Oriented points lets you place virtual objects on angled surfaces. When you perform a hit test that returns a feature point, ARCore will look at nearby feature points and use those to attempt to estimate the angle of the surface at the given feature point. ARCore will then return a pose that takes that angle into account.

Because ARCore uses clusters of feature points to detect the surface's angle, surfaces without texture, such as a white wall, may not be detected properly.

Anchor and trackables

Poses can change as ARCore improves its understanding of its own position and its environment. When you want to place a virtual object, you need to define an anchor to ensure that ARCore tracks the object's position over time. Often times you create an anchor based on the pose returned by a hit test, as described in user interaction.

The fact that poses can change means that ARCore may update the position of environmental objects like geometric planes and feature points over time. Planes and points are a special type of object called a trackable. Like the name suggests, these are objects that ARCore will track over time. You can anchor virtual objects to specific trackables to ensure that the relationship between your virtual object and the trackable remains stable even as the device moves around. This means that if you place a virtual Android figurine on your desk, if ARCore later adjusts the pose of the geometric plane associated with the desk, the Android figurine will still appear to stay on top of the table.

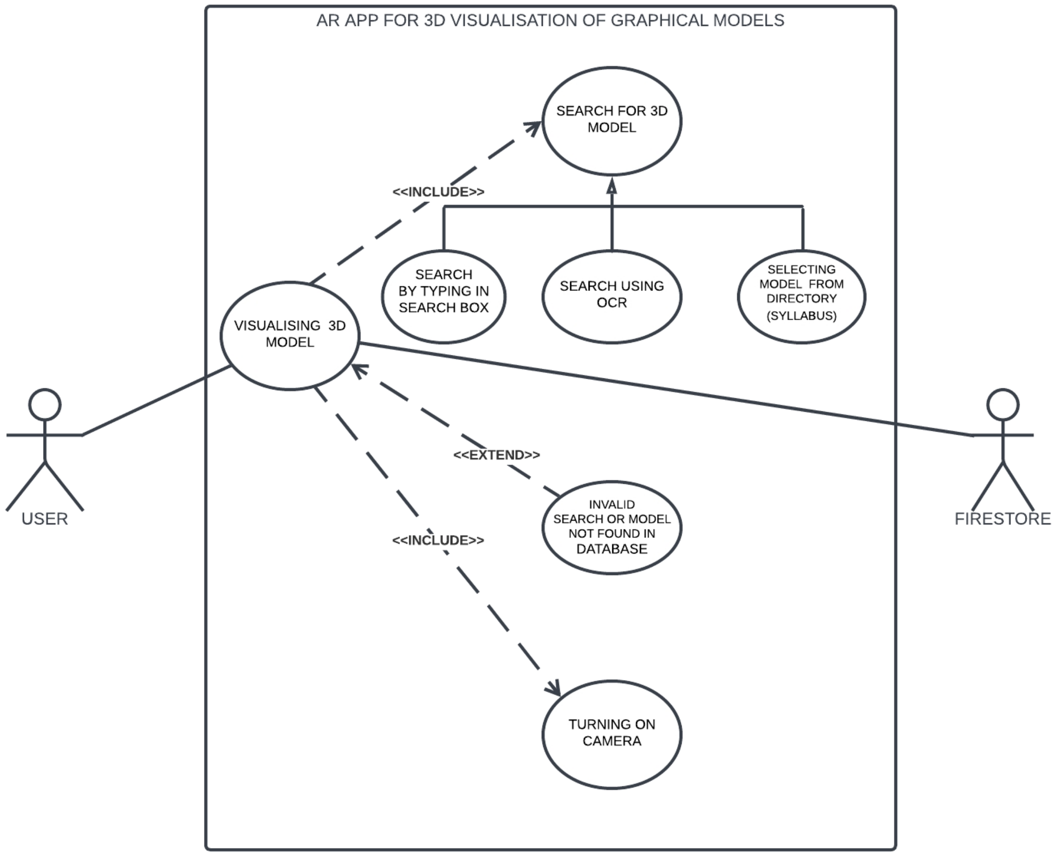
3.5 Advantages

- Able to grasp things more by listening to them or seeing their visual representation more than by reading them. Also, they are able to memorize more and learn more in such cases.
- Smartphone-based virtual application-based classes make the students more interactive.
- The 3D models can help the students to understand and have in-depth knowledge about the concepts which are generally hard and unclear to all the unexplained ways if explained by reading.
- One does not need to be physically present in a set location so as be able to get the topics we need not be in contact with or need not be in any educational or school setup to be able to learn.
- It does not require any specific complex tools and devices to operate. All it takes is an application and a smartphone with an internet connection

DESIGN

4.DESIGN

4.1 Use Case Diagram



A use case diagram is a dynamic or behaviour diagram in UML. Use case diagrams model the functionality of a system using actors and use cases. Use cases are a set of actions, services, and functions that the system needs to perform. In this context, a "system" is something being developed or operated, such as a web site. The "actors" are people or entities operating under defined roles within the system.

4.1.1 System

The system's boundaries are drawn using a rectangle that contains use cases. Place actors outside the system's boundaries. Here the system is the **3D visualizer for Graphical Shapes**

4.1.2 Actor

Actors are the users of a system. When one system is the actor of another system, label the actor system with the actor stereotype. Here primary actor is the **user** and the secondary actor is **Firestore.**

4.1.3 Use case

Use cases are drawn using ovals and we label the ovals with verbs that represent the system's functions. Here there is only one base use case **Visualizing 3D model**

Include use cases are **Search for 3D model and Turning on camera**

And extended use case is **invalid search for model/not found in database.**

Specialized use case children **of Search for 3D model** is **Search by Typing in search box, search using OCR, selecting model from syllabus**

4.1.4 Relationships

Relationships are illustrated between an actor and a use case with a simple line. For relationships among use cases, use arrows labelled either "uses" or "extends." A "uses" relationship indicates that one use case is needed by another in order to perform a task. An "extends" relationship indicates alternative options under a certain use case.

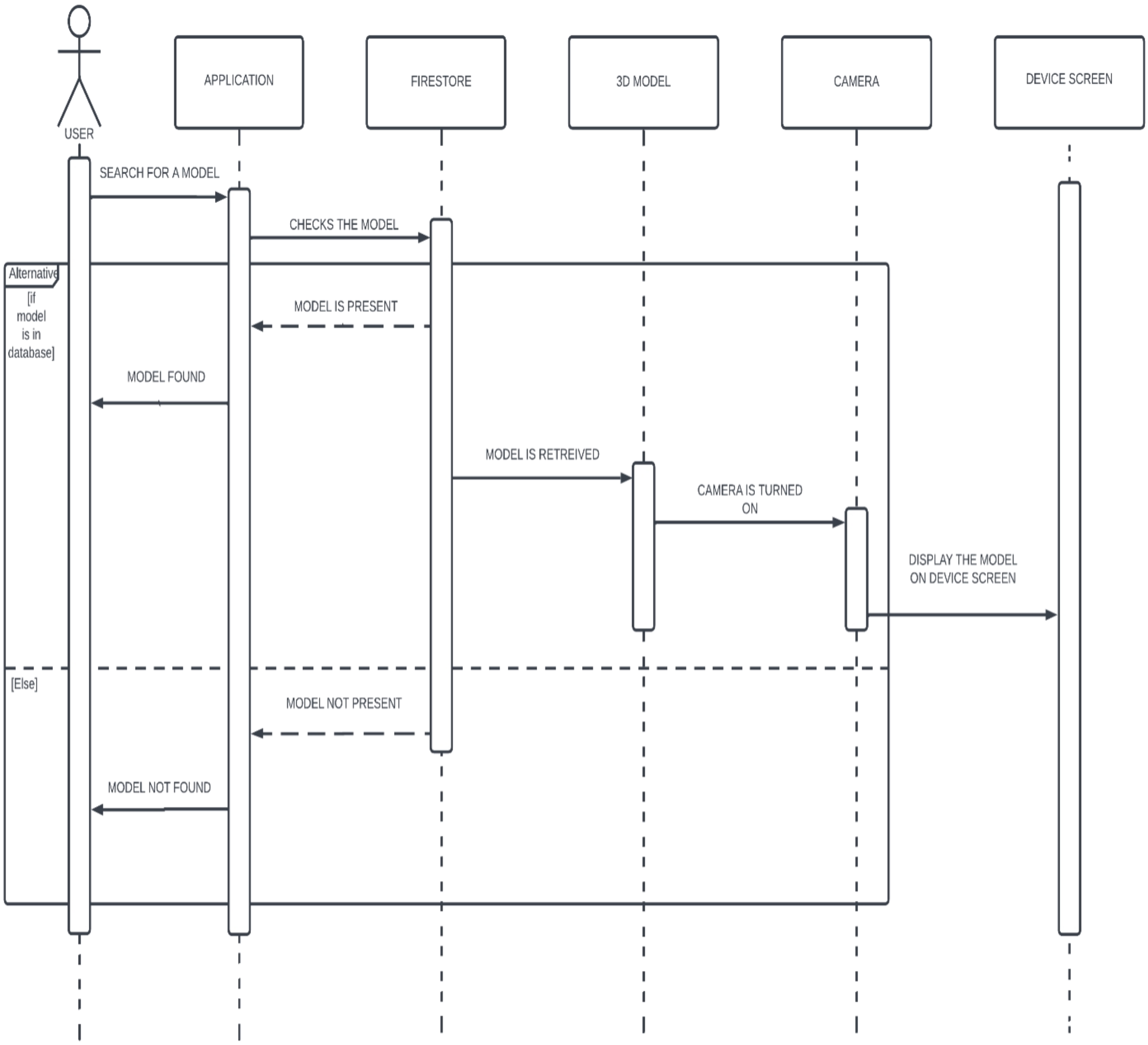
Here **User** and **Database** have relationships with the base use case.

Visualizing 3D model has an **include relationship** with **Search for 3D model** and it has **specialized use case children** that are **Search by Typing in search box, search using OCR, selecting model from syllabus.**

It has another **include relationship** with **turning on camera.**

And it has only **one extend relationship** with **invalid search for model/not found in database**

4.2 Sequence Diagram



Sequence diagrams, commonly used by developers, model the interactions between objects in a single use case. They illustrate how the different parts of a system interact with each other to carry out a function, and the order in which the interactions occur when a particular use case is executed. In simpler words, a sequence diagram shows different parts of a system work in a 'sequence' to get something done.

The key function of 3D visualizer app is to visualize the model. Here the interacting objects are application, Firestore, 3D model, camera and device screen which are shown in boxes at the top of the sequence diagram.

When the user search for a 3D model in the application. First the application search for model in the Firestore and if the model is present in database of Firestore, then the model is retrieved from database by the application, camera is turned on and model is visualized on users device screen, such a way that the model is integrated with the surrounding.

If the model is not present in database, the application will return the message “Model is not found” to the user. In the given sequence diagram in order to represent the above described ‘if else case’ an alternative fragment box is used.

Activation bars are used to show the lifeline of each objects during every sequence of interaction between objects of the system.

4.2.1 Lifeline notation

A sequence diagram is made up of several of these lifeline notations that should be arranged horizontally across the top of the diagram. No two lifeline notations should overlap each other. They represent the different objects or parts that interact with each other in the system during the sequence. A lifeline notation with an actor element symbol is used when the particular sequence diagram is owned by a use case.

4.2.2 Activation bars

Activation bar is the box placed on the lifeline. It is used to indicate that an object is active (or instantiated) during an interaction between two objects. The length of the rectangle indicates the duration of the objects staying active. In a sequence diagram, an interaction between two objects occurs when one object sends a message to another. The use of the activation bar on the lifelines of the Message Caller (the object that sends the message) and the Message Receiver (the object that receives the message) indicates that both are active/is instantiated during the exchange of the message

4.2.3 Message arrows

An arrow from the Message Caller to the Message Receiver specifies a message in a sequence diagram. A message can flow in any direction; from left to right, right to left or back to the Message Caller itself. While you can describe the message being sent from one object to the other on the arrow, with different arrowheads you can indicate the type of message being sent or received. The message arrow comes with a description, which is known as a message signature, on it. The format for this message signature is below. All parts except the message name are optional.

4.2.3.1 Synchronous message

A synchronous message is used when the sender waits for the receiver to process the message and return before carrying on with another message. The arrowhead used to indicate this type of message is a solid one.

4.2.3.2 Return message

A return message is used to indicate that the message receiver is done processing the message and is returning control over to the message caller. Return messages are optional notation pieces, for an activation bar that is triggered by a synchronous message always implies a return message. Return messages are dotted arrows.

4.2.4 Fragments

A sequence fragment is represented as a box that frames a section of interactions between objects (as shown in the examples below) in a sequence diagram. It is used to show complex interactions such as alternative flows and loops in a more structured way. On the top left corner of the fragment sits an operator. This – the fragment operator – specifies what sort of a fragment it is.

4.2.4.1 Alternative fragment

The alternative combination fragment is used when a choice needs to be made between two or more message sequences. It models the “if then else” logic. The alternative fragment is represented by a large rectangle or a frame; it is specified by mentioning ‘alt’ inside the frame’s name box (a.k.a. fragment operator). To show two or more alternatives, the larger rectangle is then divided into what is called interaction operands using a dashed line, as shown in the sequence diagram example below. Each operand has a guard to test against and it is placed at the top left corner of the operand.

5. CONCLUSION

In classrooms all throughout the world, augmented reality is becoming more and more common. By fostering greater involvement and interactivity, educators help students learn better. Our application can increase the grasping power of people.It mainly focuses on Engineering Graphics. It enhance a range of abilities, including pupils' ability to solve problems and get ready for future partnerships. Traditional techniques are replaced with augmented reality, which also brings innovative teaching strategies. AR engages, interacts, and inspires kids to develop their skills, which helps pupils understand curricular subjects. Encourage pupils to focus more on class material and spend less time on social networking sites. The three-dimensional visualization of graphic shapes and objects is possible with the Android app we designed.

6. REFERENCES

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