VIRTUAL REALITY BASED EDUCATIONAL PLATFORM

A PROJCT REPORT

Submitted by

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In partial fulfillment of requirements for the award of the course

AGB1121–DESING THINKING

IN

COMPUTER SCIENCE AND ENGINEERING

(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

K.RAMAKRISHNAN COLLEGE OF ENGINEERING (AUTONOMOUS)
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CHENNAI 600 025

DECEMBER 2024

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PROJECT WORK

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of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Under the Guidance of

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Under

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DECLARATION BY THE CANDIDATES

We declare that to the best of our knowledge the work reported here in has been composed solely by ourselves and that it has not been in whole or in part in any previous application for a degree.

Submitted for the project Viva- Voice held at K. Ramakrishnan College of Engineering on ___________

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

We thank the almighty GOD, without whom it would not have been possible for us to complete our project.

We wish to address our profound gratitude to **Dr.K.RAMAKRISHNAN**, Chairman, K. Ramakrishnan College of Engineering(Autonomous), who encouraged and gave us all help throughout the course.

We extend our hearty gratitude and thanks to our honorable and grateful Executive Director **Dr.S.KUPPUSAMY, B.Sc., MBA., Ph.D.,** K. Ramakrishnan College of Engineering(Autonomous).

We are glad to thank our Principal **Dr.D.SRINIVASAN, M.E., Ph.D., FIE., MIIW., MISTE., MISAE., C.Engg,** for giving us permission to carry out this project.

We wish to convey our sincere thanks to **Dr.B.KIRAN BALA, M.E., M.B.A., Ph.D.,** Head of the Department, Artificial Intelligence and Data Science for giving us constant encouragement and advice throughout the course.

We are grateful to **M.PONNI VALAVAN M.E.**, Artificial Intelligence and Data Science, K. Ramakrishnan College of Engineering (Autonomous), for his guidance and valuable suggestions during the course of study.

Finally, we sincerely acknowledged in no less terms all our staff members, our parents and, friends for their co-operation and help at various stages of this project work.

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INSTITUTE VISION AND MISSION

VISION OF THE INSTITUTE:

To achieve a prominent position among the top technical institutions.

MISSION OF THE INSTIITUTE:

M1: To best standard technical education par excellence through state of the art infrastructure, competent faculty and high ethical standards.

M2: To nurture research and entrepreneurial skills among students in cuttingtechnologies.

M3: To provide education for developing high-quality professionals to transform the society.

DEPARTMENT VISION AND MISSION

DEPARTMENT OF CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Vision of the Department

To become a renowned hub for Artificial Intelligence and Machine Learning technologies to produce highly talented globally recognizable technocrats to meet industrial needs and societal expectations.

Mission of the Department

M1: To impart advanced education in Artificial Intelligence and Machine Learning, built upon a foundation in Computer Science and Engineering.

M2: To foster Experiential learning equips students with engineering skills to tackle real-world problems.

M3: To promote collaborative innovation in Artificial Intelligence, machine learning, and related research and development with industries.

M4: To provide an enjoyable environment for pursuing excellence while upholding strong personal and professional values and ethics.

Programme Educational Objectives (PEOs):

Graduates will be able to:

PEO1: Excel in technical abilities to build intelligent systems in the fields of Artificial Intelligence and Machine Learning in order to find new opportunities**.**

PEO2: Embrace new technology to solve real-world problems, whether alone or as a team, while prioritizing ethics and societal benefits.

PEO3: Accept lifelong learning to expand future opportunities in research and product development.

Programme Specific Outcomes (PSOs):

PSO1: Ability to create and use Artificial Intelligence and Machine Learning algorithms, including supervised and unsupervised learning, reinforcement learning, and deep learning models.

PSO2: Ability to collect, pre-process, and analyze large datasets, including data cleaning, feature engineering, and data visualization..

.

PROGRAM OUTCOMES(POs)

Engineering students will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:**Identify,formulate,review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

3. **Design/development of solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the the professional engineering solutions in societal, environmental contexts, and demonstrate the knowledge of, and need for sustainable development

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ABSTRACT

Virtual reality (VR) based educational platforms are transforming traditional learning experiences by immersing students in interactive, three dimensional environments. These platforms enable learners to explore complex concepts through simulations and virtual labs, making education more engaging and effective. By providing realistic scenarios, VR enhances understanding and retention of information. This technology supports diverse learning styles and encourages active participation. VR education bridges geographical gaps, offering access to quality education globally. It fosters collaboration among students in virtual classrooms, irrespective of their physical location. Additionally VR platforms are customizable, catering to specific curriculum needs and individual learning paces.

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LIST OF ABBREVIATIONS

ABBREVIATIONS

VR	VIRTUAL REALITY
3D	3 DIMENSIONAL
AI	ARTIFICIAL INTELLIGENCE
FPS	FRAMES PER SECOND
UI	USER INTERFACE

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Virtual reality (VR) based educational platforms are revolutionizing the way we learn by providing immersive, interactive experiences. These platforms enable students to explore complex subjects through simulations and virtual environments, enhancing engagement and comprehension.

1.2 PURPOSE AND IMPORTANCE

The purpose of a VR-based educational platform is to provide immersive, hands-on learning experiences that enhance engagement and retention. It bridges the gap between theory and practice through realistic simulations in a safe, virtual environment. Additionally, it increases accessibility and personalizes education for diverse learners, fostering deeper understanding and skill development.

1. **Boosts Retention and Comprehension:** Research indicates that experiential learning improves memory and understanding compared to traditional methods.

2. **Encourages Collaboration and Teamwork:** VR platforms can support multi-user experiences, fostering collaboration among students in shared virtual spaces.

3. **Bridges the Gap Between Theory and Practice:** By enabling practical, real-world simulations, VR connects academic concepts to their applications, making learning more relevant and impactful.

4. **Promotes Inclusivity:** VR can cater to students with disabilities, offering customizable environments that adapt to their needs.

5. **Global Reach and Scalability:** A VR platform can reach students worldwide, democratizing access to quality education and enabling institutions to scale their offerings.

6. **Preparation for Future Careers:** As VR is being adopted in various industries, familiarity with the technology equips students with relevant skills for the future workforce.

1.3 OBJECTIVES:

1. **Immersion in Learning:** Provide authentic, realistic environments to simulate hands-on learning experiences.

2. **Flexibility in Content Delivery:** Allow customization of learning paths and sorting of modules based on topics or user preferences.

3. **Scalability to Accommodate Growth:** Support an increasing number of users and diverse educational content without compromising performance.

4. **Optimization for Smooth Performance:** Ensure fast loading, seamless transitions, and responsive interactions in the virtual environment.

5. **Reliability in Functionality:** Implement robust error-handling mechanisms to manage connectivity or system failures.

1.4 PROJECT SUMMARIZATION

A **Virtual Reality (VR)-Based Educational Platform** is an innovative project aimed at transforming traditional learning by leveraging immersive VR technology. Designed for scalability, flexibility, and accessibility, it supports personalized learning paths, collaborative experiences, and the integration of diverse educational resources.

CHAPTER 2

PROJECT METHODOLOGY

2.1 INTRODUCTION TO SYSTEM ARCHITECTURE

The **system architecture** of a Virtual Reality (VR)-Based Educational Platform outlines the structural framework that integrates various components to deliver immersive and effective learning experiences. It serves as a blueprint that defines how the platform's hardware, software, and network components interact to ensure seamless functionality.

Key Components of System Architecture:

1. User Interface Layer:

This layer facilitates interaction between users and the platform through VR headsets, motion controllers, or gesture tracking. It ensures the interface is intuitive, responsive, and immersive, allowing learners to navigate and engage with the educational content seamlessly.

2. Application Layer:

This layer hosts the core functionality of the platform, including VR simulations, learning modules, quizzes, and assessments. It handles user activities and ensures a cohesive experience, tailoring content to individual learning paths and preferences.

3. Processing Layer:

Responsible for rendering 3D environments and simulations in real time, this layer ensures smooth performance and responsiveness. It optimizes graphical fidelity, physics simulations, and interactive elements to enhance immersion.

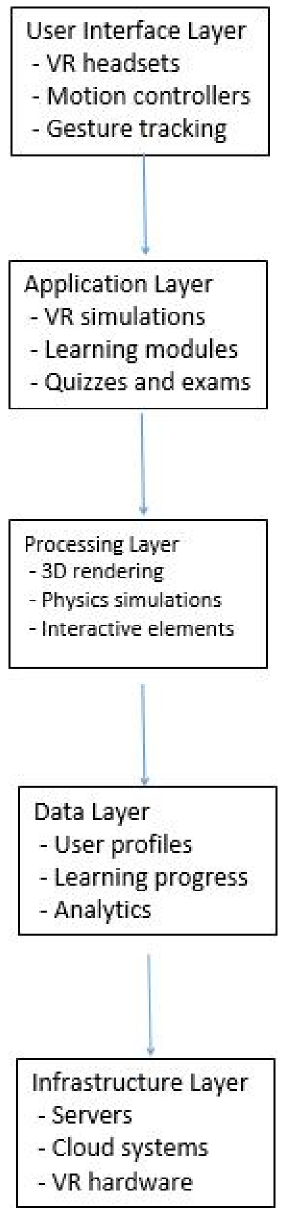
4. Data Layer:

This layer stores and retrieves critical data, such as user profiles, learning progress, and educational content. It supports data analytics to provide insights into user engagement and learning outcomes.

5. Infrastructure Layer:

Comprising the physical and cloud-based infrastructure, this layer supports the platform's scalability and reliability. It includes servers, network connections, and VR-compatible hardware to deliver a seamless user experience

2.2 DETAILED SYSTEM FLOW DIAGRAM



Here’s the flow explained in simple steps:

1. Users Access the Platform:

Students and teachers use VR headsets or devices to log in to the platform.

2. Enter Virtual Classrooms:

They join virtual classrooms or immersive environments designed for learning.

3. Engage with Learning Content:

Interactive content like 3D models, videos, or lectures is displayed for hands-on learning.

4. Backend Support Works:

Cloud servers store and deliver the content, while AI personalizes the experience.

5. Communicate in Real-Time:

Users interact using built-in voice, video, or messaging tools for seamless collaboration.

CHAPTER 3

CORE FEATURES AND MODULES

3.1 . Content Representation in VR

In a VR environment, articles and learning materials can be displayed as interactive, immersive content:

- **3D Visualization**: Complex topics such as anatomy, geography, or physics can be represented with 3D models that the user can explore.

- **Interactive Elements**: Users can interact with the content by clicking on hotspots, dragging objects, or manipulating elements in the virtual environment.

- **Narrative & Voice-over**: For better engagement, content can be accompanied by a voice-over or narrated explanations while exploring the material in VR.

3.2 Usage of VR in Various field

Here's a brief explanation of how VR is used in five key fields:

1. Education and Training

In education, VR creates immersive learning environments that enhance engagement and concept understanding. It allows for virtual classrooms, medical and engineering simulations, and virtual field trips to historical sites, offering students an interactive experience that helps them grasp difficult concepts more easily and safely. This also makes training cost-effective by reducing the need for physical resources and the risks associated with hands-on practice.

2. Healthcare

In healthcare, VR is used for surgical training, where medical professionals can practice procedures without the risk of harming patients. It also serves as a therapy tool for mental health conditions like PTSD and anxiety by exposing patients to controlled virtual environments. Additionally, VR is used in physical rehabilitation, creating interactive exercises that help patients recover mobility and coordination in a fun, engaging way.

3. Real Estate and Architecture

VR is a game-changer in real estate and architecture by offering virtual walk throughs of properties, enabling potential buyers or investors to experience spaces remotely. It also allows architects and designers to visualize their plans in 3D before construction begins,reducing the risk of errors and costly changes. Virtual staging of homes can also help in making properties more appealing to potential buyers, saving time and money.

4. Gaming and Entertainment

The gaming industry is one of the most prominent users of VR, offering fully immersive video games that transport players into virtual worlds. VR also enhances other forms of entertainment, such as virtual concerts, movie experiences, and theme park attractions, creating a deeper level of engagement than traditional media. By providing new, interactive ways to experience content, VR is redefining storytelling and audience interaction.

5. Retail and E-commerce

In retail, VR allows customers to shop in virtual stores where they can interact with products in a 3D environment. Virtual fitting rooms enable shoppers to try on clothes, accessories, and even furniture virtually, improving the shopping experience. VR can also provide 3D visualizations of products before purchase, helping customers make more informed decisions, reducing returns, and enhancing overall sales.

These applications illustrate how VR is not only enhancing current practices but also opening new possibilities for growth, creativity, and innovation across industries.

CHAPTER 4

USER RECOMMENDATIONS

4.1 User-Friendly Interface

The VR platform should have an intuitive interface that simplifies navigation, making it accessible for users with varying levels of technical expertise. Clear menus, minimal setup steps, and guided tutorials can enhance the on boarding process. Providing options for users to customize their VR experience, such as adjusting visual, audio, and interaction settings, ensures that individuals can tailor the platform to meet their personal preferences and comfort levels.

4.2 Device Compatibility

A successful VR platform should support a wide range of VR devices, from premium headsets to more affordable options, ensuring accessibility for diverse user demographics. It should also include compatibility with non-VR devices, like desktops and smartphones, to allow users without VR equipment to engage with basic functionalities. This approach broadens the user base and ensures that more people can benefit from the platform.

4.3 Content Diversity

To maintain user engagement, the platform must offer a variety of content tailored to different interests, industries, and age groups. For example, in educational VR, this might range from history and science simulations to skill-based training for professionals. Regularly updating the content library with fresh experiences, themes, and interactive elements ensures continued relevance and encourages users to return.

4.4 Collaboration and social Features

Integrating collaborative features, such as multi-user sessions, enables group learning, teamwork, and social interaction in virtual environments. This can include voice chat, personalized avatars, and shared spaces where users can interaction real time. Social elements like virtual meetups or co-op games foster a sense of community, which is particularly important in both educational and recreational VR applications.

4.5 Performance and Accessibility

High performance is crucial for an immersive VR experience. The platform should minimize latency and optimize graphics to deliver smooth and responsive interactions, especially in high-fidelity applications like gaming or simulation training. Accessibility features like voice commands, adjustable text sizes, and alternative control schemes ensure inclusivity for users with disabilities, enhancing their experience and usability.

CHAPTER 5

PERFORMANCE CONSIDERATION

5.1 System Responsiveness and Latency:

System responsiveness is a critical factor in delivering a smooth and immersive VR experience. Latency should ideally be below 20 milliseconds to avoid disruptions such as motion sickness and input lag, which can diminish the user experience. High frame rates (90 FPS or higher) are essential to ensure seamless visual transitions and prevent stuttering during interactions.

To achieve this, the platform must employ advanced rendering techniques such as **foveated rendering**, where only the area of focus is rendered at high resolution, reducing the load on the GPU. Additional optimizations include multi-threading, which distributes computational tasks efficiently across processing cores, and lightweight UI frameworks to ensure that interactions feel natural and immediate. Prioritizing these aspects ensures a responsive environment that maintains user engagement.

5.2 Resource Efficiency and Device Compatibility

Resource-intensive VR applications demand significant processing power, which can lead to overheating or frame drops, especially on lower-end devices. The platform must be optimized for efficient use of CPU, GPU, and memory resources while ensuring compatibility with a wide range of VR headsets and devices

This is achieved by employing **adaptive graphics settings**, which dynamically adjust resolution and effects based on the device's capabilities. Efficient memory management and resource scheduling ensure that the system operates smoothly under load, even during demanding VR simulations. Such optimizations not only prevent thermal issues but also expand accessibility by accommodating users with varying hardware specifications.

5.3 Network and Audio Performance

As VR platforms increasingly rely on cloud-based processing and multiplayer experiences, robust network performance becomes paramount. Real-time interactions demand low-latency, high-speed connections to synchronize user actions and environmental changes across participants. Unstable networks can disrupt the immersive experience, causing lag or disconnections that detract from user satisfaction.

To mitigate these issues, the platform can leverage **predictive data caching** and **adaptive streaming technologies**, which pre-load critical information and adjust data quality based on current network conditions. For audio, immersive 3D spatial soundscapes enhance realism and engagement. Using **spatial audio processing** techniques ensures that sound aligns accurately with the virtual environment, while advanced compression methods maintain quality without overloading system resources.

CHAPTER 6

APPLICATION DEVELOPMENT

The **Application Development** process for a Virtual Reality (VR) platform focuses on building immersive and interactive experiences that cater to specific user needs, whether educational, training-based, or entertainment-oriented.

6.1 Overview

Main Application Code

VR Platform Class

Mock Data Generator (JSON)

API Handler

6.2 Project Architecture

The **Project Architecture** outlines the structural design and integration of different components that power the VR application. It serves as the backbone of the application, ensuring seamless communication between hardware, software, and user interfaces.

Step 1: Main Application Code

The main file initializes and runs the VR platform, connecting all components together.

```
// main.js
import { VRPlatform } from "./vrPlatform.js";

function main() {
  console.log("Initializing Virtual Reality Platform...");
  const platform = new VRPlatform();
  platform.start();
}

main();
```

Step 2: VR Platform Class

This class manages the platform's core functionalities, such as content handling and user sessions.

```
// vrPlatform.js
export class VRPlatform {
  constructor() {
    this.users = [];
    this.contentLibrary = [];
  }

  start() {
    this.loadContent();
    console.log("VR Platform started successfully.");
  }

  loadContent() {
    this.contentLibrary.push("Interactive Training Module");
    this.contentLibrary.push("Virtual Tour Simulation");
    console.log("Content loaded:", this.contentLibrary);
  }
}
```

Step 3: Mock Data Generator (JSON)

Handles communication between the client and the backend server.

```
// mockData.js
export const mockUsers = [
  { id: 1, name: "John Doe", email: "john.doe@example.com" },
  { id: 2, name: "Jane Smith", email: "jane.smith@example.com" },
];

export const mockContent = [
  { id: 101, title: "VR Training 101", type: "Education" },
  { id: 102, title: "Virtual City Tour", type: "Entertainment" },
];
```

Step 4: API Handler

Handles communication between the client and the backend server.

```
export class APIHandler {
  constructor(baseURL) {
    this.baseURL = baseURL;
  }

  async fetchContent() {
    try {
      const response = await fetch(`${this.baseURL}/content`);
      return await response.json();
    } catch (error) {
      console.error("Error fetching content:", error);
    }
  }
}
```

CHAPTER 7

CONCLUSION & FUTURE SCOPE

7.1 CONCLUSION

Virtual Reality (VR) has proven to be a transformative technology with the potential to revolutionize various industries, including education, healthcare, gaming, real estate, and more. Through its immersive and interactive nature, VR enables users to experience environments and scenarios in ways that traditional media cannot. The applications of VR in fields such as training, therapy, design, and simulation have demonstrated significant benefits, including enhanced learning outcomes, improved patient care, and more efficient work processes.

As a result, VR technology has gained considerable attention from both academia and industry, establishing itself as a key tool in innovation and development. Despite its current applications, the technology still faces challenges such as hardware limitations, high costs, and the need for specialized expertise. However, ongoing research and development are expected to address these issues and further unlock the potential of VR.

7.2 FUTURE SCOPE

The future of VR technology is vast and full of exciting possibilities. Here are some key areas where VR is expected to make a significant impact:

1. **Integration with Artificial Intelligence (AI):**
   The fusion of VR with AI can create more adaptive, personalized, and intelligent virtual environments. AI-powered VR systems will allow for more accurate simulations, real-time decision-making, and tailored user experiences, particularly in education and healthcare.

2. **Enhanced Hardware and Devices:**

   As VR hardware becomes more affordable and efficient, we can expect to see lighter, more comfortable, and more powerful headsets. Advances in brain-computer interfaces (BCI) and haptic feedback devices will further enhance user immersion and interactivity.

3. **Expanding Applications in Healthcare:**

   VR's future in healthcare holds great promise, from advanced surgical training and rehabilitation techniques to mental health treatments such as VR therapy for PTSD and anxiety. The ongoing development of VR-based therapies is likely to transform patient care and medical practices.

4. **Collaborative Virtual Spaces:**

   As remote work and online collaboration become more prevalent, VR will play a critical role in creating collaborative virtual environments for teams and individuals to work together. Virtual offices and meeting spaces are expected to replace traditional video conferencing tools, offering more immersive and interactive experiences.

5. **VR for Social Interaction and Entertainment:**

   Virtual reality will increasingly be used for socializing, gaming, and entertainment. With the rise of social VR platforms, people will be able to interact in shared virtual spaces, attend virtual concerts, or even explore virtual worlds together, creating new forms of social connection.

6. **Applications in Education and Training:**

   The future of VR in education holds exciting potential, particularly in the form of highly interactive learning environments and remote classrooms. VR simulations can provide hands-on learning experiences that would be impossible or dangerous in real life, such as medical procedures or engineering experiments.

7. **Sustainability and Environmental Impact:**
   VR's role in environmental sustainability will continue to grow, with the ability to simulate natural environments for educational purposes and reduce the carbon footprint by replacing physical travel (e.g., virtual tourism). It can also play a crucial role in environmental research and wildlife conservation by providing virtual tours of ecosystems.

8. **Ethical and Social Implications:**
   As VR becomes more pervasive, questions around its ethical use, data privacy, and its impact on society will need to be addressed. The potential for addiction, desensitization, and privacy concerns will require regulation and thoughtful implementation of VR technology

APPENDICES

APPENDIX A SOURCECODE

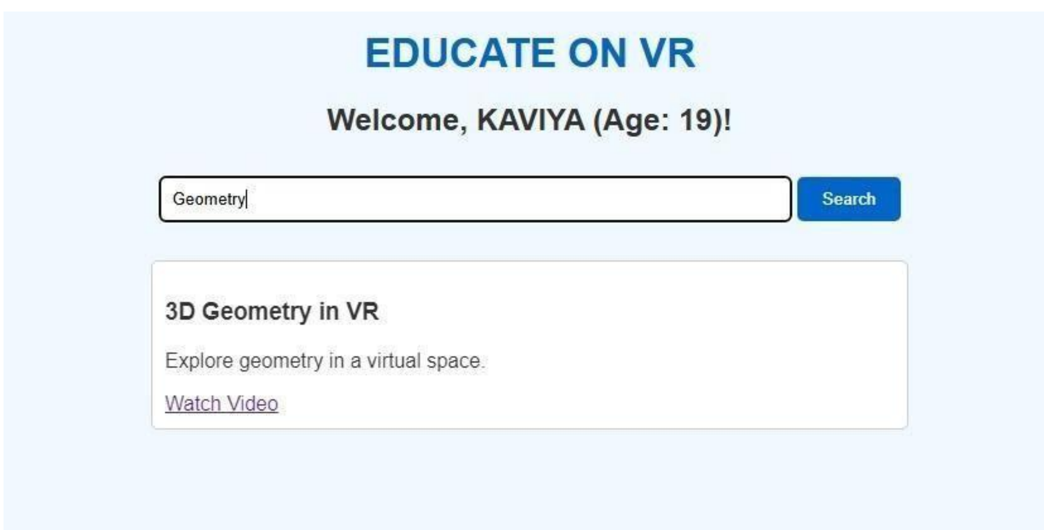
```
using UnityEngine;

public class VREnvironmentSetup : MonoBehaviour
{
   void Start()
   {
      // Set up VR environment
      InitializeEnvironment();
   }

   void InitializeEnvironment()
   {
      // Code to initialize the VR scene
      RenderSettings.skybox = Resources.Load<Material>("SkyboxMaterial");
      // Add more initialization code here
   }
}

using UnityEngine;
using UnityEngine.XR.Interaction.Toolkit;

public class VRInteraction : MonoBehaviour
{
   private XRController controller;
   private XRRayInteractor rayInteractor;

   void Start()
   {
      // Initialize VR controller and ray interactor
      controller = GetComponent<XRController>();
      rayInteractor = GetComponent<XRRayInteractor>();
   }

   void Update()
   {
```

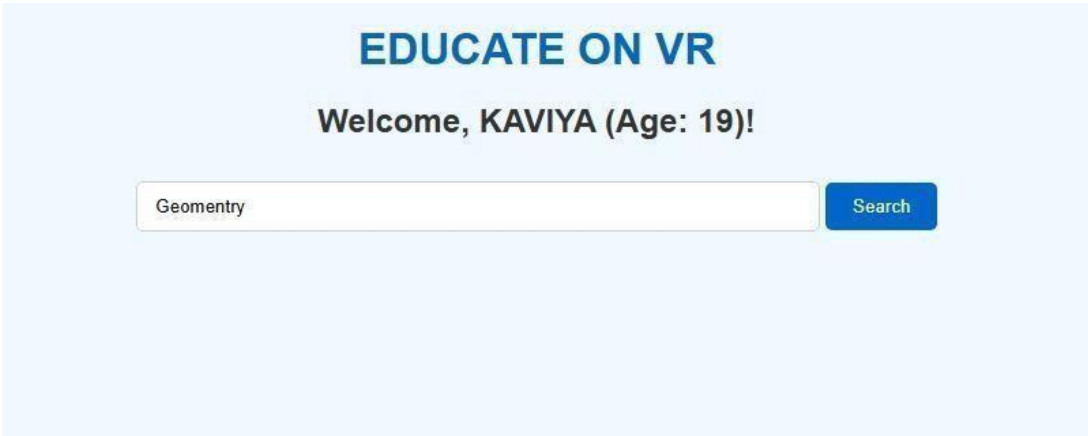
```
        // Handle user input and interactions
        if (controller.inputDevice.TryGetFeatureValue(CommonUsages.triggerButton, out bool
isPressed) && isPressed)
        {
            InteractWithObject();
        }
    }

    void InteractWithObject()
    {
        // Code for interacting with objects in the VR environment
        if (rayInteractor.TryGetCurrent3DRaycastHit(out RaycastHit hit))
        {
            // Example interaction: Change the color of the object
            Renderer renderer = hit.transform.GetComponent<Renderer>();
            if (renderer != null)
            {
                renderer.material.color = Color.red;
            }
        }
    }
}
using UnityEngine;

public class VREducationalContent : MonoBehaviour
{
    public GameObject[] contentObjects;
    private int currentIndex = 0;

    void Start()
    {
        // Initialize educational content
        ShowContent(currentIndex);
    }

    public void ShowNextContent()
    {
        currentIndex = (currentIndex + 1) % contentObjects.Length;
        ShowContent(currentIndex);
    }

    void ShowContent(int index)
    {
        for (int i = 0; i < contentObjects.Length; i++)
        {
            contentObjects[i].SetActive(i == index);
        }
    }
```

```
}
using UnityEngine;

public class VRUserInterface : MonoBehaviour
{
    public Canvas vrCanvas;

    void Start()
    {
        // Initialize VR user interface
        vrCanvas.worldCamera = Camera.main;
    }

    public void OnButtonClick()
    {
        // Handle button click in VR interface
        Debug.Log("Button clicked!");
    }
}
```

APPENDIX B SCREENSHOT

RESULT




EDUCATE ON VR
Welcome, KAVIYA (Age: 19)!
Geomentry
Search

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