DEPARTMENT OF COMPUTER SCIENCE ENGINEERING,
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SHARDA UNIVERSITY, GREATER NOIDA

VIRTUAL TOUR

A project submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Technology in Computer Science and Engineering

by
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CERTIFICATE

This is to certify that the report entitled **"Virtual Tour"** submitted by Mr. / Ms. **Shashank Sharma(2018013126), Arpita Debnath(2018008957), Neeraj Rana(2018015582)** to Sharda University, towards the fulfillment of requirements of the degree of Bachelor of Technology is record of bonafide final year Project work carried out by him/her in the Department of Computer Science and Engineering, School of Engineering and Technology, Sharda University. The results/findings contained in this Project have not been submitted in part or full to any other University/Institute for award of any other Degree/Diploma.

Signature of Supervisor

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Date:

Signature of External Examiner

Date:

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Abstract

The Virtual Tour application permits people to visit the spots they are not able to visit physically. These are open passages, windows and entryways to new and energizing virtual universes. Using augmented reality, individuals position virtual entrances in real-world locations which they would then be able to stroll through and move into new dimensions. One such example of an augmented reality-based application is the Pokemon Go android application. Another is Snapchat or Instagram filters that are used by users every day to change the feature of their faces. Using AR Foundation - a platform, which is a combination of AR Kit which permits iOS developers to produce increased reality applications for iOS devices and ARCore which permits AndroidOS developers to create AR Apps for android devices, allows to create AR applications that can run both on iOS and android devices making it less complicated for the application to run on any platform.

For the application development, the software Unity- 3D is used that helps in the creation of unique, animated and beautiful applications.

Keywords: Augmented Reality, Unity 3D, AR Foundation, Virtual Tour

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Chapter1: INTRODUCTION

AR represents Augmented Reality which gives a honestly clever, instructive, informative and fun surrounding and environment through a super AR application with the presence of AR Portals, people can experience the virtual world through transferring themselves to any other part of the world through a device, in which a doorway or a window is played as a passage to stroll around. AR Portal permits a walk around an alternate universe in Augmented Reality. With 3D Modelling and Animations, virtual objects are positioned into the actual global which makes it an important interplay for human beings to view things that they could need to see without a doubt journeying the ones locations. With ARKit and ARCore SDKs, people on Android and iOS each can get a possibility to experience these unusual and new virtual worlds . Some of the benefits of AR gateways are that you may Virtually Travel to places they have never been to, assist youngsters engage with an ARBook wherein they are able to examine visually the factors, their shape, and structure, how they look within the actual world. People can buy products by having a 360 view of them without touring a shop to check its capabilities by having a 360 view of them without touring a shop to check its capabilities. While in VR the environment is created and in telepresence it is real, in AR the client sees this present reality enlarged with virtual objects. The use of location-based marker less augmented reality can turn into an extraordinary method of improving the traveling experience. Presently it is broadly utilized, especially in this area. It assists tourists with locating new places and unexpectedly tracks the maximum well-known sightseeing in a real-time mode with the usage of their cellular gadgets or phones . Augmented introduces a whole new manner of promoting products and services. Numerous businesses started out using AR in selling because of a few motives. It is a lot much less high priced than traditional printed commercials and promotes animations through which clients might be capable of viewing the goods while having an experience of Augmented Reality.

1.1: Motivation

Our idea was to make people visit places that sometimes seem too difficult or to go to due to any critical situation or circumstances. Thus, to provide an application that can help people have a look and feel of the actual place that they want to visit without physically going to that place. So we got the motivation to build an application based on the idea we got and implement it in the real world and make people's lives simpler and better with the help of Augmented Reality Technology and bring more light into this new idea to change the way we travel and make it more interesting and different.

We have seen a lot of different applications that work on Augmented Reality to make digital things look real by placing them in real world. So, it inspired us to make something for tourism industry and we have created this application through which people can place virtual door in real world and can experience completely different scenes from the comfort of their homes.

1.2: Overview

1. **Problem Definition**

To create a virtual tour application that will let users take a virtual tour of a museum, monument, aquarium, zoo, coral reefs, or any other imaginary place from the comfort of their homes by simply walking, using only a smartphone. The idea is to make people visit places that sometimes seem too difficult or to go to due to any critical situation or circumstances. Thus, to provide an application that can help people have a look and feel of the actual place that they want to visit without physically going to that place.

1. **Project Description:**

To explore various places through an AR based application. We understood the basic requirements needed to build an Augmented Reality based application

through research papers, various tutorials, etc. We had gone through several approaches and gained knowledge about various aspects in creating an AR application. We understood the specifications needed and all the aspects that is required to build the app. Our main approach is to mainly focus on the integration of Augmented Reality and bringing more light onto this advancing technology and moving further with it to create and deliver our idea of the application.

AR represents Augmented Reality which gives a honestly clever, instructive, informative and fun surrounding and environment through a super AR application with the presence of AR Portals, people can experience the virtual world through transferring themselves to any other part of the world through a device, in which a doorway or a window is played as a passage to stroll around. AR Portal permits a walk around an alternate universe in Augmented Reality. With 3D Modelling and Animations, virtual objects are positioned into the actual global which makes it an important interplay for human beings to view things that they could need to see without a doubt journeying the ones locations. With ARKit and ARCore SDKs, people on Android and iOS each can get a possibility to experience these unusual and new virtual worlds . Some of the benefits of AR gateways are that you may Virtually Travel to places they have never been to, assist youngsters engage with an ARBook wherein they are able to examine visually the factors, their shape, and structure, how they look within the actual world. People can buy products by having a 360 view of them without touring a shop to check its capabilities by having a 360 view of them without touring a shop to check its capabilities. Augmented introduces a whole new manner of promoting products and services. Numerous businesses started out using AR in selling because of a few motives. It is a lot much less high priced than traditional printed commercials and promotes animations through which clients might be capable of viewing the goods while having an experience of Augmented Reality. While in VR the environment is created and in telepresence it is real, in AR the client sees this present reality enlarged with virtual objects. The use of location-based marker less augmented reality can turn into an extraordinary method of improving the traveling experience. Presently it is broadly utilized, especially in this area. It assists tourists

with locating new places and unexpectedly tracks the maximum well-known sightseeing in a real-time mode with the usage of their cellular gadgets or phones.

1.2.3.Specifications:

a) Hardware Specification

4GB RAM –Minimum space required for installation.
i3 processor.

b) Software Specification

Unity-A cross-platform game engine.
Operating System-Windows 7 or above.

1.3: Expected outcome

<u>Product Outcome</u>

Our final outcome is a Virtual Tour Application which consists of 3 scenes. It can be used both in Android /iOS devices as we have used AR Foundation Package which allows our application to be downloaded on any device. First, the user has to detect the plane on ground/floor then place the door through which the user will travel to various scenes. The user can change scenes according to his/her preferences and visit those places.

<u>Project Outcome</u>

Our project outcome is Hackathon. We have participated in various hackathons and got 2nd position in the Shobhit University Hackathon and we were in the Top 20 teams in BMU Hackathon organised on Dare2Compete platform where 633 teams were registered.

1.4: Gantt Chart

Task Name	First Half			Second Half		
	Week 0	Week 5	Week 10	Week 15	Week 20	Week 25
Planning	▆▆	▆				
Research		▆▆				
Design			▆▆			
Implementation				▆▆	▆	
Follow up					▆	▆

1.5: Possible risks

Our possible risks can be brought down to the fact that there will be less mobility of users to visit those places physically and using an application throughout can have some impact on the health of the users that are using our application as having more screen time and less movement can have several issues on health. In AR, people are missing out on important moments. Low performance level is a concern which needs to be addressed during testing process. It requires basic learning to effectively use AR compliant devices.

Some Other Risks can be related to the addiction, like if one gets addicted to the Augmented reality then it became his/her habit to use the app consistently and they can miss out their important task and daily activities.

1.6: SRS

1.6.1. Functional Requirement

The user should be able to take his/her phone and generate a virtual world in his/her surroundings and be able to navigate that world by walking around in the real world which should correspond to walking in the virtual world.

1.6.2. User Goals

The following goals have to achieved for developing the mobile application:

- User wants to scan plane and place virtual world
- Single phone should store multiple virtual worlds
- User should be able to switch between different worlds
- Pop up menu/Side bar menu for choosing between worlds and ui buttons for place detection

1.6.3 Usability

- The user interface must be GUI based.
- The user interface consists of Selection Buttons, Navigation Buttons and Canvas.
- User has the option of changing permissions
- Users can place virtual door in real world
- They need to detect plane in order to place the door
- This app can be used in education field
- Users can switch between different scenes
- They can interact with the scene components
- It can be used freely without paying any amount

1.6.4 Design Constraints

The SRS document has been developed based on the requirement with assumption. Here each actor needs some requirement to fulfil the user's expectations.

The following supports are needed for mobile phone:

1. WAP 1.0 or above (Wireless Access Protocol)

2. Camera Module with AR support

3. Gyroscope

4. Touch Screen Support

The following support needed for network: Network consistency and reliability for sending/receiving the data

1.6.5. Literature Survey

The research paper that we have gone through gave information about how Augmented Reality can be used in various fields. From medical to news businesses to entertainment, it gave ideas about the use of AR in weather reporting, that is how weather news studios are able to augment various backgrounds and keep on changing them. It is due to the use of AR where this real image is augmented with computer generated maps using a technique called chroma-keying. Entertainment and infotainment areas such as video and game creation also extensively use AR. It also has usage in the military field. It provided information about the AR Foundation platform which is useful for creating applications for both Android and IOS devices. It brings together the functionalities of ARKit and ARCore in a single module. Moreover, it gave idea how books can be displayed to children using Augmented Reality so that reading and learning can become more exuberant for the viewers. With an interactive book, a range of factors contribute to the user experience: the story itself, the visuals, the interactive process and how the user interacts with these, how 3D elements, interactive sequences and traditional text relate to each other, and the overall interactive augmented reality book is being handled . It gives light to the fact that dull and dusky objects can become more lively creating 3D visuals of those objects and placing virtual objects into the real world. It imparted knowledge that with Augmented Reality every field of science and technology can make advancements in their methods. It is also being used in the tourism sector to refine the tourism experience. Vacationers can point the camera of their phones at present-day street-side views and can see pictures related to history, how the place was occupied by their ancestors, how it looked like, drawn from the Museum's tremendous collection, superimposed on top of the real view, while more information is also accessible through the buttons placed on the application.

1. **"Introduction to Augmented Reality"**
   - This paper discussed how MRI or registered tomography gives the expert an essential perspective on the inward life systems. Utilized in climate forecast, where the speaker stays remaining before changing climate maps. In the studio, the reporter is really remaining before a blue screen
   - One of its drawbacks was registration errors are critical and unavoidable in AR frameworks.

2. **"ARKit and ARCore in serve to augmented reality"**
   - The utilization of AR Foundation which unites the functionalities of ARKit and ARCore in a solitary module, permits the engineer to target the two IOS and Android stages with a similar source code. This permits an application to be grown once and conveyed on the two gadgets with no adjustment.
   - In contrast to the Android gadget, the equipment and sensors are unique in relation to one gadget to another and the user must set up the ARCore utility from google play to download Augmented Reality applications.

3. **"Lessons from an AR Book study"**
   - The book shows how photos appear to come out inside the form of actual images. Adding textual and visual highlights and inviting newcomers to explore and manage its pages. Teachers expect extended books with intuitive 3-D representations to present an advanced comprehension of complicated materials that can be effectively controlled and investigated, and to rouse college students and enhance commitment, assisting great studying and learning.

- The youngsters continuously had issues to navigate from one page to another page ,specifically when transferring among text pages and interactive sequences.

4. **"Augmented reality technologies, systems and applications"**

- It lists approximately 3 sorts of displays: head mounted, handheld and spatial. Four significant methods/interfaces of communication in AR applications: tangible, collaborative, hybrid, and the emerging multimodal interfaces.
- There is social recognition trouble associated with the applications. The machine must be socially conventional, easy to have interaction with so that it will be successful inside the marketplace.

5. **"Enhancing the Tourism Experience through Mobile Augmented Reality: Challenges and Prospects"**
- AR programs can assist tourists to benefit from distinguished facts about the metropolis's ancient tradition, knowledge about various locations mixed with a high degree of leisure. Like the Tuscany, which acts like a local escort, is built for vacationers to fetch records related to various locations that human beings want to know about.
- AR applications in tourist sectors most customarily require Internet connection.

6. **"Augmented Reality: An Overview"**
- Augmented Reality improves the lives of humans and makes it less difficult. AR improves the communication between the people and the real world. While Virtual Reality absolutely engulfs clients into a world that is simply created without searching into the real world, AR

innovation will increase the feeling of reality via rendering digital gadgets into the real world. AR can provide a low-cost way to the post-stroke hand rehabilitation problem.

- Security concerns arise as such applications not only affect medical applications but can reveal the sensitive information about people by detecting and recognizing them.

Chapter-2: Methodology

2.1: Product / system view
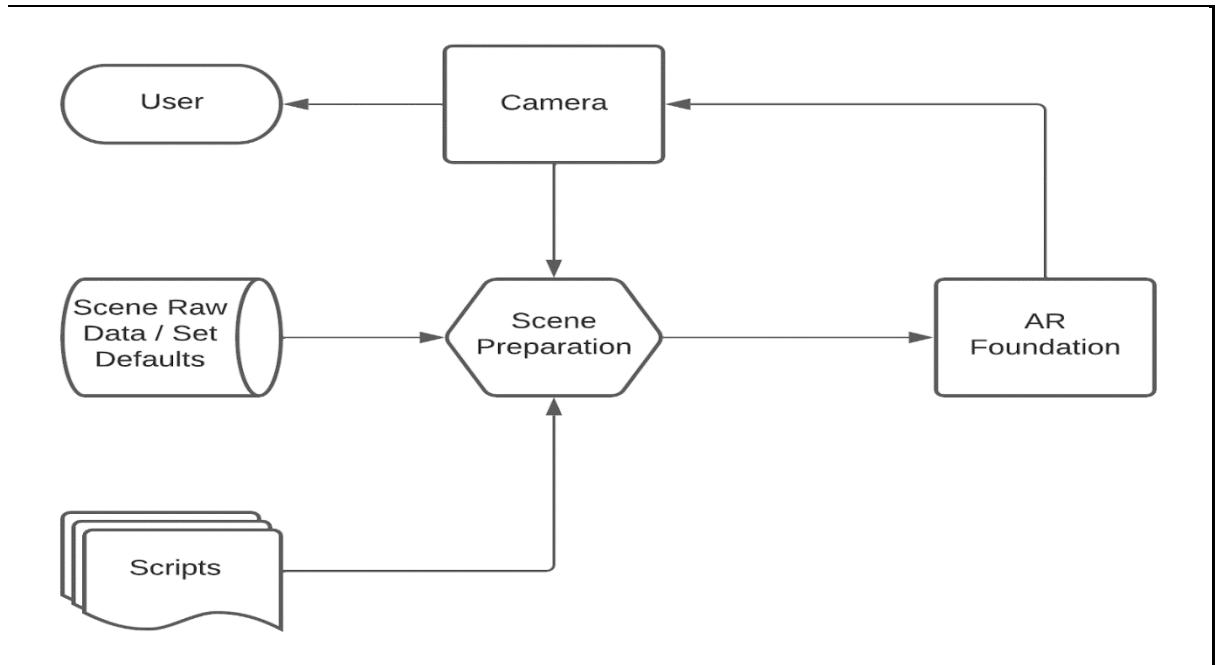
2.2: System components & Functionalities

1. Camera (Feed): The camera feed is one the most important parts of this system. It is the component which empowers the system to receive the video information about the surroundings and makes the system capable of superimposing/augmenting information on the real world.

2. AR Foundation Framework: This framework makes up the base of Augmented Reality which provides scripts for ray tracing, ground detection, image stabilization and interactivity. This framework enables the application to support all types of mobile phone devices.

3. Shaders: These are the files which control how an object is shown (or not) on the user's device. On the basis of some conditions, properties of objects are changed. This allows the computer-generated superimposed objects to be controlled.

4. Storage and Camera Permissions: At the time of application installation, storage permissions are asked for storing all the components in the file system of the phone. When camera permissions is asked for the first time, the granted permissions are stored and retrieved when necessary.
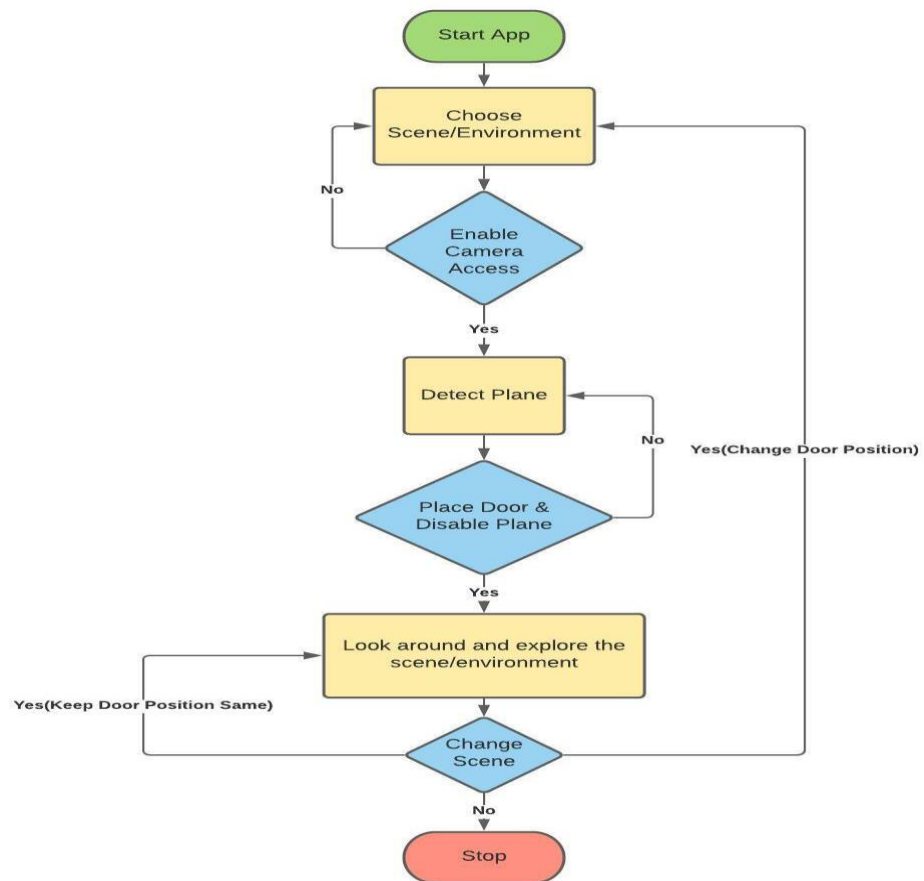
2.3: Data & relational views
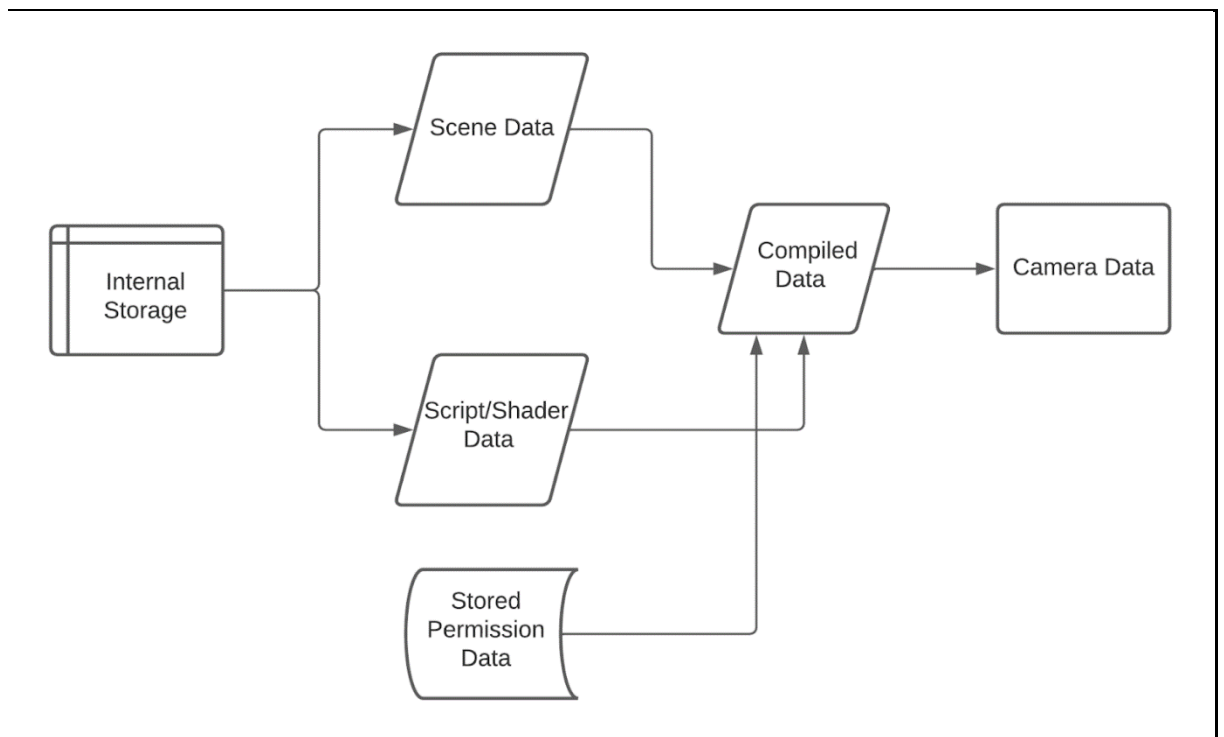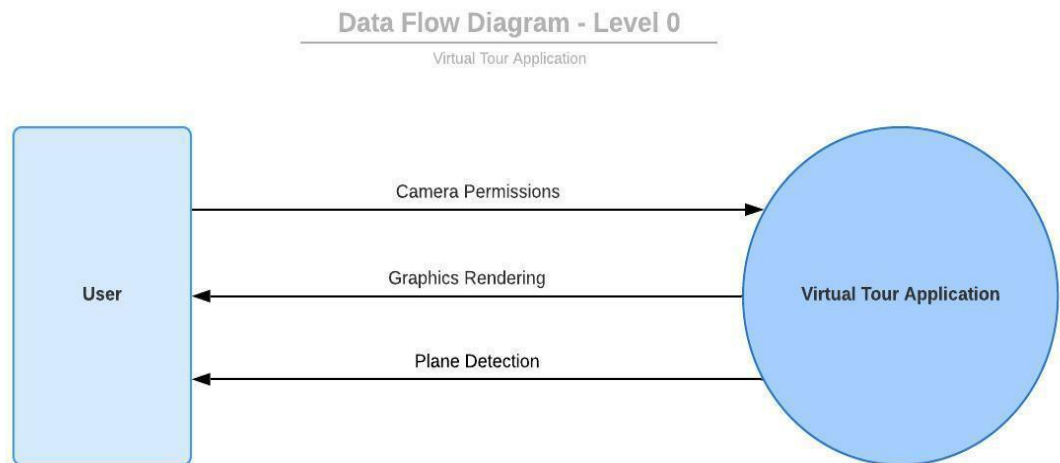
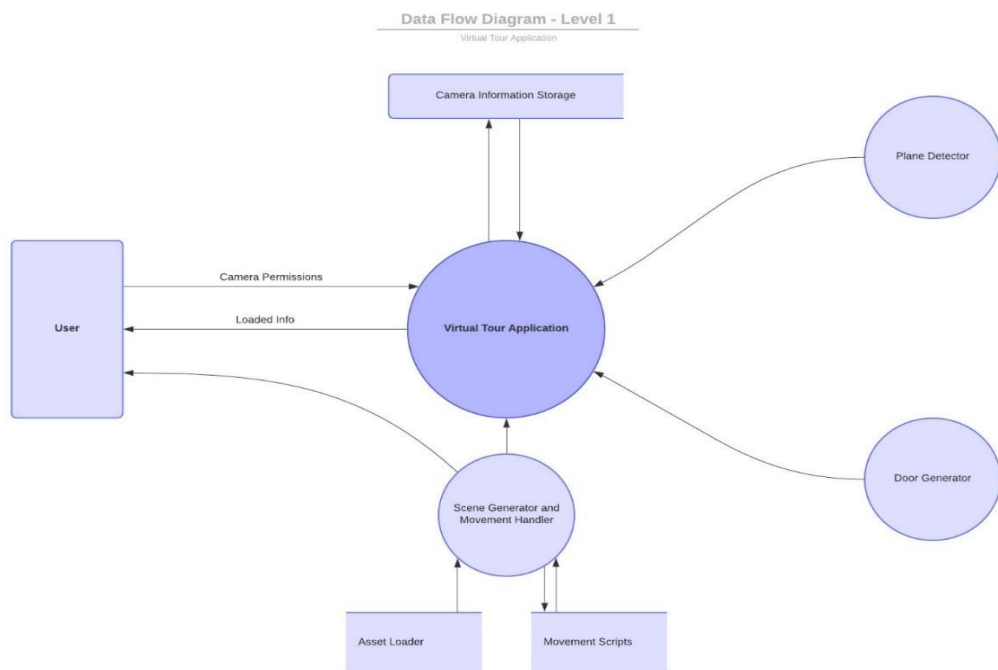# Chapter-3: Design Criteria

3.1: System Design

3.1.1 Flowchart

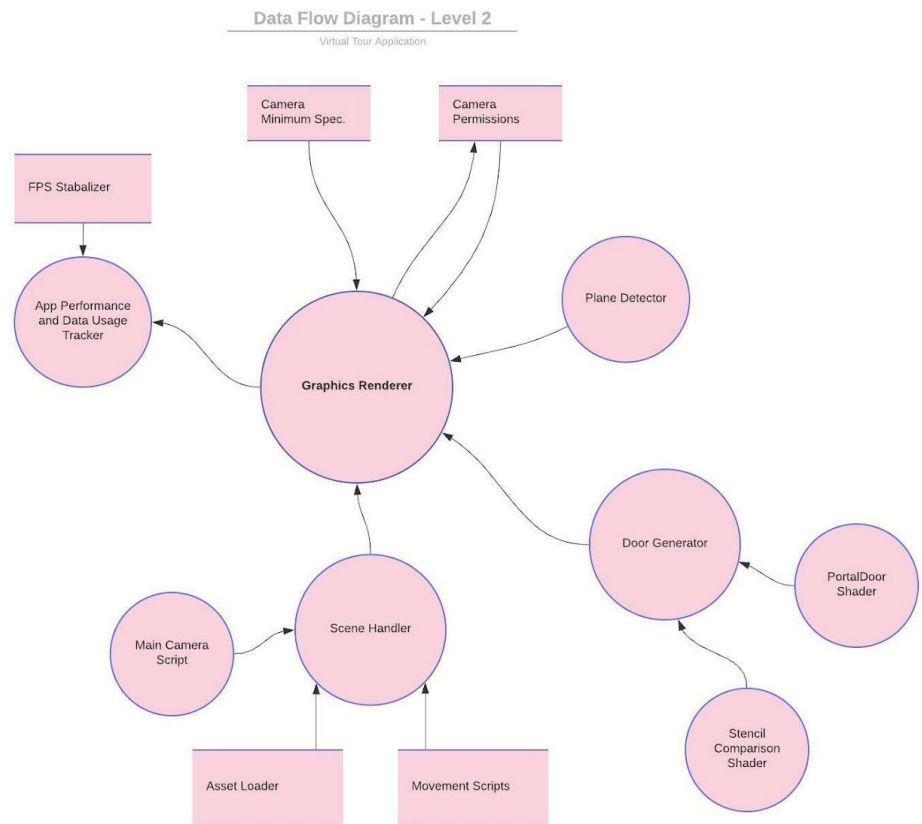**Fig 1:** Flowchart of Virtual Tour

3.2: Design Diagrams

3.2.1 DFDs
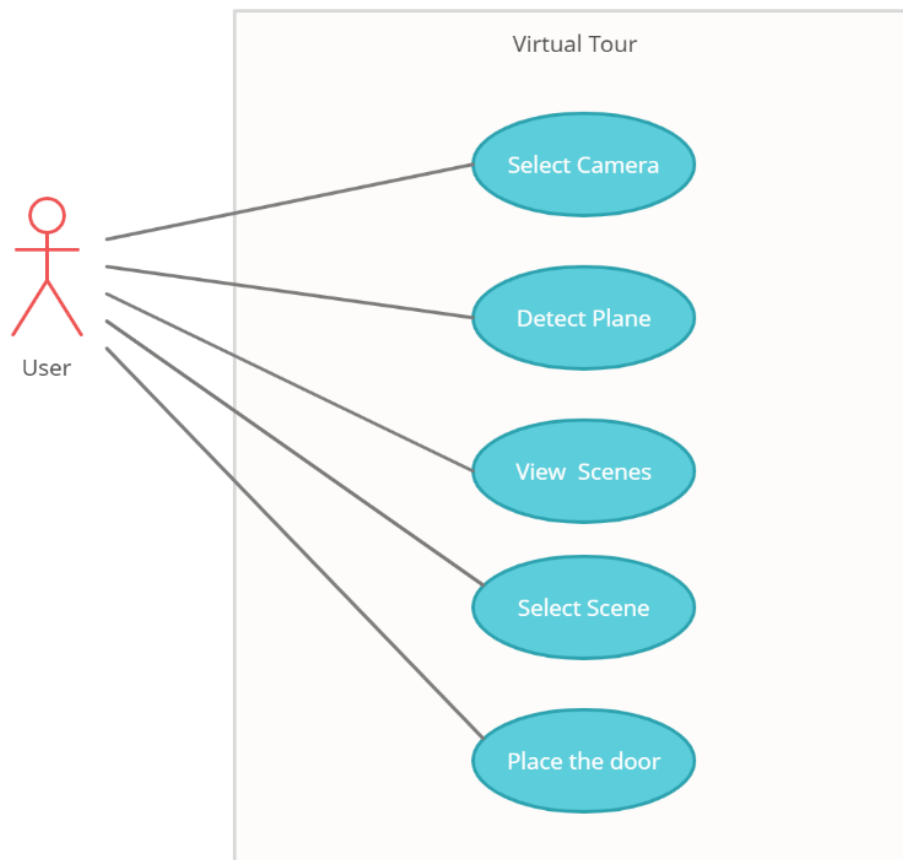

Figure 2. Virtual Tour data flow diagram Level 0.

Figure 3.Virtual Tour data flow diagram Level 1.

Figure 4. Virtual tour data flow diagram Level 2.

3.3 :System Architecture

FIG 5: USE -CASE DIAGRAM OF VIRTUAL TOUR

3.4: Information & Communication design and Flow of Application:

Step 1: Start

Step 2: Select allow camera.

Step 3: IF plane detected on the ground's surface, place the portal door.

ELSE

Exit and restart the application to search for the plane surface.

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Step 3: Select 'Disable Plane' to stop the detection of plane so that it does not appear over the door, once the door is visible.

Step 4: Choose from the various scenes that you want to visit.

Step 5: IF the camera is inside the portal door then the virtual worlds and objects are visible.

ELSE

Select different scenes to change to a different location.

Step 5: stop

Chapter-4: Development & Implementation

4.1: Developmental feasibility

4.1.1. Operational Feasibility:

The requirements of hardware and software specifications practically gave us solution to create the Virtual Tour application. With the use of Unity 3D software and language C# we were able to create the application without any problem. With the ease of AR Foundation Package we created the application so that it can be operational in all devices. The application does not require external devices to be connected with to make it work. All that is required is any smartphone to download the app and use it.

4.1.2 Technical Feasibility:

The technology that we have used is feasible and practical. Unity allows us to create enormous and beautiful 3D animations and objects that seem realistic. With Unity we can create applications in the field of gaming, AR, VR, etc. Unity platform focuses more on creating the product rather than coding everything. With this functionality, the developers can focus more on the release of the actual product, its features, its working, functionalities, user friendly with a good user interface. Unity is an open-source and Saas software. It provides all the components, features, plugins,data,assets,etc ,it's just that people need to install it and start building the 2D,3D,etc applications that they want.

4.1.3. Economic Feasibility

The application requires no external device to be connected with which comes with a hefty price. It requires your smartphone to simply download the application and start using it.
Anyone will be able to enjoy the benefits of this application without buying any external expensive device. It is a cheap, affordable and user-friendly product. Economically the product is built without keeping in mind the need of any other third party product. The main aim was to provide a reliable, cost-effective solution that

people will approve and use rather than thinking about the level of cost that they will need to purchase it. It is an implementation of an idea which can further be more polished and improved so that it provides more features and add-ons in future.

4.2: Implementation Specifications

The implementation details of the different components of the application:

1. First component of our application is the splash screen animation that is shown when we open the application.
2. User Interface: We have provided very easy to use interface with the help of UI buttons so that the users can switch between the scenes.
3. 3d Models: We have created 3 scenes for this project which can be changed according to the user's choice.
4. Movement Scripts: These scripts were written in C# and controls things such as rotation, movement of camera, movement of objects, etc.
5. Shaders: These files dictate the shape, size, brightness and overall characteristics of the various objects.
6. Augmented Reality Setup: This was achieved through the AR Foundation framework.
7. Collision Detection Script: This is also the important script that is used to provide the interactivity within our application. With this user can interact with different components of a scene. For e.g., Idols and Trees.

4.3: System modules and flow of implementations

The application can operate on any iOS or android device when installed. No external device needs to be connected in order to view the output. The camera of the device scans for an area to be used as a plane in order to place the portal door, then the portal door opens up passages to visit different places with a 360-degree view.

Modules added:

1.Interface: To provide the user option to swap various scenes that they want to visit. The interface provides buttons that the user will click upon to change the scenes. The user interface contains buttons of Detect Plane, Temple, Forest, Space and Back button.

2.Splash Screen: It is a screen that is visible whenever we start the application. It can be any animated logo to provide the user a feel of entering into an interactive environment.

3.Door: The door is made as the first game object that serves as the entrance to various scenes that the user will choose from. The user will have to enter through this door to view the 360deg Virtual scenes that will be in front of them. The door serves as the entrance to a virtual world.

4.Camera Movement Script: This script will perform the operation of moving the camera in all directions. The user can move the camera towards any direction that will give them the feel of actually visiting the place, city or anywhere else. This script is a required field and a must to have a smooth view and move the camera 360 degrees and give a flawless view of the surroundings.

```csharp
void Update()
{
    float moveCam = Input.GetAxis("Vertical") * speed * Time.deltaTime;
    transform.Translate(0,0,moveCam);

    float rotateCam = 0;
    float up_down = 0;

    if (Input.GetKey(KeyCode.LeftArrow)){
        rotateCam = rotateCam - 1;
    }

    else if (Input.GetKey(KeyCode.RightArrow)){
        rotateCam = rotateCam + 1;
    }

    else if (Input.GetKey(KeyCode.W)) {
        up_down = up_down + 1;
    }
    else if (Input.GetKey(KeyCode.S)){
        up_down = up_down - 1;
    }
    transform.Rotate(0, rotateCam, 0);
    transform.Rotate(up_down, 0, 0);
}
}
```

5.Portal Door Shader: In this shader, there will be pixels set upon the door so that it becomes transparent. It is basically used to make the portal door game object transparent. **Colormask** is set to **0** to make the portal door transparent. **Zwrite** is set off to stop the stretching of the door when we move inside it. **Cull off** is used so that both the front and back side of the game object will be visible i.e., when we enter inside the door, the outside of the door will be visible.

6. 360 Video Shader: In this shader, the reference number required to view the various scenes will be kept the same as the portal door so that we can start looking onto the different scenes that keep on changing one after the other. A Reference number is used so that when the object inside the door matches with the surface of the reference number placed in the door then it will be visible through the door.

7.Portal Door Script: This script will direct the camera to make the person view the virtual objects only when the user enters through the door. A collider will be used in it

to ensure that whenever the camera detects the door, it gets triggered and starts viewing the objects but if the camera does not pass through the portal door the user will not be able to see anything through it. For e.g.: The following script shows the code implementation:

```csharp
void OnTriggerStay(Collider collide)
{
    if (collide.gameObject.CompareTag("MainCamera"))
    {
        if (transform.position.z >= collide.transform.position.z)
        {
            foreach(Material mat in PGMat)
            {
                mat.SetInt("stest", (int)CompareFunction.Equal);
            }
        }
        else
        {
            foreach (Material mat in PGMat)
            {
                mat.SetInt("stest", (int)CompareFunction.NotEqual);
            }
        }
    }
}
```

8.Stencil Comparison Shader: This shader will match the reference number set upon the objects inside the portal door. If the number matches the pixels set upon the portal door, then the objects will be visible otherwise, we will not be able to see any scene inside the door.

The script shown below is where we have used the logic to set reference number:

```
Shader "Unlit/StencilComparision"
{
    Properties
    {
    [Enum(Equal,3,NotEqual,6)] stest ("STENCILTEST", int) = 3
    }
    SubShader
    {
        Stencil{
            Ref 1
            Comp[stest]
        }


        Pass
        {

        }
    }
}
```

Stencil is used to shade different game objects like for e.g. A sphere above another game object such as a plane. If both the game objects have the same reference number then it will be visible.

9. Canvas: The **Canvas** is the area that all UI elements should be inside. The Canvas is a Game Object with a Canvas component on it, and all UI elements must be children of such a Canvas.

Creating a new UI element, such as an Image using the menu **GameObject > UI > Image**, automatically creates a Canvas, if there isn't already a Canvas in the scene. The UI element is created as a child to this Canvas.

The Canvas area is shown as a rectangle in the Scene View. This makes it easy to position UI elements without needing to have the Game View visible at all times.

Canvas uses the Event System object to help the Messaging System

Implemented canvas in every scene so that we can jump through the scenes using interactive buttons on this canvas.
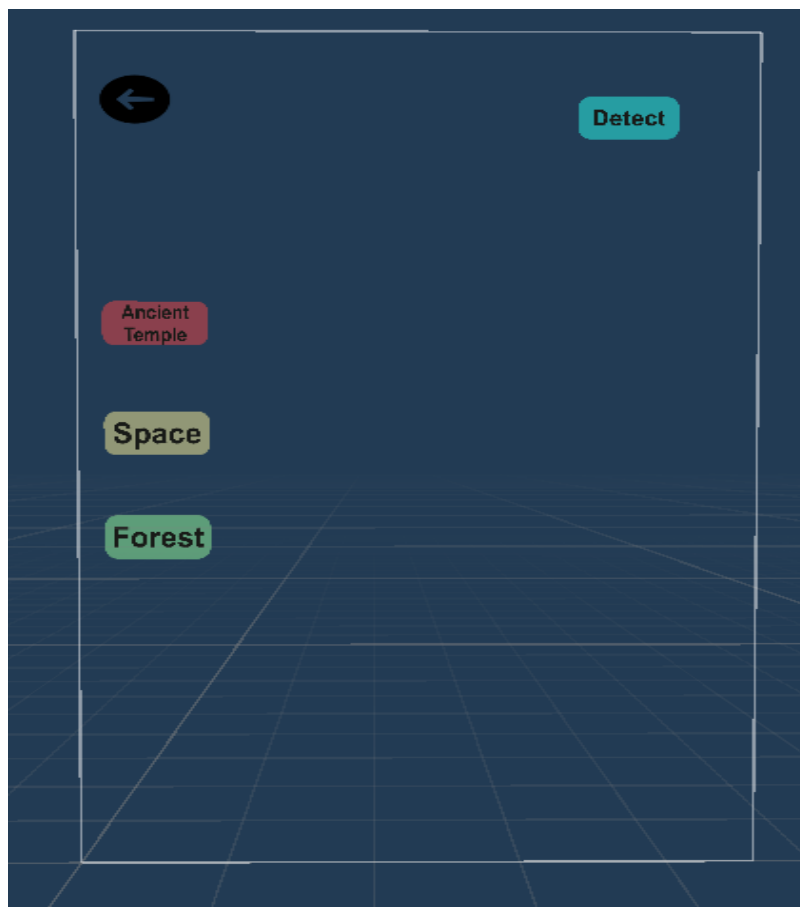
10.Scene Manager Script: This script allows user to change from one scene to another while clicking on the button placed on canvas that is used for changing scene.

```
using UnityEngine.SceneManagement;
using UnityEngine;

public class SceneChange : MonoBehaviour
{
    public void forestScene()
    {
        SceneManager.LoadScene(2);

    }
    public void TempleScene()
    {
        SceneManager.LoadScene(3);

    }
    public void BackScene()
    {
        SceneManager.LoadScene(1);

    }
}
```

11.Implementation of AR Foundation: AR Foundation allows you to work with augmented reality platforms in a multi-platform way within Unity. This package presents an interface for Unity developers to use, but doesn't implement any AR features itself. To use AR Foundation on a target device, you also need separate packages for the target platforms officially supported by Unity

Adding AR to the virtual 3D objects so that it is visible in the real world when seen through the door. People will be able to enter the scene and view the environment which they select according to their preference. The implementation of AR makes the digital objects render into the environment as real objects.

Differences in operating systems can make a huge impact in the market when an application is built only for specific OS. So keeping that in mind, we used ARFoundation package which is a combination of ARKit and ARCore to give users of both platforms, that is iOS and Android, enjoy the benefits and be compatible in using its resources that the app provides.

12) Components of Unity: We have also added more components such as Lightning, Wind, etc components provided by unity itself which eases and saves time in creating the application as unity focuses mainly on delivering product with less time doing manual work and engaging more time towards building the product without giving more time in doing tedious task to code everything.This feature of Unity Platform does provide developers to build apps that they want to without focusing much on the backend cases. Unity provides its Asset store to integrate several models, packages to be installed to progress the work and many more facilities which does ease the work of an application developer.

4.4: Critical modules of product/system

4.4.1. **Collision Detection Script:** This script is a critical one because it stores information about the virtual object that the user will collide with. This script will give additional information to those who want to know about what the object is that they are colliding with, when it was built and who built it. For eg: In the field of education, this script will give information to the children using it what a Sun, Moon, and other planets look like and how its visual representation is.

```
void OnTriggerEnter(Collider other)
{
    if (other.tag == "Stone")
    {

        if (TextInfoPrefab)
        {
            TextInfoPrefab.GetComponent<TextMesh>().text = "Stone\n";
            GameObject temp = Instantiate(TextInfoPrefab, other.transform.position - new Vector3(1.5f,-5,0), other.transform.rotation
            * Quaternion.Euler(new Vector3(0,180,0)));
            Destroy(temp, 5f);
        }

    }
    else if (other.tag == "Tree")
    {

        if (TextInfoPrefab)
        {
            TextInfoPrefab.GetComponent<TextMesh>().text = "Tree\nName:Maple Tree\nTree Age-50yrs";
            GameObject temp = Instantiate(TextInfoPrefab, other.transform.position - new Vector3(1.5f,-5,0), other.transform.rotation
            * Quaternion.Euler(new Vector3(0,180,0)));
            Destroy(temp, 5f);
        }
    }
```

For eg: This script shows that when the camera collides with the tag "Tree" or "Stone" for an object, it should give the following information.

4.4.2. **Camera Movement Script:** This script is also critical as without this script the camera will not move and the user will not have the capability to move their cameras and see the objects. So this allows movement of the camera in 360 view to see the different objects.

This is script shows the implementation of camera script:

```csharp
void Update()
{
    float moveCam = Input.GetAxis("Vertical") * speed * Time.deltaTime;
    transform.Translate(0,0,moveCam);

    float rotateCam = 0;
    float up_down = 0;

    if (Input.GetKey(KeyCode.LeftArrow)){
        rotateCam = rotateCam - 1;
    }

    else if (Input.GetKey(KeyCode.RightArrow)){
        rotateCam = rotateCam + 1;
    }

    else if (Input.GetKey(KeyCode.W)){
        up_down = up_down + 1;
    }
    else if (Input.GetKey(KeyCode.S)){
        up_down = up_down - 1;
    }

    transform.Rotate(0, rotateCam, 0);
    transform.Rotate(up_down, 0, 0);
}
```

5.1: Result

These are the results of the application that we have completed till now. We have included various models and represented the UI interface and the scenes that we will visit after adding AR into it. AR will let the user enter these virtual worlds by simply installing the application and using their camera to view these scenes and take a walk into these places. We have installed the complete application on our phones and have used the app ourselves to ensure that it is working properly. All the three scenes that we have created does provide the look and feel of actually visiting a place.

1.Ancient Temple

Fig 6: Ancient Temple Scene

This ancient temple tour includes an old stone idol surrounded by tomb-like structures, complete with rocks lying on the floor with a dilapidated looking compound and hallways. The ancient temple scene is created to give a tour to a medieval period so that people can enjoy the traditional way of building sculptures. Knowing and gaining the knowledge how structures were created in those early days and what were the basic facilities used by people back then when there was no modern technology involved in building these eye-capturing places.
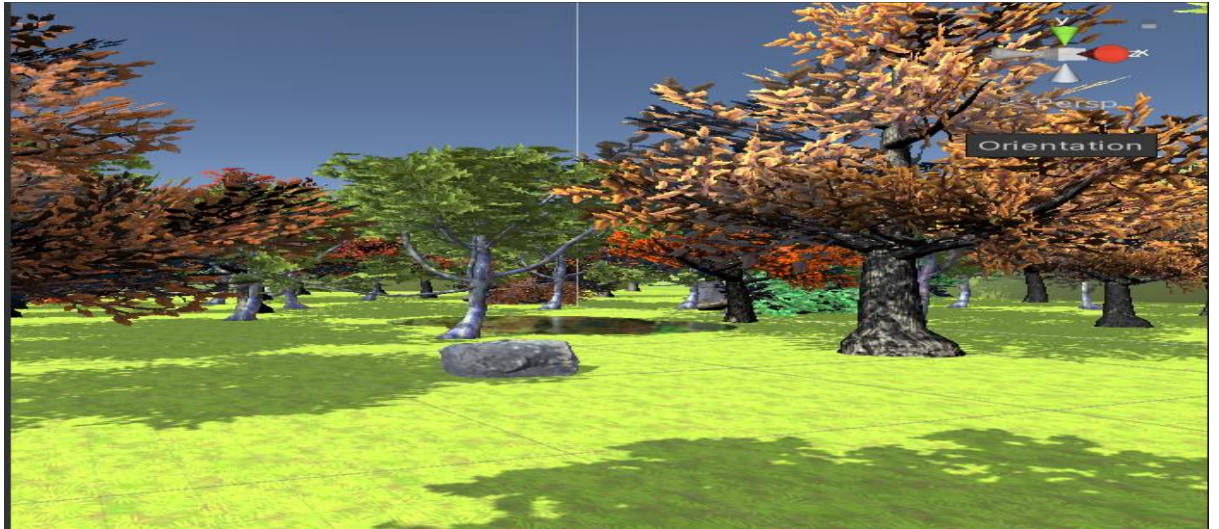
2. Forest

Fig 7: Forest scene

The forest scene includes a lush green forest complete with big trees swaying in the wind, filtered sunlight passing through the gaps. It also includes old leaves falling from the trees. The forest scene is created to take people to a place to come close to nature itself and relieve their stress. In this modern world, the stress of people is increasing day by day. Keeping that in mind, going to a place where they are away from all stress and anxiety can really be beneficial for their mental health.

3. Space/Solar System

Fig 8: Space or Solar System Scene

The space/solar system scene includes all the components of the solar system, complete with spinning and revolving planets and an endless space providing ample opportunities for children to learn about our solar system and immerse themselves in it. This scene is created keeping in mind the education of children. Involving 3D views we thought that to modernize the learning process and make a change how children are taught in schools. Providing visual representations to them can increase their ways of grasping things more clearly, enjoying the learning process and not feeling like a burden to them, having the urge to study with more fun and less boring.
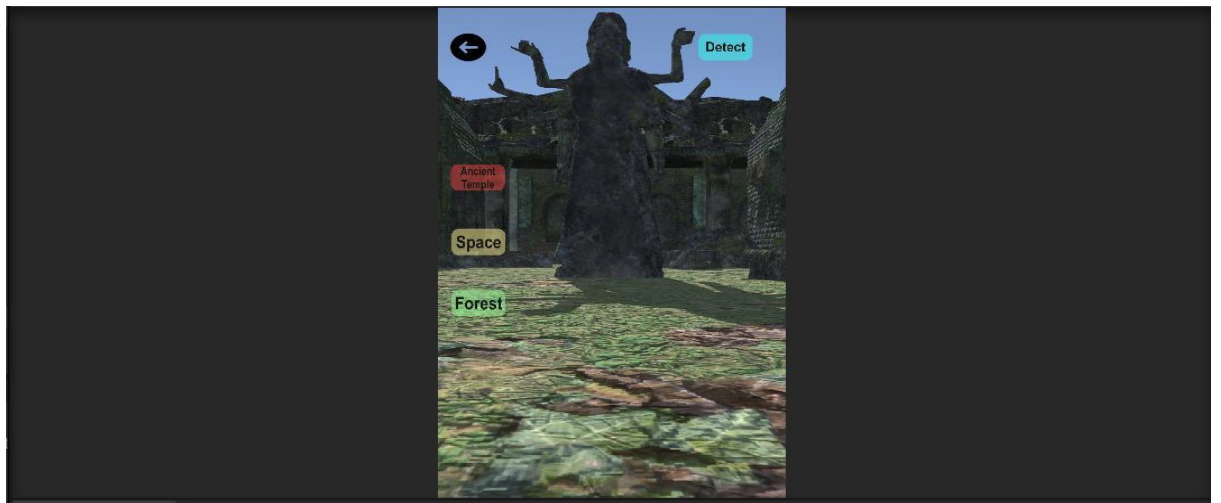
UI Interface

Fig 9: User Interface of all three scenes

- In-display UI buttons to change tour/scene
- Button to start/stop plane detection

- Back Button

5.1: Success/Failure Cases

Functionalities	Passed/Failed
App Starts	✔
UI buttons Working	✔
AR is loading properly	✔
Scene is displaying	✔
Server Connectivity	✘
Database Used	✘
Secure Login	✘

5.2: Testing

Testing is the most common way of executing a program determined to track down bugs and errors. To make our product perform well it ought to be error-free. Successful testing finds all errors and bugs from the code which results in removal of error and producing an error-free product.

Software Testing is a crucial part since, supposing that there are any bugs or blunders in the product, it very well may be recognized early and can be settled before conveyance of the product item. Appropriately tested product guarantees accuracy, security and good performance which further outcomes in efficiency, cost viability and satisfaction of users.

Some of the principles of testing are:

1) Testing cases should be written in a way such that it meets customer requirements.

2) Testing of components should start from small components and then move towards bigger parts in the application.

3) The test cases should be planned and written down before executing it and should also cover all critical areas that might lead to failure in application.

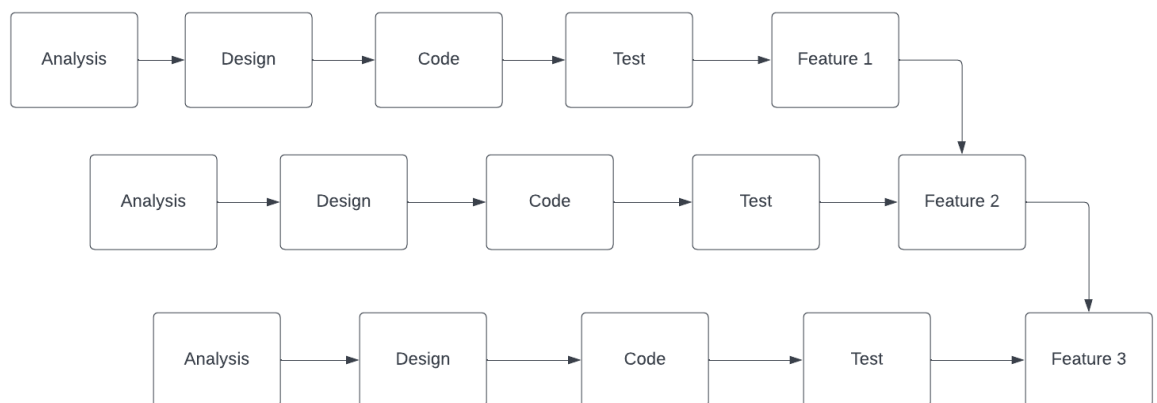The benefits of testing application:

Cost-effective: It is one of the significant benefits of programming testing. Testing any IT project on time assists you with setting aside your cash as long as possible. In the event that assuming the bugs trapped in the prior phase of programming testing, it costs less to fix.

Security: It is the most powerless and delicate advantage of programming testing. Individuals are searching for confided in items. It helps in eliminating dangers and issues prior.

Quality Product: It is a fundamental necessity of any product item. Testing guarantees a quality item is conveyed to clients.

Consumer loyalty: The primary point of any item is to give fulfilment to their clients. UI/UX Testing guarantees the best client experience.

```
Analysis → Design → Code → Test → Feature 1
                                          ↓
Analysis → Design → Code → Test → Feature 2
                                          ↓
Analysis → Design → Code → Test → Feature 3
```

5.2.1: Type of testing adapted

1) Unit Testing: In this testing, it tests the smallest units or components in the application such as checking for loop, methods, initialisation exceptions, etc. It is usually done by a programmer.

2) Integration Testing: This testing is done after all the components are unit tested. In thai all the components are integrated and then tested together to check if the functionalities are working together. For eg:

i) Black Box Testing : In this the tester does not require coding knowledge as it only focuses on inserting inputs and what are the outputs that are produced. It checks if the expected result matches the actual result.

ii) White Box Testing: It focuses on the internal code and how it works. It focuses on how the outputs are achieved.

3) Regression Testing: Each time another module is added prompts changes in the program. This sort of testing ensures that the entire part works appropriately even after adding parts to the application.

4) System Testing: This test checks if the software works on different operating systems.
This testing is done under black box testing.

5) GUI Testing: This testing is to check if the UI interface is working properly. It checks for the working of buttons we have used on screens.

5.2.2: Test results of various stages

Various stages are written below:

Use Case ID	1
Test Case Name	Check Scene Change on button click
Test Case Description	For checking the three scenes when clicking different buttons related to the scenes.
Steps	1.Open App 2.Detect Plane 3.Click on the left buttons in the UI.
Expected Results	Scene is visible
Actual Results	As expected

Use Case ID	2
Test Case Name	Check Collision Data
Test Case Description	For checking the information that will be seen when the camera collides with an object.

Steps	1.Open App 2.Detect Plane 3.Click on the left buttons in the UI. 4. Move towards the virtual object
Expected Results	Data is visible
Actual Results	As expected

Use Case ID	3
Test Case Name	Animations in Scenes
Test Case Description	For checking that animations in different scenes are working correctly or not
Steps	1.Open App 2.Detect Plane 3.Click on the left buttons in the UI. 4. Scene opens 5. Check if animation is visible or not
Expected Results	Animation is working

Actual Results	As expected

5.2.3: Conclusion of Testing

We have tested all the components that we have used in our project. We have created the full application and also used it in all our smartphones. We have tested the UI screen, the internal functionality that includes camera movement. The camera scripts that we have used are working accurately when we move the camera of our phone. We have used other scripts such as Portal Door script, shaders that help in rendering the object in the virtual world. All the scripts and shaders are working synchronously together and all the objects are visible through the portal door. Overall the application is ready to be used by anyone who wishes to have a view into the virtual world and can also be used for education purposes.

5.3: Success of System

The points that contribute to our success of the system is:

1) Scheduled Delivery of Product: We have completed our product stages of gathering requirements, discussing use-cases, implementation of the features in agile process, testing of the features, deploying the app and using it in our smartphones. We have completed our product on time.

2) Quality Assurance: We have timely checked the quality of our application. We continued working upon the small mistakes that we made while implementing the features, we resolved hundreds of errors to make the app error-free and improve its quality and working. We have coded the scripts and shaders to improve the precision and accuracy of the application to deliver good results when users will be using it.

3) Budget: As we have said earlier as well, the making of the application was cost-effective for the developers also as Unity 3D game engine is an open source software which can be used by N number of people who wish to develop such AR,VR, Gaming, Healthcare based, etc. any type of application.

4) Satisfaction of Users: We have created the application and after each step we have been evaluated. Our evaluation was done based on whether we were meeting the customer requirements in our product or we are missing out the brief. The evaluation of our product creation time to time gave us idea that we were on the right path to deliver the product that we wanted to and creating the application in the way that we have imagined it to be. Our main purpose was to implement the product in the field of Tourism and Education and we were able to do so and present and finish the product.

5) Business Requirement: The main motive was firstly to know if the idea that we wanted to implement would bring a change in the daily lives of people. We wanted to make an impact in the tourism and travel sector to help people enjoy the views that they were missing or to help children make their learning process more interesting than traditional methods. Our business requirement does solve the problem and brings out a new solution. The implementation of the idea never went in vain and gave an amazing product out of it.

Chapter-6: Conclusion & Future Improvements

6.1: Performance Estimation

This AR Project is made for educational purposes and for giving better travel experience digitally from their home or any other place. We have introduced as many concepts as possible to make an AR Virtual Tour for people with low-cost and highly effective application. The approach we have used may have an impact in the tourism sectors. It is a cost-effective product. Users can easily adapt themselves with the changes that we have created in the application as it is highly user-friendly. The response time and throughput of the product is highly efficient with no screen or data lagging. This product is a socially acceptable product as it has combined features within itself that can help greatly in the field of education, learning , tour and travel.The users will not face any issues regarding its working and UI flow as it does provide self-explanatory informations that can guide users to move from one field in the application to another.
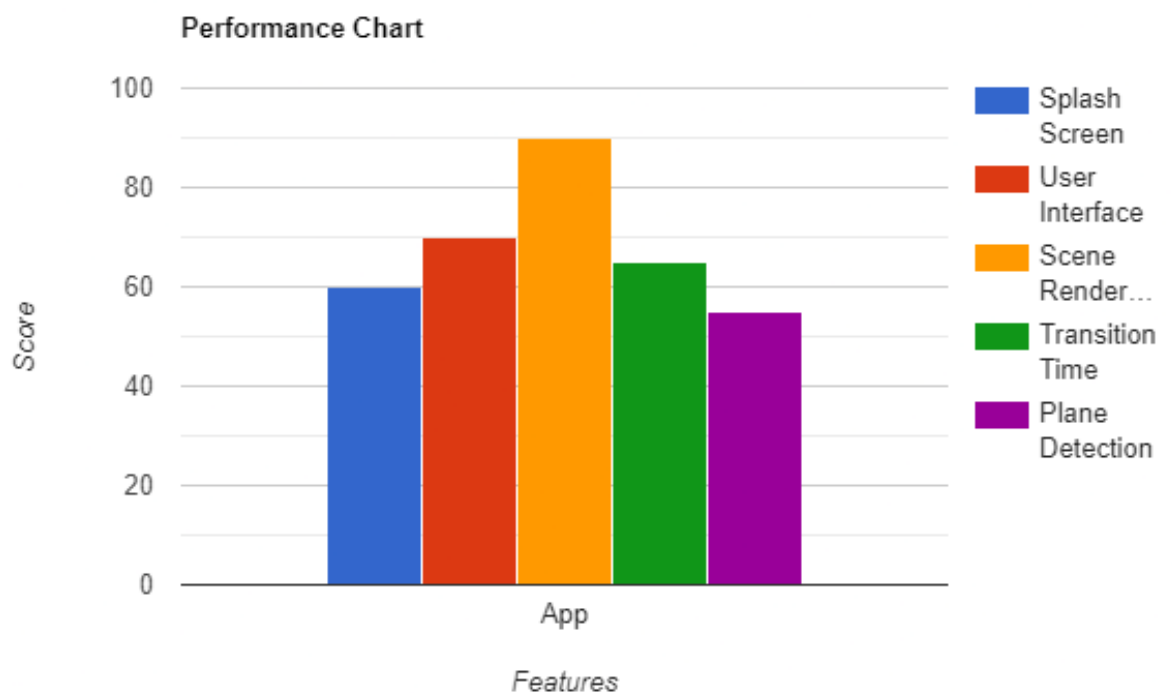
6.2: Usability of Product / system

The application can be widely used in the field of education,travel, entertainment, etc. The application we have created does satisfy the following factors mentioned:

- **Design and Architecture**: We have designed and followed a simple architecture for the ease of users.

- **Fun Learning Experience**: It is built in a way that a user who has seen the interface for the first time will not demand much time to blend with it.

- **Scalability**: It is a scalable product that can be further instilled with more new attributes and components.

- **Memorability**: The users' will have more appeal to visit back the scenes and have a look into what more additional is concocted within the app.

- **User satisfaction**: Customers will have a splendid, fun, and unique way of visiting places that they want to visit without physically appearing into that place. These benchmarks will surely ease the lives of people to use such an application that provides and helps people to bring a solution to a big problem.

- **Speed:** The application provides fast performance and less downtime. It allows performing the tasks for movement,changing scene,detect plane,placing the door and letting users view the objects with faster response time.

- **Less amount of dependency:** We have not used any third party APIs or storage features in our app that may lead to more time in getting and posting responses.

- **Lightweight:** We have created a lightweight application that will not take up much storage space and will render all objects without any delay in the application. Users will have a great experience enjoying a lightweight application without any concern about memory space.

6.3: Limitations

AR is utilized in different areas for a wide assortment of utilizations. The normal areas where it is utilized are Engineering, Medical, Military, Gaming,Medical, etc. Some Examples of AR (Augmented Reality) frameworks are virtual changing areas, virtual games, for example, Pokemon Go and so on. It is broadly utilized in clinical and medical care applications, for example, keyhole medical procedure, Accu Vein, EyeDecide AR application, SimX and so forth.

Some of the key limitations of this app could be:

1) Rendering issues related to virtual objects. As providing better quality and precision requires time to time advancements and processes to make quality better. So the rendering issue will be less with more work upon the application.

2) Another limitation is that the use of AR/VR Technologies has not gripped the market till now as people still follow traditional methods of education and travel. So in order to bring a change to provide ease and access to a better lifestyle will require more time when people are ready to bring themselves to a change that they want to implement in their lives.

6.4: Scope of Improvement

Some of the points that can increase the features could be:

1) Increasing the number of scenes in the app so that users can enjoy visiting places with lots of options to visit from. We are thinking to use Artificial Intelligence in our project at the further stages so that we can load any type scene that user demands by anlaysing the query using some AI algorithm.

2) Including more studies based objects to introduce the application in the field of education that students will use to understand concepts clearly with more visual and 3D animations. These will increase their urge to learn about various concepts more and enjoy their learning process. The basic idea would be to take place the traditional way that is still being used to continue the education process. So with a new technology, it will lead to more future scopes with great learning and exposure to the

environment to contribute more ideas towards creating more new technologies like AR/VR.

3) Placing the application on a web server. So that the models can be loaded from the server with a faster response time and the application can be smaller as compared to static models in the phone memory. We can improve the size and efficiency of the complete product by doing the following step.

4) Nowadays Metaverse is at boom, everything from crypto to nfts are getting pace in the market. So, we are tthinking to put this app in the metaverse with the help of blockchain technology. There are many applications that are in metaverse for e.g. Sandbox is an application that works on blockchain technology and allows the users to buy land or properties in virtual world i.e. Metaverse.

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APPENDIX