

ASSIGNMENT 1

DEPARTMENT OF MECHANICAL ENGINEERING
ANNA UNIVERSITY REGIONAL CAMPUS COIMBATORE

Subject code & name

CME345 – Haptics and Immersive Technologies

SUBMITTED BY

NAME : MADHAVAN S

REG NO : 710021114019

SEMESTER : 08

PROGRAMME : BE-MECHANICAL ENGINEERING

DATE : / /25

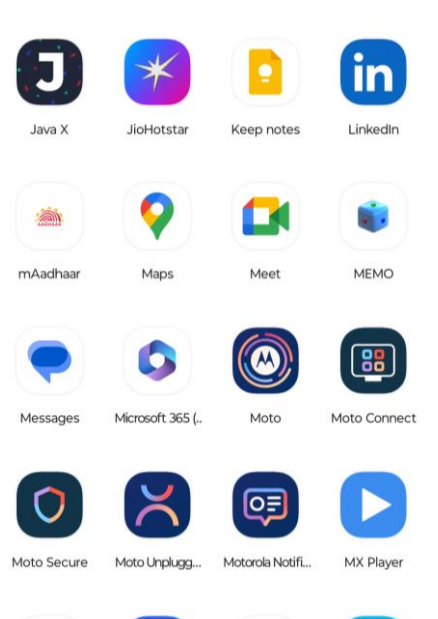
STAFF'S REMARKS

STUDENT'S REMARKS

Development of an Augmented Reality App with Animated Character Activation via QR Code Scanning

Abstract

This report details the development of an AR mobile application using Unity and Vuforia that enables real-time camera access, QR code scanning, and the projection of a 3D animated character in a physical environment. The integration of computer vision, animation, and AR frameworks demonstrates the convergence of immersive and interactive technologies in a user-centered application. The app enhances understanding of how virtual elements can be anchored in real-world contexts, a concept pivotal to haptics and immersive systems.



Introduction

Immersive technologies have transformed human-computer interaction by blending the physical and digital worlds. Augmented Reality (AR), a subset of these technologies, overlays virtual objects on real-world environments in real time. This project focuses on developing a marker-based AR application that utilizes a QR code to trigger the appearance of an animated 3D character, thus demonstrating spatial awareness and real-time interactivity — foundational concepts in CME345.

The project aligns with modern industry practices in AR used in education, marketing, games, and simulation training.

Suggested Readings:

- Azuma, R. T. (1997). A survey of augmented reality. *Presence*, 6(4), 355–385.
- Craig, A. B. (2013). *Understanding Augmented Reality: Concepts and Applications*.
- Billinghurst, M., Clark, A., & Lee, G. (2015). *A survey of augmented reality*.

Objectives

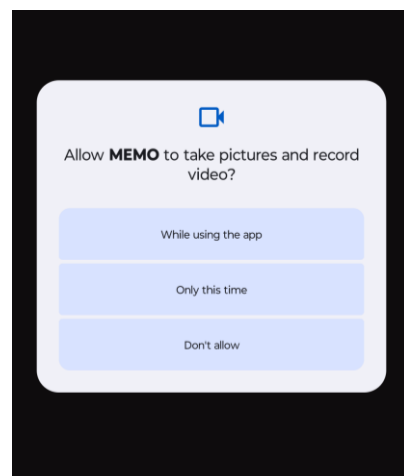
- To develop an AR app that activates upon scanning a QR code.
- To render a 3D animated character in the physical environment.
- To integrate animation logic with image recognition in Unity.
- To explore real-time AR rendering performance on mobile devices.

Tools and Technologies Used

Technologies used:

- Unity 2022.x
- Vuforia Engine
- C# Programming Language
- FBX 3D Model Format
- Android Platform (APK build)
- Unity Animator & Timeline

System Architecture and Methodology



Workflow Overview

1. QR Code Generation
2. Target Setup in Vuforia

3. 3D Model Import
4. Animation Setup
5. App Build and Deployment

Code Snippet Example

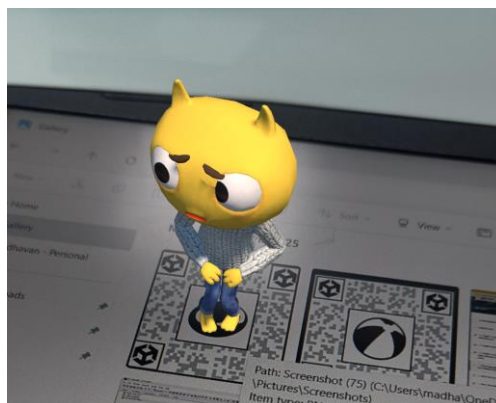
```
public class CharacterActivator : MonoBehaviour {  
    public GameObject character;  
    void Start() {  
        character.SetActive(false);  
    }  
    public void OnTargetFound() {  
        character.SetActive(true);  
    }  
}
```

Animation Integration

- Animation Type: Humanoid walking/idle loop
- Trigger Mechanism: Detection of QR code using ARCamera
- Animation Control: Unity's Timeline and Animator Controller for seamless loop/playback



Results and Performance Evaluation



Performance metrics:

- Detection Accuracy: High
- Render Delay: < 1 second
- Animation Smoothness: 30–60 FPS
- Detection Range: Up to 1.2 meters

Challenges Faced

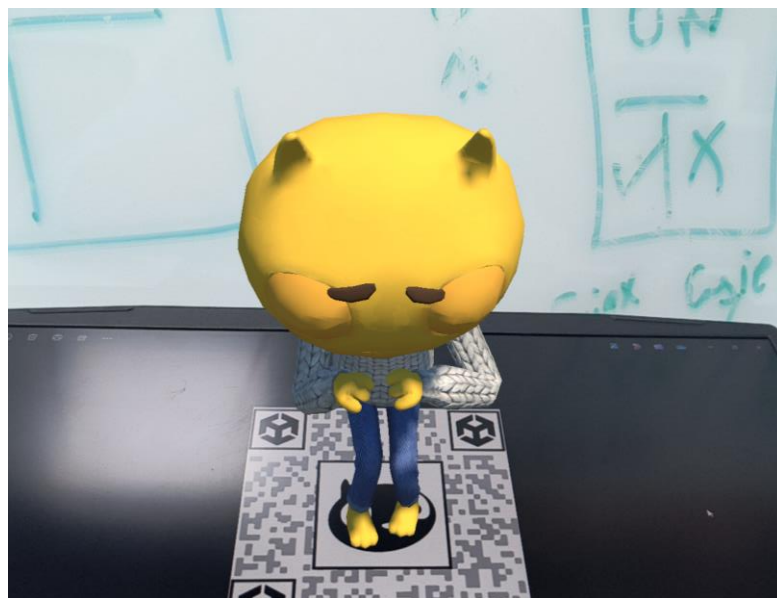
- Camera permission handling
- Lighting and detection stability
- Performance optimization for low-end devices

Future Enhancements

- Gesture-based interaction using AR Foundation
- Markerless AR via ARCore/ARKit
- Haptic feedback integration
- Voice command recognition and response

Conclusion

This project exemplifies how AR and animation technologies can be fused to produce an interactive user experience. By integrating computer vision, 3D modeling, and animation pipelines within Unity, the project serves as a foundation for future immersive apps in education, simulation, and entertainment. The use of QR as a simple, low-cost marker enables accessible AR experiences.



References

1. Azuma, R. (1997). A Survey of Augmented Reality, MIT Press.
2. Billinghurst, M., et al. (2015). A Survey of Augmented Reality. Foundations and Trends® in HCI.
3. Unity Documentation: <https://docs.unity3d.com>
4. Vuforia Developer Portal: <https://developer.vuforia.com>
5. Craig, A. B. (2013). Understanding Augmented Reality. Morgan Kaufmann.