DAYANANDA SAGAR UNIVERSITY

Devarakaggalahalli, Harohalli
Kanakapura Road, Ramanagara - 562112, Karnataka, India

SCHOOL OF ENGINEERING

Bachelor of Technology
in
COMPUTER SCIENCE AND ENGINEERING

Major Project Phase-II Report

INTRAVENOUS DRUG ADMINISTRATION CLINICAL PHARMACOLOGY TECHNIQUES USING AR & VR

Batch:64

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING
DAYANANDA SAGAR UNIVERSITY

(2024-2025)

DAYANANDA SAGAR UNIVERSITY

School of Engineering
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Karnataka, India

CERTIFICATE

This is to certify that the Major Project Phase-II work titled **"INTRAVENOUS DRUG ADMINISTRATION CLINICAL PHARMACOLOGY TECHNIQUES USING AUGMENTED REALITY & VIRTUAL REALITY"** is carried out by **Lata (ENG21CS0200), Kalyan Ram (ENG21CS0177), M.Sreenivasula Reddy (ENG21CS0224), N M Tharun Sagar (ENG21CS0253),** bonafide students of Bachelor of Technology in Computer Science and Engineering at the School of Engineering, Dayananda Sagar University, Bangalore in partial fulfillment for the award of degree in Bachelor of Technology in Computer Science and Engineering, during the year **2024-2025**.

Dr. J.S. Nixon	**Dr. Girisha G S**	**Dr. Udaya Kumar Reddy K R**
Professor Dept. of CS&E, School of Engineering Dayananda Sagar University	Chairman CSE School of Engineering Dayananda Sagar University	Dean School of Engineering Dayananda Sagar University
Date:	Date	Date:

Name of the Examiner	**Signature of Examiner**
1.	
2.	

DECLARATION

We , **Lata (ENG21CS0200) , Kalyan Ram (ENG21CS0177) , M. Sreenivasula Reddy (ENG21CS0224) , N M Tharun Sagar (ENG21CS0253),** are students of eighth semester B.Tech in **Computer Science and Engineering**, at School of Engineering, **Dayananda Sagar University**, hereby declare that the Major Project Phase-II titled **"Intravenous drug administration Clinical pharmacology techniques using Augmented Reality and Virtual Reality"** has been carried out by us and submitted in partial fulfilment for the award of degree in **Bachelor of Technology in Computer Science and Engineering** during the academic year **2024-2025.**

Student	**Signature**
Name1:	
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Place : Bangalore

Date :

ACKNOWLEDGEMENT

It is a great pleasure for us to acknowledge the assistance and support of many individuals who have been responsible for the successful completion of this project work.
First, we take this opportunity to express our sincere gratitude to School of Engineering & Technology, Dayananda Sagar University for providing us with a great opportunity to pursue our Bachelor’s degree in this institution.
We would like to thank **Dr. Udaya Kumar Reddy K R, Dean, School of Engineering & Technology, Dayananda Sagar University** for his constant encouragement and expert advice.
It is a matter of immense pleasure to express our sincere thanks to **Dr. Girisha G S, Department Chairman**, **Computer Science and Engineering**, **Dayananda Sagar University,** for providing right academic guidance that made our task possible.

We would like to thank our guides **Dr. J. S. Nixon , Professor**, **Dept. of Computer Science and Engineering**, **Dayananda Sagar University and Dr. Shiva Murthy , Professor , CDSIMER** for sparing their valuable time to extend help in every step of our project work, which paved the way for smooth progress and fruitful culmination of the project.

We would like to thank our **Project Coordinators: Dr. Meenakshi Malhotra , Dr. Kumar Dilip and Dr. Sivananda Reddy E** , and all the staff members of Computer Science and Engineering for their support.
We are also grateful to our family and friends who provided us with every requirement throughout the course.
We would like to thank one and all who directly or indirectly helped us in the Project work.

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LIST OF ABBREVIATIONS

AR	Augmented Reality
VR	Virtual Reality
IN	Intravenous
GPU	Graphics Processing Unit
CPU	Central Processing Unit
SDK	Software Development Kit
HMD	Head Mounted Display
RAM	Random Access Memory

LIST OF FIGURES

ABSTRACT

Augmented Reality (AR) and Virtual Reality (VR) are emerging technologies that have revolutionized clinical pharmacology, particularly in training and improving the precision of intravenous (IV) drug administration. AR and VR provide immersive, interactive environments for medical students and professionals to practice IV drug administration in a risk-free, controlled setting. AR technologies allow real-time visualization of veins and anatomical structures, improving accuracy in needle insertion and drug delivery. VR can simulate complex clinical scenarios like emergencies or difficult patient cases (e.g., collapsed veins), helping professionals develop decision-making skills under pressure. Using AR/VR in pharmacology reduces the need for physical materials and live patients, saving time and costs associated with traditional training methods.

Keywords :- AR , VR , IV , Drug , pharmacology .

CHAPTER 1

INTRODUCTION

Advancements in technology have transformed traditional education, leading to the integration of innovative teaching methodologies. The younger generation, particularly millennials and Gen Z, are accustomed to digital platforms and prefer interactive learning experiences [1,2]. Educational institutions must recognize this shift and incorporate digital tools to align with students' evolving learning styles [3].

Virtual Reality (VR) is an immersive technology that simulates real-world environments, enabling interactive experiences. By wearing a VR headset, users can engage with three-dimensional simulations that enhance practical learning [4]. VR is increasingly utilized in healthcare education to improve skill development and reduce medical errors [5].

Intravenous (IV) drug administration is a critical procedure in clinical settings, delivering medication directly into the bloodstream for immediate effects. However, IV administration requires precision in dosing, technique, and patient monitoring, as errors can lead to severe complications [6]. To enhance safety and accuracy, clinical pharmacology is now exploring VR and Augmented Reality (AR) for IV training [7].

These advanced tools simulate complex medical scenarios, provide real-time vein visualization, and create immersive learning environments for trainees [8]. VR can offer interactive guidance, allowing students to practice IV injections repeatedly in a risk-free setting, thereby improving competency [9].

Despite its success in medical training, VR remains underutilized in IV drug administration education [10]. Nursing and medical students often struggle with IV techniques due to limited hands-on practice, leading to lower confidence levels and increased procedural errors [11]. By integrating VR into IV training, students can refine their skills, improve decision-making, and reduce patient risk. This study explores the potential of a Virtual Reality Intravenous Injection Simulator (VRIIS) to enhance IV administration training and improve overall healthcare education [12].

1.1. SCOPE

Design and deploy immersive VR modules that simulate different IV drug administration scenarios. These will include common challenges, such as administering drugs to patients with difficult veins, handling emergencies, or managing complex drug interactions. Develop AR applications that assist clinicians during actual IV drug procedures. For instance, AR glasses or devices could overlay a patient's vein structure, providing real-time guidance for successful needle insertion. Integrate patient monitoring data into AR systems, allowing clinicians to see critical patient information (e.g., heart rate, blood pressure) in real time during the procedure. Leverage VR simulations to experiment with different drug dosages and combinations, helping clinicians understand how drug interactions affect specific patients and ensuring personalized medicine approaches.The VR training environment will include built-in feedback mechanisms to assess the performance of users, providing suggestions and corrective actions to improve skills and knowledge retention.

By the end of this project, it is expected that healthcare institutions will have access to advanced AR/VR tools for training and real-time support in intravenous drug administration, leading to improved medical outcomes, cost savings, and a more standardized approach to clinical pharmacology. This will contribute to safer, more efficient IV drug administration and overall advancements in patient care.

Social Impact

Improved Training and Skill Development: AR and VR technologies democratize access to advanced training, enabling medical professionals to enhance their skills regardless of Geographical location. This contributes to reducing disparities in healthcare quality across different regions.

Environmental Impact

Reduction in Training Resources: Traditional medical training requires physical resources such as disposable syringes, drug simulants, and cadavers, which contribute to waste. AR and VR reduce the need for physical training materials, lowering medical waste.

1.2. OBJECTIVE

Immersive Training and Skill Development :

Utilize VR to simulate realistic IV drug administration scenarios for healthcare professionals, enhancing their hands-on skills and confidence without risk to patients.

Real-Time Guidance and Error Reduction :

Implement AR to provide real-time, context-sensitive information during procedures, helping healthcare providers improve accuracy and minimize the risk of errors in drug administration.

Visualization of Drug Effects and Pharmacokinetics :

Use VR/AR to visually demonstrate the pharmacokinetics and pharmacodynamics of IV drugs, helping healthcare providers better understand drug interactions, metabolism, and patient response.

CHAPTER 2

PROBLEM DEFINITION

Problem: Current intravenous (IV) drug administration training in clinical pharmacology relies on physical mannequins and consumables like syringes and gloves, which generate significant waste and increase training costs. This method also lacks technological sophistication to provide immersive, real -world scenarios for students.Solution: Develop an AI-powered AR/VR system that offers a reusable, waste-free training environment for IV drug administration, allowing students to gain proficiency in realistic clinical scenarios without the need for physical consumables.

Despite the widespread use of IV drug administration, several challenges persist in ensuring its effectiveness and safe:Inadequate Training: Traditional training methods may not fully prepare healthcare professionals for the range of scenarios they encounter, leading to skill gaps in IV administration.Lack of Real-Time Support: Clinicians may lack immediate guidance during complex IV procedures,especially in emergency situations where swift decision-making is critical.Limited Feedback Mechanisms: Current training lacks interactive feedback that could help professionals correct mistakes or optimize techniques.Drug Interaction and Dosage Customization: Determining the right dosage based on patient-specific factors and avoiding harmful drug interactions requires advanced analytical tools that current methods often do not provide.

CHAPTER 3

LITERATURE SURVEY

VR provides an immersive computer-generated learning experience that enables nursing students to engage with diverse clinical scenarios and patient interactions. This technology allows them to practice skills and develop technical abilities within a safe environment [13]. The simulation immerses students in a 3D environment enhanced with visual and sensory feedback. Furthermore, instructors can guide training within a controlled environment and utilize VR to assess students' progress and competency development [14].

Bayram et al. examined a game-based VR phone application for tracheostomy care education and found that it significantly improved students' skill retention and confidence [9].

Bracq et al. highlighted the acceptability of VR for learning procedural skills, emphasizing its ability to enhance hands-on learning experiences [10].

Fealy et al. conducted a scoping review on VR integration in nursing education and found that immersive learning environments contributed to better procedural accuracy [8].

Choi explored VR-based wound dressing simulations and reported improved student engagement and technical proficiency [15].

Wood et al. investigated VR simulation methods in patient resuscitation training, concluding that VR reduced student stress and increased confidence [16].

Yu et al. developed a VR program for neonatal infection control education, demonstrating its potential for high-risk clinical training scenarios [17].

O’Connor et al. noted that while VR enhances learning outcomes, integration into curricula requires institutional support and technological infrastructure [18].

Chang et al. explored nursing students' experiences with immersive VR and identified usability and accessibility issues as potential barriers to implementation [19].

CHAPTER 4

PROJECT DESCRIPTION

Augmented Reality (AR) and Virtual Reality (VR) are emerging technologies that have revolutionized clinical pharmacology, particularly in training and improving the precision of intravenous (IV) drug administration.AR and VR provide immersive, interactive environments for medical students and professionals to practice IV drug administration in a risk-free, controlled setting. AR technologies allow real-time visualization of veins and anatomical structures, improving accuracy in needle insertion and drug delivery.VR can simulate complex clinical scenarios like emergencies or difficult patient cases (e.g., collapsed veins), helping professionals develop decision-making skills under pressure.Using AR/VR in pharmacology reduces the need for physical materials and live patients, saving time and costs associated with traditional training methods.

Develop an AR/VR system that offers a reusable, waste-free training environment for IV drug administration, allowing students to gain proficiency in realistic clinical scenarios without the need for physical consumables.

By the end of this project, it is expected that healthcare institutions will have access to advanced AR/VR tools for training and real-time support in intravenous drug administration, leading to improved medical outcomes, cost savings, and a more standardized approach to clinical pharmacology. This will contribute to safer, more efficient IV drug administration and overall advancements in patient care.

4.1. PROPOSED DESIGN

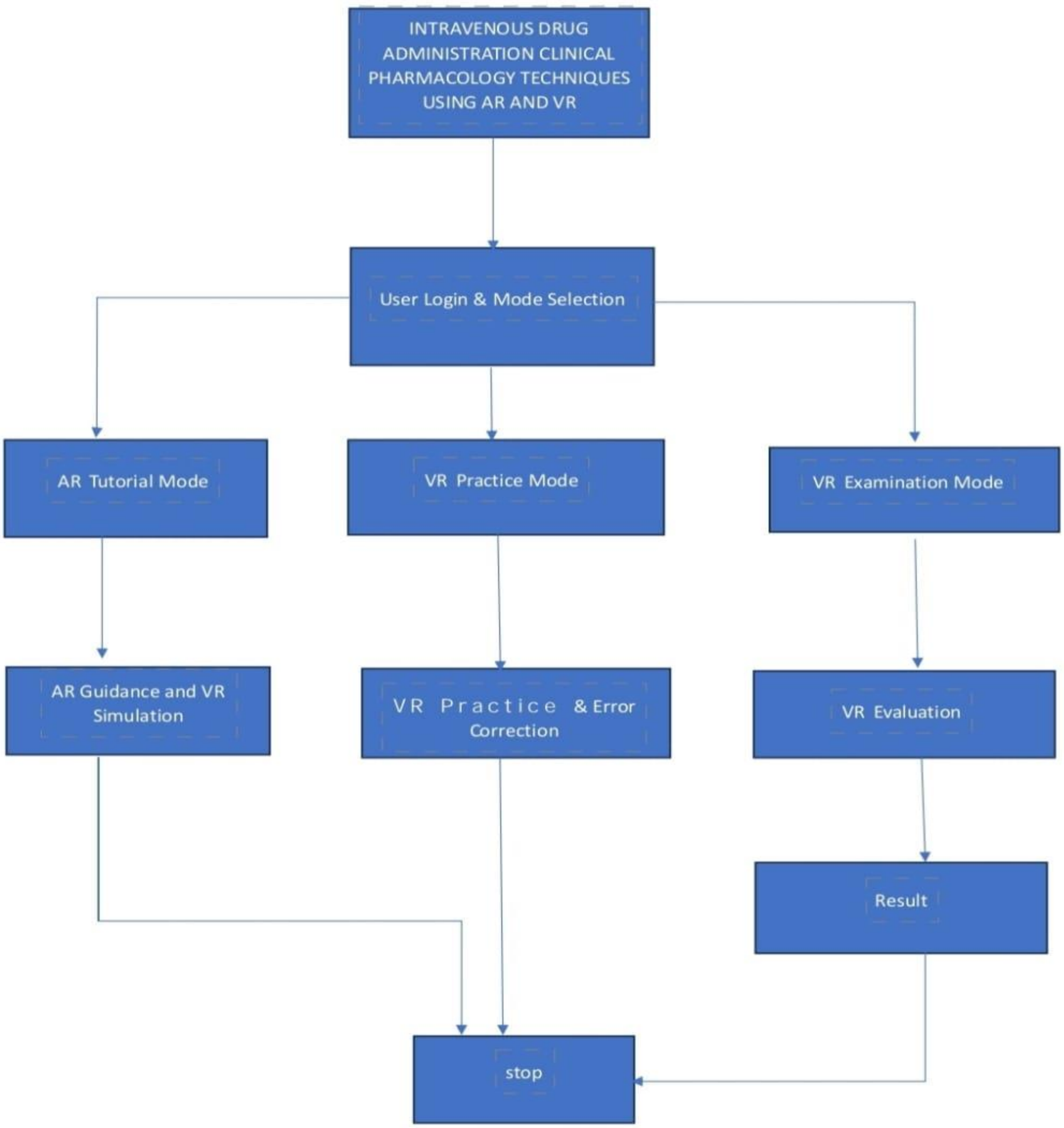

Fig. 4.1 Proposed Design

4.2. SYSTEM DESIGN

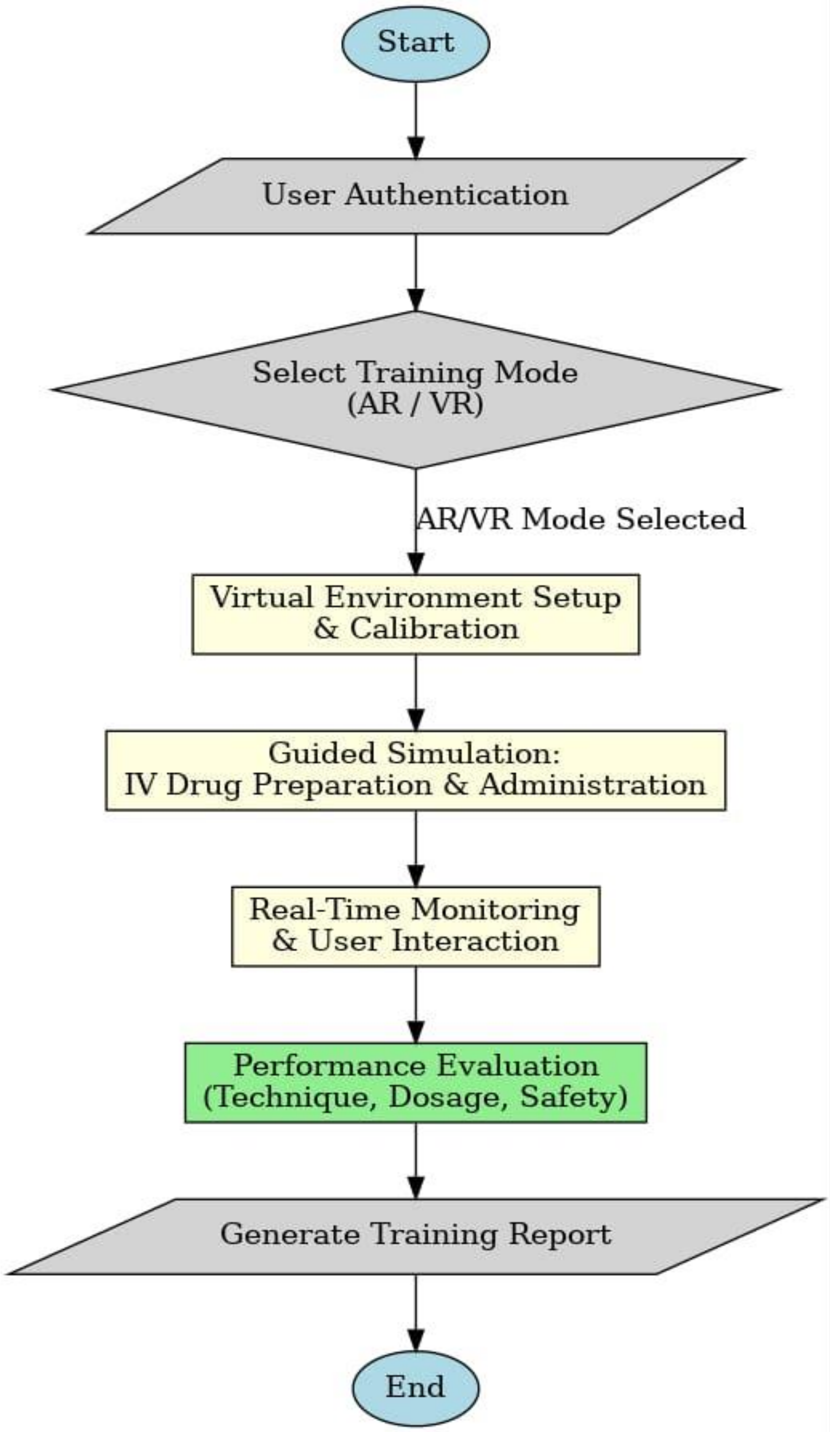

Fig. 4.2 System Design

The system is designed to enhance the training and execution of intravenous (IV) drug administration by integrating augmented reality (AR) and virtual reality (VR) technologies. The core components of the system include:

AR-Based Guidance System

- Displays real-time overlays to guide vein identification and catheter placement.
- Uses depth-sensing cameras and AR markers for precise visualization.
- Provides step-by-step procedural instructions.

VR Training Module

- Simulates different IV drug administration scenarios.
- Includes interactive 3D models of human anatomy.
- Offers multi-sensory feedback for enhanced learning.

Haptic Feedback Mechanism

- Simulates needle insertion resistance and vein palpation.
- Enhances the realism of the procedure.

User Performance Tracking System

- Logs user actions and mistakes for feedback.
- Uses AI-driven analysis to improve skill development.

Cloud-Based Data Storage and Analysis

- Stores training progress and performance metrics.
- Enables remote monitoring and assessment.

4.3. ASSUMPTIONS

- Medical professionals and students will use the system for training and skill enhancement.
- The AR and VR environments accurately replicate real-world IV drug administration scenarios.
- Users have access to compatible AR/VR hardware for optimal experience.

- The system will function in a controlled environment with stable connectivity for cloud-based features.
- The haptic feedback and motion tracking will accurately mimic real-world IV administration.

4.4. DEPENDENCIES

Hardware Dependencies

- VR headsets (e.g., Oculus, HTC Vive) for immersive training.
- AR glasses or tablets for real-time procedural guidance.
- Haptic feedback devices for tactile simulation.
- Motion-tracking sensors for hand and instrument movement analysis.

Software Dependencies

- 3D modeling and simulation software for realistic anatomy rendering.
- AR SDKs (e.g., ARKit, ARCore) for overlay functionalities.
- Machine learning algorithms for performance analysis.
- Cloud storage platforms for data logging and remote access.

User and Environmental Dependencies

- Medical institutions adopting the system for training.
- Stable internet connection for cloud-based features.
- Regulatory compliance for medical training software.

By integrating these elements, the system ensures an **interactive, accurate, and efficient** training experience for IV drug administration in clinical pharmacology.

CHAPTER 5

REQUIREMENTS

5.1. FUNCTIONAL REQUIREMENTS:

- User Authentication: Users can log in with unique credentials and have different access based on their roles (students or instructors).

- Mode Selection: Users can choose between Tutorial, Practice, and Examination modes.

- AR/VR Environment Setup: The system creates a virtual clinical setting for training.

- Tutorial Mode: Provides step-by-step guidance with visual cues for intravenous procedures.

- Practice Mode: Monitors user actions and gives real-time feedback and error correction.

- Examination Mode: Evaluates user performance and generates assessment reports.

- Data Storage: Safely stores user profiles, training progress, and performance metrics.

- User Interface: Easy-to-use interface with visual and audio instructions.

- System Integration:Works with existing educational systems and provides APIs for additional tools.

- Performance and Scalability: Supports multiple users at once and ensures smooth operation.

- Security: Protects user data and restricts access to authorized users only.

5.2. NON-FUCTIONAL REQUIREMENTS:

- Performance: The system should run smoothly without lag and respond quickly.
- Usability: It should be easy to use, even for beginners, with minimal instructions.
- Reliability: The system must be dependable and recover easily from errors or crashes.
- Scalability: It should support many users and be easily expandable with new features.
- Security: All user data should be safe and protected from unauthorized access.
- Maintainability: It should be easy to update, fix bugs, and add new features over time.
- Accessibility: The system should be usable by people with disabilities.
- Localization: It should support multiple languages for different regions.
- Testing: It should be tested thoroughly to ensure it works well under different conditions.

5.3. HARDWARE AND SOFTWARE REQUIREMENTS:

- OS : Windows 10 64 - Bit

- Unity / Unreal Engine: Powerful AR/VR solution helps to build engaging AR/VR Apps, games, or experiences and deploy them across mobile and wearable devices.

- Vuforia SDK: Vuforia is one of the most popular SDKs used for AR app development. The AR SDK is embodied with the computer vision capability which allows it to easily track images or 3D objects in real-time. Using Vuforia, we can build an AR mobile app capable of placing artificial objects right in front of the users, which is a sort of overlapping the real-world objects with virtual ones.

- Computing device: It is a strong, powerful machine that processes and creates the 3dimensional world. All other input devices pass their data onto it, it tracks the user movement and renders all the graphics. Computing devices should have a large amount of RAM, a good GPU, a powerful CPU, and a sufficient storage device.

- HMDs: It is a head-mounted display that consists of two screens that display the virtual world in front of the users. They have motion sensors that detect the orientation and position of your head and adjust the picture accordingly. It also usually has built-in headphones or external audio connectors to output sound. Moreover, they have a blackout blindfold to ensure the users are fully disconnected from the outside world.

- Sensors: Sensors are mostly incorporated into the headset of VR. They track users' poses and their head position, detect movement and rotation, and then pass all this data to the VR processor/computing device. Because of these sensors, the user can interact with the virtual environment. VR depends upon several sensors, including accelerometers, gyroscopes, magnetometers, and 6DoF.

- Input devices: Input devices are used by users in the VR system to interact with the virtual world in front of them. These devices might be a tool or a weapon in their artificial world. The input devices include mice, controllers, joysticks, gloves with sensors, and body tracking systems.

- Audio system: Audio systems have a particularly important job in VR, ensuring a great VR experience in which users' brain is forced to think like they are in that artificial world. They are mostly integrated inside the HMD. VR provides spatial audio, so the users feel how real the virtual world is.

- Software: Software is a crucial part of AR - VR systems. The software is an application designed that runs on VR hardware and creates an artificial world. There are several different types of software based on what users need. For example, games, simulations, medical ecosystems, etc.

- VR Headset: Meta Quest 3 / HTC Vive Pro / Valve Index / Oculus Rift S with high-resolution display (minimum 90Hz refresh rate) , 6DoF (Six Degrees of Freedom) tracking for immersive interaction compatible controllers for hand tracking.

CHAPTER 6

METHODOLOGY

Intravenous (IV) drug administration is a critical procedure in clinical pharmacology that requires precision, skill, and extensive hands-on training. Traditional training methods rely heavily on textbooks, video demonstrations, and physical mannequins, which may not provide a fully immersive or interactive experience. To enhance the learning process and minimize real-world errors, this project aims to develop an Augmented Reality (AR) and Virtual Reality (VR)-based simulation system for IV drug administration training.

The methodology adopted for this project follows a structured and phased approach, beginning with 3D modeling and AR integration, followed by the full implementation of a VR-based training environment. This approach ensures a progressive development cycle, where each phase builds upon the previous one, incorporating user feedback and technological advancements.

The current phase of the project focuses on AR model creation, allowing trainees to interact with digital overlays of human anatomy and medical instruments in real-world scenarios. The next phase involves building an immersive VR experience, where users can practice IV drug administration in a fully virtual clinical environment with realistic physics, AI-driven guidance, and haptic feedback for enhanced training.

This methodology ensures that learners receive hands-on experience in a risk-free setting, improving competency, precision, and confidence before handling real patients. The project is designed to bridge the gap between theoretical knowledge and practical application, using AR/VR technologies to revolutionize clinical pharmacology training.

This project focuses on developing an Augmented Reality (AR) and Virtual Reality (VR)-based training system for intravenous (IV) drug administration. The methodology follows a structured approach, beginning with 3D modeling and AR implementation, and progressing toward VR system development.

AR Model Development

At this stage, we have successfully created 3D models required for the AR-based simulation. These models include:

- Human anatomical structures relevant to IV drug administration.
- Medical instruments such as syringes, IV bags, and catheter insertion kits.
- Augmented Reality (AR) integration, enabling interactive learning on real-world mannequins or digital overlays.

Tools Used:

- Blender for 3D modeling.
- Unity for AR implementation.

The AR system allows trainees to visualize and interact with the virtual IV administration process, improving their understanding before performing procedures on real patients.

CHAPTER 7

EXPERIMENTATION

The experimental phase involved creating a simulated clinical environment where intravenous (IV) drug administration was performed using augmented reality (AR) and virtual reality (VR) technologies. Medical professionals and students participated in the simulations to assess the effectiveness of AR-guided IV insertions and VR-based procedural training. The experiments includes:

- Virtual Practice Scenarios: Users engaged in hands-on VR simulations of IV drug administration.
- AR-assisted IV Placement: Real-time AR overlays guided users during vein identification and catheter insertion.
- Haptic Response Analysis: Tactile feedback was incorporated to mimic real-world sensations.
- Skill Assessment: Performance was evaluated based on accuracy, efficiency, and adherence to clinical protocols.

7.1. SOFTWARE DEVELOPMENT

The software was developed to integrate VR-based training modules with AR-assisted procedural guidance. The key aspects of development includes:

- 3D Modeling and Simulation: Realistic anatomical models were created for VR training.
- AR Overlay System: Visual markers and dynamic instructions were integrated for real-time procedural guidance.
- User Interface and Interaction: Intuitive navigation and gesture-based controls were designed for seamless user experience.
- Data Logging and Analysis: Performance metrics were recorded to provide feedback on user proficiency and error reduction.

7.2. HARDWARE IMPLEMENTATION

The system required specialized hardware components to support immersive AR and VR experiences. The hardware setup includes:

- VR Headsets: Used for an immersive learning environment, allowing users to practice IV administration techniques.
- AR Glasses/Tablets: Enabled real-time guidance with overlaid instructions and anatomical visuals.
- Haptic Feedback Devices: Provided realistic touch sensations during IV insertion.
- Motion Tracking Sensors: Captured user movements to assess precision and technique.

This combination of software and hardware created an integrated platform for enhanced clinical training, ensuring a more effective and interactive learning experience in intravenous drug administration.

CHAPTER 8

TESTING AND RESULTS

The testing and result phases includes:

VR-based Simulation: Users practiced IV administration techniques in a virtual environment with interactive 3D models.

AR-assisted Guidance: AR overlays provided real-time guidance for inserting IV lines and drug administration.

Immersive Experience: The VR-based practice environment improved confidence and decision-making in critical situations.

Human-Computer Interaction: The integration of AR/VR ensured seamless interaction, allowing users to perform tasks with minimal distractions.

Simulation Accuracy: The virtual anatomical structures closely resembled real-world scenarios, making training more effective.

Result 3D model (AR):

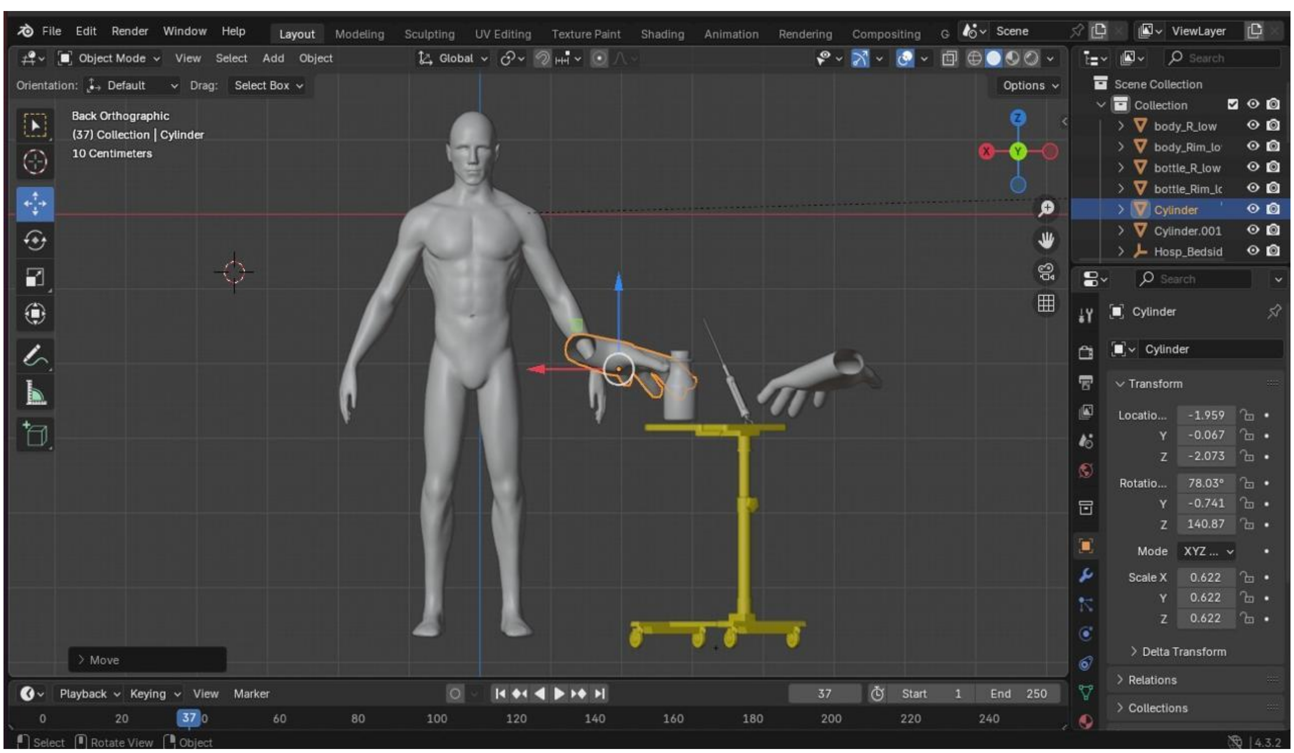

Fig. 8.1 Screenshot of 3D Model

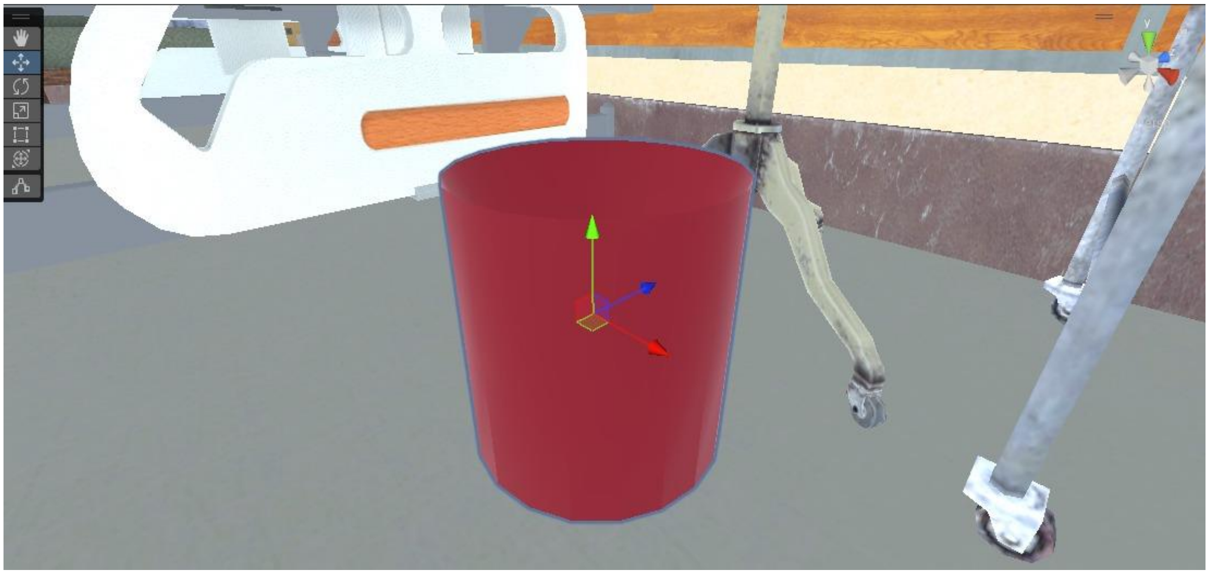

Fig. 8.2 Screenshot of Result

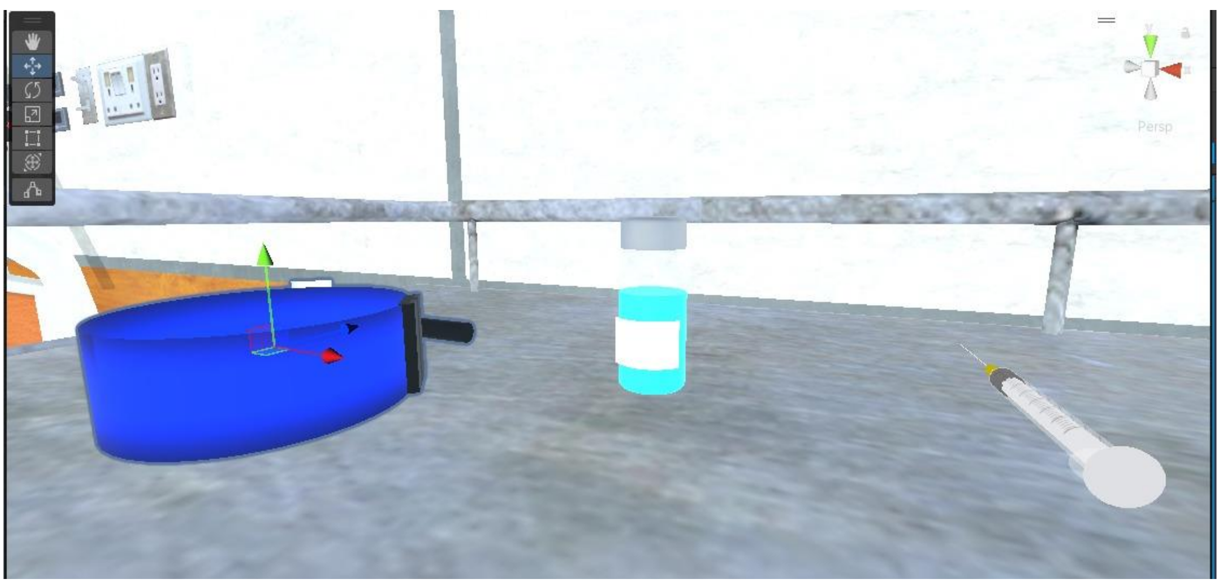

Fig. 8.3 Screenshot of Result

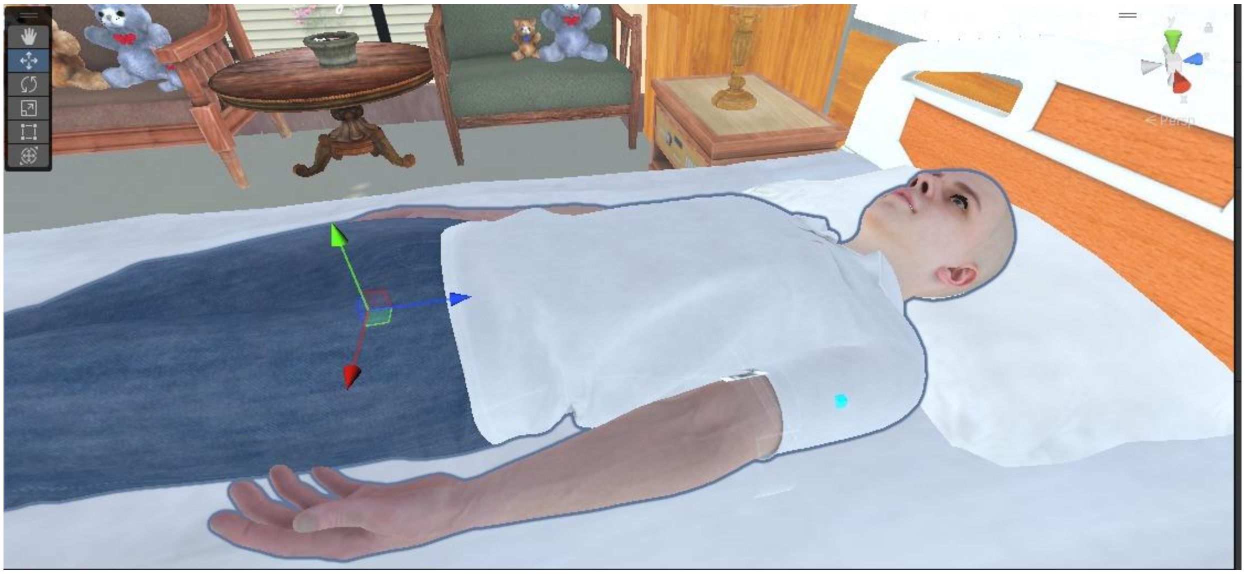

Fig. 8.4 Screenshot of Result

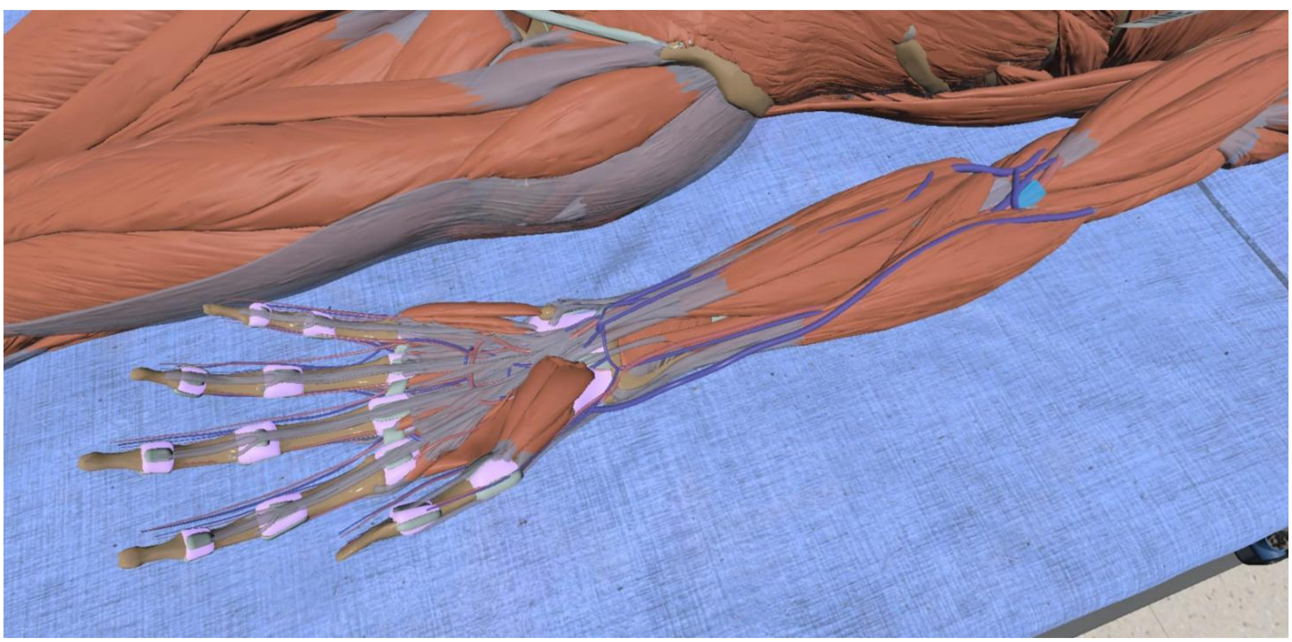

Fig. 8.5 Screenshot of Result

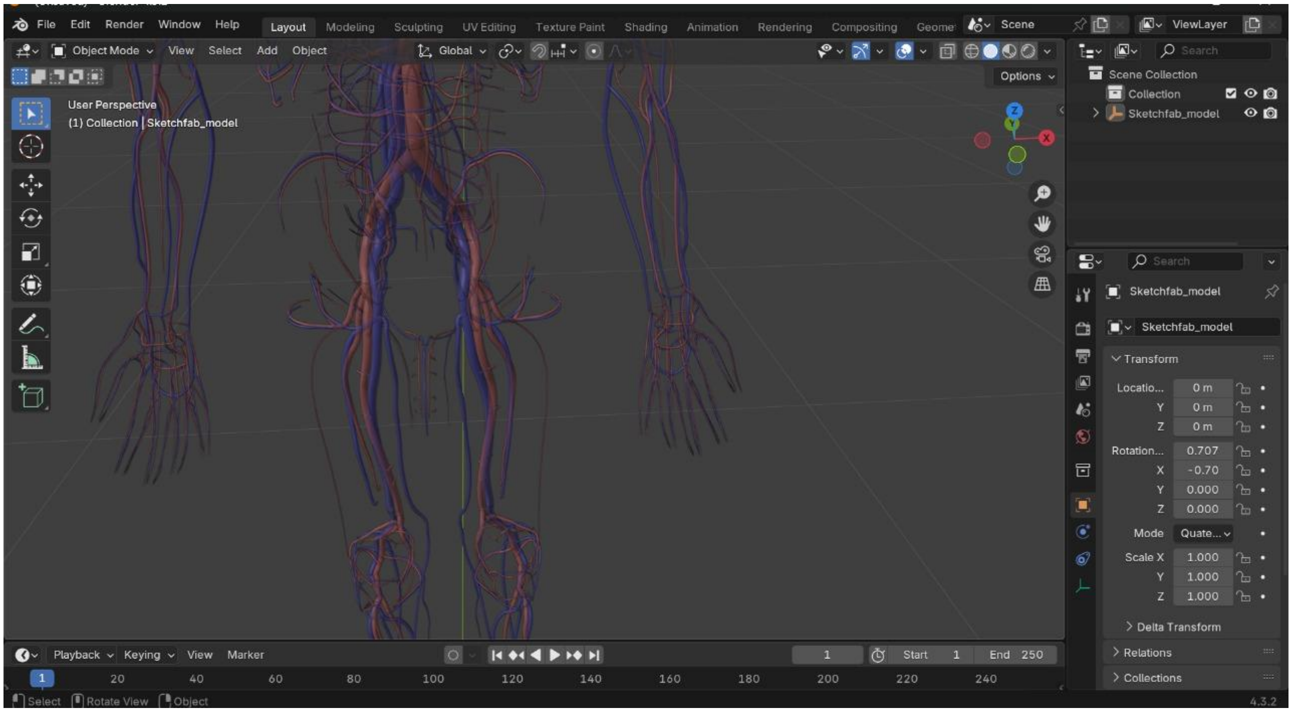

Fig. 8.6 Screenshot of Result

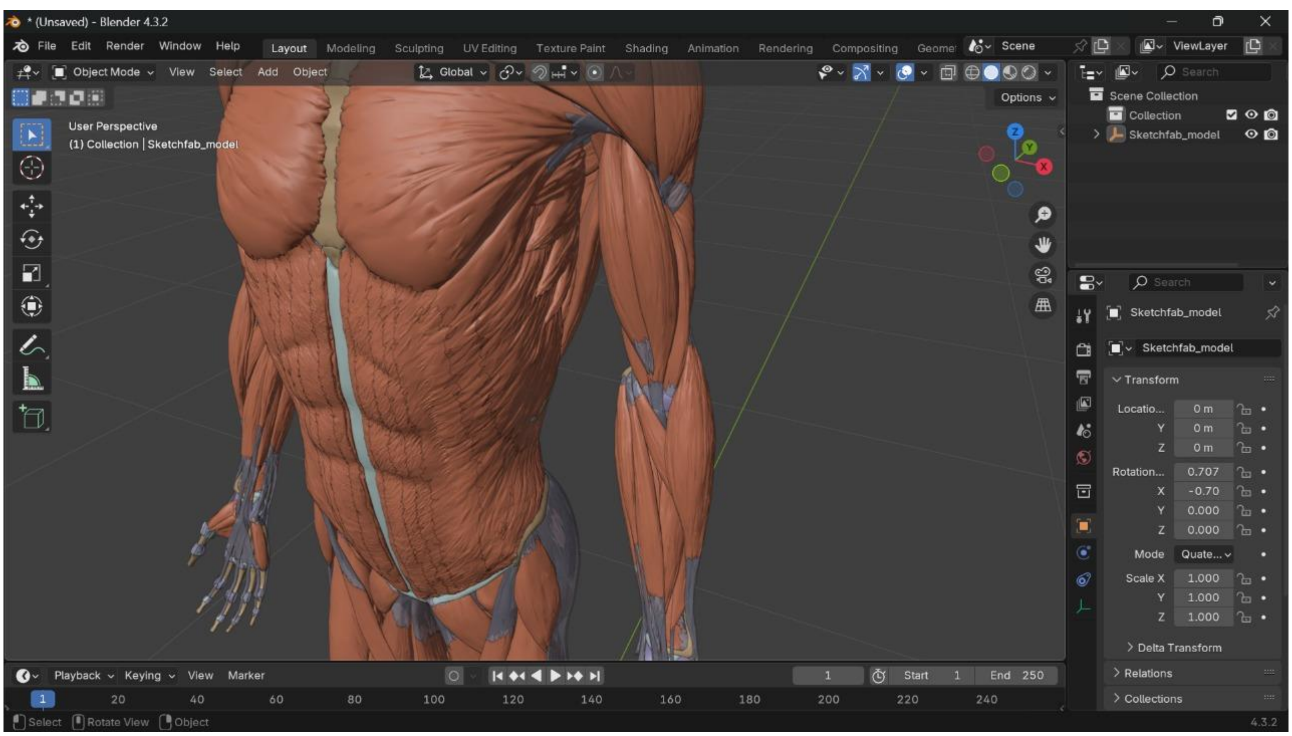

Fig. 8.7 Screenshot of Result

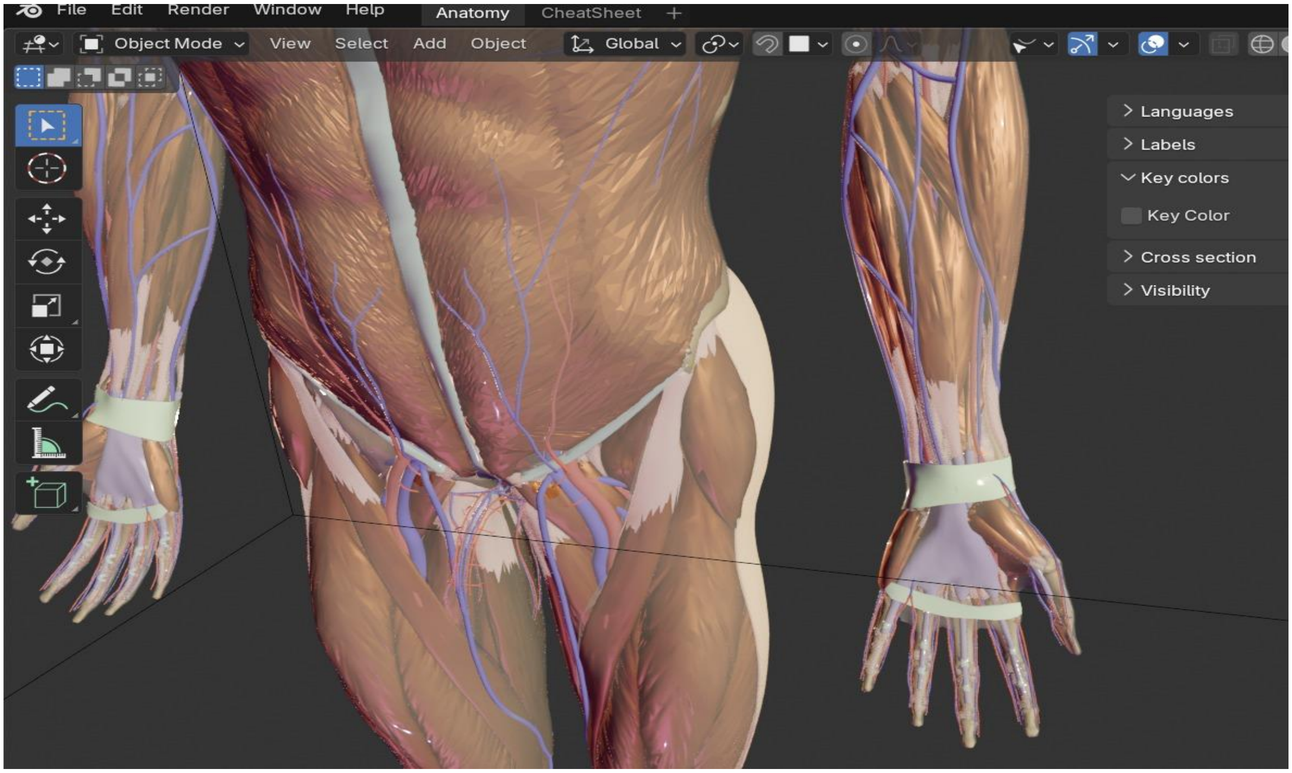

Fig. 8.8 Screenshot of Result

CHAPTER 9

CONCLUSION

Enhanced Training and Skill Development : AR and VR provide immersive, hands-on experiences that allow healthcare professionals to practice IV drug administration techniques in a risk-free, controlled environment. This leads to improved skill retention and greater confidence in performing procedures accurately.

Improved Patient Safety : The real-time feedback and error-correction capabilities of AR/VR systems help reduce human errors during IV drug administration. By simulating real-world scenarios, these technologies enable practitioners to learn the correct techniques and troubleshoot potential issues, ultimately enhancing patient safety.

Cost-Effective and Accessible Education : AR and VR offer a flexible, scalable solution for medical training, making it easier for healthcare professionals to access high-quality education anywhere, anytime. These technologies can reduce training costs and offer continuous professional development opportunities, especially for remote or under-resourced areas.

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APPENDIX A

CODE

1. VR Interaction Setup with XR Toolkit

```
using UnityEngine;
using UnityEngine.XR.Interaction.Toolkit;
[RequireComponent(typeof(XRGrabInteractable))]
public class VRGrab : MonoBehaviour
{
private XRGrabInteractable grabInteractable;
void Awake()
{
grabInteractable = GetComponent<XRGrabInteractable>();
grabInteractable.selectEntered.AddListener(OnGrab);
grabInteractable.selectExited.AddListener(OnRelease);
}
private void OnGrab(SelectEnterEventArgs args)
{
Debug.Log("Object grabbed: " + gameObject.name);
}
private void OnRelease(SelectExitEventArgs args)
{
Debug.Log("Object released: " + gameObject.name);
}
}
```

2. Accurate Needle Attachment to Vein

```
using UnityEngine;
public class NeedleAttach : MonoBehaviour
{
public Transform needlePoint;
```

```
public Transform veinPoint;
public float attachmentThreshold = 0.005f;
public bool isAttached = false;
void Update()
{
if (!isAttached && Vector3.Distance(needlePoint.position, veinPoint.position) <
attachmentThreshold)
{
AttachNeedle();
}
}
void AttachNeedle()
{
isAttached = true;
Debug.Log("Needle successfully attached to the vein.");
// Lock the needle in position
transform.position = veinPoint.position;
transform.rotation = veinPoint.rotation;
}
}
```

3. Advanced Drug Animation Trigger

```
using UnityEngine;
public class DrugAnimationTrigger : MonoBehaviour
{
public Animator animator;
public string triggerName = "Inject";
public void TriggerInjectionAnimation()
{
if (animator != null)
{
```

```
animator.SetTrigger(triggerName);
Debug.Log("Injection animation triggered.");
}
}
}
```

4. VR Instruction Panel with Voice Assistance

```
using UnityEngine;
public class InstructionDisplay : MonoBehaviour
{
public GameObject instructionPanel;
public AudioSource voiceInstructions;
public void ShowInstructions()
{
instructionPanel.SetActive(true);
voiceInstructions?.Play();
Debug.Log("Instructions shown and audio played.");
}
public void HideInstructions()
{
instructionPanel.SetActive(false);
voiceInstructions?.Stop();
Debug.Log("Instructions hidden.");
}
}
```

5. Haptic Feedback During Injection

```
using UnityEngine;
using UnityEngine.XR;
public class HapticFeedback : MonoBehaviour
{
```

```
public XRNode controllerNode = XRNode.RightHand;
public void SendHapticFeedback(float amplitude = 0.7f, float duration = 1.5f)
{
InputDevice device = InputDevices.GetDeviceAtXRNode(controllerNode);
if (device.TryGetHapticCapabilities(out HapticCapabilities capabilities) &&
capabilities.supportsImpulse)
{
device.SendHapticImpulse(0, amplitude, duration);
Debug.Log("Haptic feedback sent.");
}
}
}
```

6. VR Patient Feedback System

```
using UnityEngine;
public class PatientFeedback : MonoBehaviour
{
public Animator patientAnimator;
public AudioSource patientVoice;
public void ReactToInjection()
{
patientAnimator?.SetTrigger("React");
patientVoice?.Play();
Debug.Log("Patient reacted to injection.");
}
}
```

7. Logging and Monitoring Module

```
using UnityEngine;
using System.IO;
public class Logger : MonoBehaviour
```

```
{
private string logFilePath;
void Start()
{
logFilePath = Application.persistentDataPath + "/session_log.txt";
LogMessage("VR IV session started.");
}
public void LogMessage(string message)
{
File.AppendAllText(logFilePath, System.DateTime.Now + ": " + message + "\n");
}
}
```

8. Drug Dosage Manager

```
using UnityEngine;
public class DosageManager : MonoBehaviour
{
public float maxDosage = 100f;
private float currentDosage = 0f;
public void AdministerDose(float dose)
{
if (currentDosage + dose <= maxDosage)
{
currentDosage += dose;
Debug.Log("Dose administered: " + dose + "mg");
}
else
{
Debug.Log("Exceeded max dosage.");
}
}
```

```
public float GetRemainingDosage()
{
return maxDosage - currentDosage;
}
}
```

9. Environment Setup with Lighting and Sound

```
using UnityEngine;
public class EnvironmentSetup : MonoBehaviour
{
public Light spotlight;
public AudioSource backgroundSound;
void Start()
{
spotlight.intensity = 1.5f;
backgroundSound?.Play();
Debug.Log("Environment initialized with lighting and sound.");
}
}
```

FUNDING DETAILS

We applied for SPP -KSCST Funding. These are the budget details for which we applied.

Budget	**Amount**
a) Materials / Consumables	Rent (equipments) :- 3500 per day. 3500*4 = 14000
b) Labor (Describe)	0.00
c) Travel (Describe)	700
e) Miscellaneous (Please specify)	0.00
Total	**14700**

GITHUB LINK

https://github.com/Lata507/Intravenous_drug_administration_Clinical_Pharmacology_techniques_using_AR_and_VR