Augmented Reality (AR) & Virtual Reality(VR)

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In

Artificial Intelligence and Machine Learning

Submitted By

Aayush Vaidya	**0901AM221002**
Mayank Jain	**0901AM221045**
Ronit Sharma	**0901AM221061**

UNDER THE SUPERVISION AND GUIDANCE OF

Dr. Vibha Tiwari
Assistant Professor

Dr. Sunil Kumar Shukla
Assistant Professor

Department of Centre for Artificial Intelligence

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
Deemed University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ Grade
Gola Ka Mandir, Gwalior (M.P.)- 474005, INDIA
Ph.:+91-751-2409300, E-mail: vicechancellor@mitsgwalior.in, Website: www.mitsgwalior.in

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CERTIFICATE

This is to certify that the work contained in these projects have been carried out by students mentioned below from the Centre for Artificial Intelligence. These Projects were done on partial fulfillment of B.Tech laboratory **"Augmented Reality(AR) & Virtual Reality(VR)".** It has been found to be satisfactory and hereby approved for submission.

Name of Students	Enrollment
Aayush Vaidya	0901AM221002
Mayank Jain	0901AM221045
Ronit Sharma	0901AM221061

Guided By:

Dr. Vibha Tiwari
[ASSISTANT PROFESSOR]
Centre for Artificial Intelligence
MITS Deemed University, Gwalior

Approved by HoD

Dr. R. R. Singh
Associate Professor and Head
Centre for Artificial Intelligence

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A special acknowledgement goes to our colleagues who helped us in completing the file and by exchanging interesting ideas to deal with problems and sharing the experience.

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Aayush Vaidya

Mayank Jain

Ronit Sharma

DECLARATION BY THE CANDIDATES

Our team **AAYUSH VAIDYA , MAYANK JAIN , RONIT SHARMA** declare that the PROJECT REPORTS for the course **Augmented Reality (AR)** entitled "**AR Fruit Learning Model**" & **Virtual Reality(VR)** entitled **"VR Basketball Game"** are being submitted in the partial fulfillment of the requirement for the award of Bachelor of Technology in Artificial Intelligence and Robotics. All the information in this document has been obtained and presented in accordance with academic rule and ethical conduct. During the session July-Dec 2025.

Aayush Vaidya	**0901AM221002**
Mayank Jain	**0901AM221045**
Ronit Sharma	**0901AM221061**

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Place: Gwalior

Augmented Reality (AR) Report

Objective

The main goal of this project is to design and implement an Augmented Reality (AR)- based learning platform that enables students to visualize mathematical concepts in 3D. The project enhances conceptual understanding by turning abstract equations and geometric shapes into interactive, real-world 3D experiences using AR technology. In doing so, the project seeks to transform the way mathematics is learned: from rote memorization and two-dimensional representations to interactive, immersive and intuitive understanding.

With mobile devices and AR technology, students can point their smartphone or tablet camera at a printed marker or target and immediately see a mathematical shape appear in their physical environment—a cube hovering above a desk, a pyramid standing on a table, a sphere rotating in mid-air alongside its volume and surface-area formula. This blending of the digital with the real world helps bridge the gap between conceptual mathematics and tangible experience. By visualizing mathematical objects in 3D, learners gain a much more concrete sense of how formulas relate to dimensions, shapes and space. They can walk around the object, rotate it, zoom in, and inspect its components from all sides. The ability to interact with geometry physically enhances spatial reasoning, which is often one of the hardest parts of mathematics for many students.

Moreover, the system helps make learning more engaging and fun. Traditional methods often rely on textbook diagrams, chalkboard drawings and static images — methods which can feel disconnected from everyday experience. In contrast, this AR-based system brings mathematical objects into the learner's own environment, making them feel closer to real life and more relevant. When students see a mathematical model sitting on their desk, they are more motivated to explore, manipulate and ask questions: How does the volume change if I stretch the shape? What happens to the surface area if I rotate it? What is the relationship between the base, height and slant of the pyramid? These are questions best answered through interaction rather than passive reading.

Description

The **AR Fruit Learning Model** is an Android-based application created using Unity and Vuforia SDK. The application detects printed image markers (such as fruit icons or flashcards) through the smartphone camera. Once recognized, it overlays corresponding 3D fruit models or animations in real time.

Use-Case Examples

- Scanning an **apple marker** displays a 3D apple model.
- Scanning a **banana marker** shows a rotating 3D banana.
- Scanning a **Watermelon marker** displays a cut-view with pulp and seed.

Working Principle

- The mobile camera identifies a Vuforia image target.
- Unity renders the associated 3D fruit model aligned on top of the marker.
- Users can rotate, zoom, and animate the fruit model to understand appearance and characteristics.

Key Learning Features

- Real-time interactive fruit visualization
- Touch-based rotation and zoom
- Animated nutritional details (e.g., vitamins, minerals)
- Cut-view animations to show internal structure

Educational Benefits

BENEFIT	DESCRIPTION
BETTER UNDERSTANDING	Students learn by seeing fruits in 3D instead of flat pictures
ENGAGEMENT	Makes learning fun and interactive
IMPROVED MEMORY	3D visualization helps long-term recall of fruit features and nutrition

Development Tools

Software Requirements

Unity (Game Engine)

Unity enables creation of interactive 3D models and handles user interactions such as rotation and zoom.

Vuforia SDK (AR Tracking)

Vuforia detects printed fruit markers and anchors the 3D fruit models on them.

Hardware Requirements

- Android smartphone with camera, gyroscope, and AR support
- Device capable of handling Unity-based AR rendering

Working Flow of the Project

Project Planning

- Defined number of fruits to include
- Selected fruit types based on educational relevance
- Prepared fruit flashcards to be used as markers

Environment Setup

- Installed Unity Hub and created a 3D project
- Enabled Vuforia AR support in Project Settings

Vuforia Configuration

- Registered on Vuforia Developer Portal
- Generated license key
- Imported Vuforia package into Unity
- Configured AR Camera for marker detection

Importing 3D Fruit Models

- Collected fruit models (FBX/OBJ) from online sources
- Imported and organized them in Unity
- Optimized polygon count and textures for better performance

Creating Image Targets

- Uploaded fruit images (apple, banana, mango, orange, etc.) into Vuforia Target Manager
- Downloaded target database and imported it into Unity
- Added ImageTarget prefabs and attached corresponding 3D fruit models

Testing & Optimization

- Tested the application on Android devices
- Refined lighting, animations, and scaling
- Optimized performance for smooth AR experience

Build & Deployment

- Configured Android Player Settings
- Built APK and deployed on device
- Verified real-time detection of fruit markers

Screenshots / Visual Outputs

Target Image

apple

Fig.1

watermelon

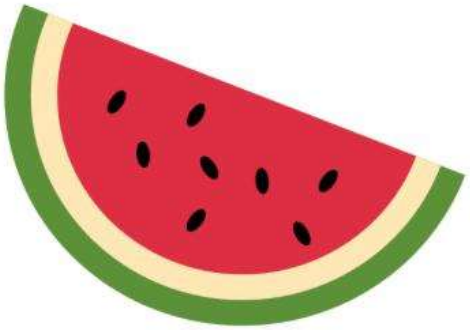

Fig.2

banana

Fig.3

Visual Output

FIG.1

FIG.2

FIG.3

Conclusion

The **AR Fruit Learning Model** brings a new way of learning about fruits by replacing normal textbook pictures with an exciting and interactive Augmented Reality experience.

Instead of looking at small, flat images on a page, students can now see **realistic 3D fruit models** that appear in front of them when they scan a printed marker with their mobile device. This makes the learning process feel more real and connected to everyday life.

With this system, students can rotate the fruit, zoom in to see details, and view it from all sides. They can clearly observe the shape, color, texture, and even the inside structure of the fruit. This interactive way of exploring helps students understand the fruit better and remember it more easily.

The project creates a strong link between theoretical knowledge and real-world experience. Instead of simply memorizing names and pictures, students actually get to *experience* the fruit in a digital 3D form. This makes learning more fun, interesting, and meaningful.

By using AR technology, the model increases student engagement, improves concentration, and supports better long-term recall of fruit types, their characteristics, and nutritional benefits.

Overall, the **AR Fruit Learning Model** shows how powerful and helpful immersive digital education can be. It makes learning simpler, more interactive, and much more enjoyable for students of all ages.

Virtual Reality (VR) Report

Introduction

The **3D Basketball Game project** is designed to create a very real, enjoyable, and interactive basketball experience using the Unity Game Engine.

In this game, a full basketball court is recreated in 3D, where players can freely move around, aim at the hoop, dribble the ball, and take shots just like they would on a real court.

The main goal of this project is to provide players with **smooth controls**, **natural and realistic ball movement**, **accurate physics**, and a **visually appealing environment** that looks and feels like an actual basketball stadium. Players can adjust the **angle, direction, and power** of their shot to score points, which makes the experience feel more engaging and skill-based.

This project strongly focuses on **realistic physics**, **user interaction**, and **immersive graphics**. Unity's built-in features like collision detection, lighting, and physics engines help the game behave realistically.

For example, the ball bounces, rolls, and reacts to surfaces based on real physical rules. The hoop also reacts when the ball enters it, giving players a satisfying scoring experience.

Besides being fun to play, this project also shows how Unity can be used to demonstrate important physical ideas such as **force**, **speed**, **direction**, **momentum**, and **gravity**.

When a player shoots the ball, they can easily see how the amount of power, the angle of the shot, and their hand movement affect where the ball goes.
In this way, the 3D Basketball Game is not just a sports game—it also becomes a simple and enjoyable way to understand how physics works in real life.

It helps players learn how different actions create different results, making the game both educational and entertaining.

Development Tools Used

Software Requirements

▪ **Unity 3D (Game Engine)**
Unity is the main software used to create this basketball game.
It provides features like:

- 3D rendering
- Physics (ball bounce, scoring triggers)
- UI system for score and timer
- Scene management (Menu → Game → Game Over)

Unity was used to design all scenes:

- Main Menu
- Gameplay Court
- Game Over Screen

▪ **Visual Studio / Visual Studio Code (C# Scripting IDE)**
This tool was used to write and edit all C# scripts that control the gameplay.
Important scripts used in this project:

- ScoreKeeper.cs – Stores and updates the score.
- DetectScoring.cs – Detects when the ball passes through the hoop and adds points.
- LevelManager.cs – Controls the timer and changes scenes (Menu → Game → Game Over).
- ScoreDisplay.cs / TimeDisplay.cs – Shows score and timer on the screen.
- ScoreAbsorber.cs – Keeps the final score for Game Over screen.
- GameOverScriptDisplay.cs – Shows final score after time ends.

▪ **Unity Asset Store (3D Models & UI Assets)**
All 3D models such as:

- Basketball hoop
- Backboard
- Rim
- Basketball

were imported from Unity Asset Store or provided inside the downloaded project.

Hardware Requirements

- A standard PC or laptop capable of running Unity.
- No special gaming hardware required.
- The game can run on mobile devices (Android APK).
- Mouse is required for aiming and shooting.

3D Models and Asset Packs

▪ Basketball Hoops & Backboards

Each hoop has two colliders:

- **Primary trigger** → Detects a ball entering
- **Secondary trigger** → Detects a score

Used for accurate scoring.

▪ Basketball Model

A textured 3D basketball with physics:

- Rigidbody
- Collider
- Bounce force

The ball moves realistically with gravity.

▪ Environment & Skybox

The court uses:

- Flat ground
- Multiple hoops
- Sunny skybox
- Basic directional light for shadows

▪ UI Elements (Main Menu, HUD, Game Over)

Includes:

- Main Title (Shoot Hoop)
- Play Button
- Score Display
- Time Display
- Game Over message
- Play Again button

Game Controls and Instructions

Starting the Game

- Click Play on the main menu.
- A timer begins (25 seconds by default).
- Shoot hoops to score as many points as possible.

Controls

ACTION	INPUT	DESCRIPTION
Aim the ball	**Mouse movement**	Move cursor to aim the throw direction
Shoot	**Left Mouse Button (Hold & Release)**	Hold to set force → release to shoot
Interact with UI	**Mouse click**	Click buttons like Play / Play Again

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Gameplay Tips

- Move your mouse slowly for better aim.
- Hold the mouse longer for more shooting power.
- Try aiming higher for distant hoops.
- Watch the score increasing when the ball passes cleanly through the hoop.
- Use quick shots to score more before time ends.

Game Mechanics and Scripts

▪ **ScoreKeeper.cs**

Stores and updates the game score.

▪ **DetectScoring.cs**

Attached to hoop colliders.Detects when the ball enters and adds score.

▪ **LevelManager.cs**Countdown timer

- Calling Game Over scene
- Moving between scenes (Menu → Game → GameOver)

▪ **ScoreDisplay.cs & TimeDisplay.cs**

Shows live score and timer on the screen using TextMeshPro UI.

▪ **ScoreAbsorber.cs**

Saves the final score and displays it on the Game Over screen.

▪ **PrimaryTrigger.cs & SecondaryTrigger.cs**

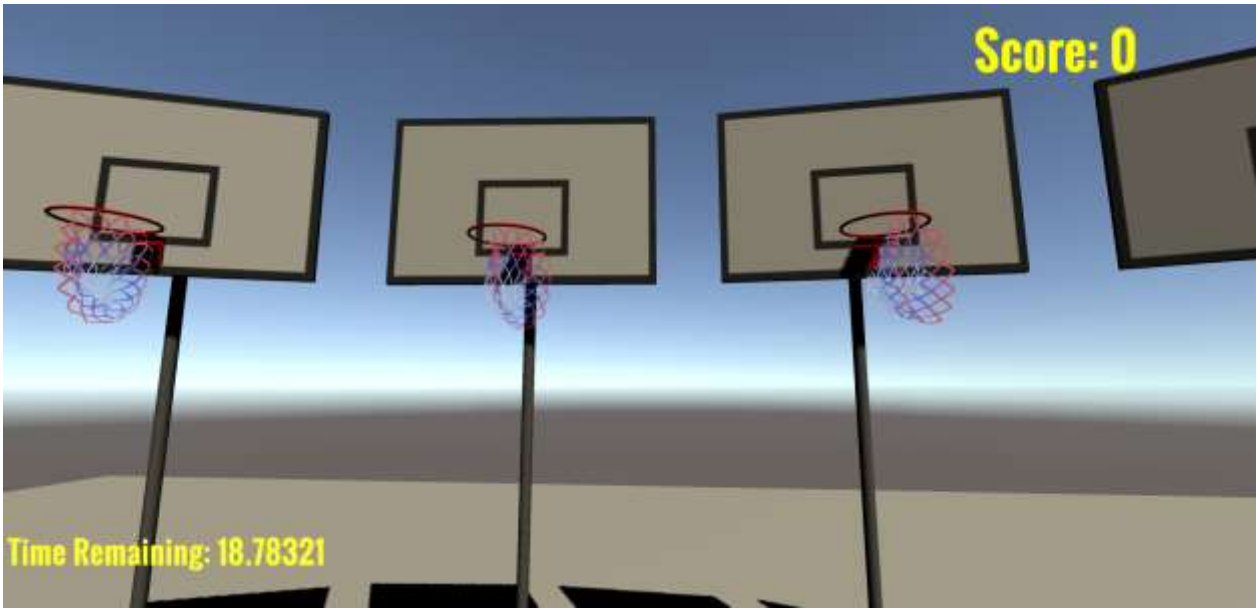
Used for accurate scoring:

- Primary → detects entry
- Secondary → confirms successful hoop score

▪ **GameOverScriptDisplay.cs**

Shows final score after the timer ends.

Output / Visual Results

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Game Over
Play Again

Conclusion

The **3D Basketball Game** clearly shows how powerful Unity is for creating realistic sports games.

It uses accurate physics, smooth animations, clean visuals, and responsive controls to give players an experience that feels close to real basketball. When the ball moves, bounces, or enters the hoop, it behaves naturally because the game uses Unity's rigidbody physics, proper lighting, detailed textures, and clear sound effects.

The game is built with a well-organized structure. Different scripts handle different tasks—like controlling the ball, tracking the score, moving the player, and managing the environment.

This kind of modular design makes the entire project easy to update, fix, and expand in the future. Developers can add new features or improve old ones without changing the whole system.

Besides being fun and enjoyable, the 3D Basketball Game also teaches players how real-world physics works. Concepts like **force**, **angle**, **speed**, **velocity**, and **gravity** can be seen directly in the movement of the ball. When a player shoots the ball with more power or changes the angle, they can instantly observe how the shot changes. This makes the game not only entertaining but also educational in a natural and interactive way.

Overall, the 3D Basketball Game is a strong example of how game engines like Unity can be used for learning, sports simulation, and entertainment.
It proves that games can help people understand physical concepts, practice skills, and enjoy a realistic digital environment at the same time.
The project successfully combines fun, learning, and technology, showing the true potential of modern game development.