VIRTUAL REALITY FOR IMMERSIVE TRAINING ON HANDLING AND IDENTIFYING VENOMOUS SNAKES IN SRI LANKA

Project ID - 24-25J-087

Project Proposal Report

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B.Sc. (Hons) Degree Information Technology Specializing in Interactive Media

Department of Information Technology

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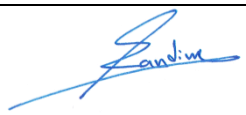
I. Declaration

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Dilshan K.A.R	IT21155598	

The supervisor/s should certify the proposal report with the following declaration. The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of Supervisor

Date

Signature of Co-Supervisor

Date

II. Abstract

Due to the inherent risks associated with handling and identifying venomous snakes, traditional training methods are often limited in their ability to effectively prepare individuals for real-world encounters. The proposed VR-based educational platform addresses these limitations by providing an immersive and safe environment for training. This document outlines the structure and methodologies used in the development of the VR system, focusing on three core components: tools and techniques for safe snake handling, detailed identification of venomous snakes with an emphasis on their anatomical structures, and understanding the physiological effects of snake venom on the human body.

The VR platform allows users to engage in practical training scenarios that replicate real-life situations, thereby enhancing their ability to safely interact with venomous snakes. Through this system, users will also gain a deeper understanding of the mechanics of venom delivery and safe extraction techniques. By integrating high-resolution 3D models, interactive modules, and real-time feedback, the platform offers a comprehensive approach to training that significantly improves both knowledge retention and skill acquisition.

The innovative nature of this VR platform lies in its ability to combine educational content with interactive, hands-on experience, all within a controlled, risk-free environment. This approach not only improves public safety but also contributes to the conservation efforts by reducing the need for direct interaction with live snakes. The outcomes of this research are intended to inform the development of more effective training tools in herpetology and related fields.

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IV. Introduction

Background & Literature Survey

The increasing risk of venomous snake encounters in Sri Lanka, coupled with the limitations of traditional training methods, necessitates a new approach to educating individuals on the safe handling and identification of these reptiles. Traditionally, training in this field has relied heavily on either theoretical instruction, which lacks practical engagement, or direct interaction with live snakes, which poses significant safety risks. Given the potentially life-threatening consequences of snakebites and the urgency of effective first response, the need for an innovative training solution is evident.

Virtual Reality (VR) offers a promising alternative by creating immersive environments where individuals can gain practical experience without the associated dangers of real-life encounters. VR technology has been successfully applied in various fields, such as medical training, military simulations, and hazardous environment handling, providing users with realistic scenarios in a controlled setting. These applications demonstrate the potential for VR to revolutionize training in handling venomous snakes by providing a safe, repeatable, and engaging learning experience.

Previous research on venomous snakes in Sri Lanka has primarily focused on their behavior, habitat, and the medical implications of their bites. Studies have documented the significant health burden posed by snakebites in rural areas, where access to immediate medical care is often limited. Additionally, research on snake anatomy, particularly the venom delivery mechanisms, has provided crucial insights into understanding the dangers these reptiles present. However, the application of this knowledge in practical, on-the-ground training remains insufficient, particularly in regions where snake encounters are frequent.

This literature review will explore the existing methods of snake identification, the anatomical study of venomous snakes, and the current techniques for venom extraction. It will also examine the advancements in VR technology and its potential

to enhance training outcomes in herpetology. By integrating these fields, this study aims to bridge the gap between theoretical knowledge and practical skill, offering a comprehensive VR-based training platform that addresses the unique challenges faced in Sri Lanka.

The advantages of using VR in training are numerous. It allows for the simulation of high-risk scenarios that would be impossible or dangerous to replicate in real life. In the context of venomous snakes, VR can provide detailed, interactive models of snakes, enabling users to study their morphology and behavior in ways that traditional methods cannot match. Furthermore, the immersive nature of VR helps reinforce learning by engaging multiple senses, thereby improving retention and understanding.

Previous studies on VR applications in education have shown that immersive environments significantly enhance learning outcomes, particularly in complex and hazardous tasks. For example, VR has been used effectively to train surgeons, pilots, and emergency responders, all of whom require a high level of precision and calm under pressure. These findings suggest that VR could similarly benefit those tasked with handling venomous snakes, providing a safe environment in which to develop and hone their skills.

In conclusion, this section will provide a comprehensive review of the literature on snake identification, anatomy, and venom extraction, as well as the application of VR in educational settings. The review will highlight the gaps in current training methods and propose VR as a solution that offers both safety and effectiveness, particularly in the context of Sri Lanka's unique challenges with venomous snakes.

V. Research Gap

A research gap refers to an area where existing studies do not fully address certain critical aspects, thereby leaving room for new research that can fill these voids. Identifying a research gap is essential for justifying the need for a new study and ensuring it contributes valuable insights to the field. In comparing my research component to existing literature on training methods for handling and identifying venomous snakes, it becomes evident that there is a distinct lack of immersive, practical training solutions in this area. Most existing research focuses on theoretical aspects of herpetology, or on in-person training with live snakes, which carries inherent risks and limitations.

The traditional methods of snake handling and identification training, while valuable, do not provide the safety or depth of engagement necessary for comprehensive learning. Current educational tools often lack the ability to simulate real-world scenarios in a controlled environment, which is critical for preparing individuals to safely and effectively manage encounters with venomous snakes. This gap in practical, hands-on training resources is particularly evident in regions like Sri Lanka, where the prevalence of venomous snakes poses significant health risks.

The proposed VR platform aims to address these shortcomings by offering an immersive and interactive learning environment that bridges the gap between theoretical knowledge and practical skills. Unlike traditional methods, this VR platform allows users to engage in realistic simulations of snake encounters, where they can safely practice identification and handling techniques. This approach not only mitigates the risks associated with live training but also enhances user engagement and knowledge retention through interactive and repetitive practice.

Moreover, while some research has explored the use of VR in education, few studies have applied this technology specifically to the field of herpetology, and even fewer have focused on venomous snakes in the context of Sri Lanka. This represents a significant gap in the current body of knowledge. The development of a VR-based training tool tailored to the needs of Sri Lankan users, therefore, stands out as a novel contribution to the field.

In summary, the research gap identified lies in the lack of practical, immersive training tools for venomous snake identification and handling. The proposed VR platform is designed to fill this gap by offering a safe, engaging, and effective educational resource that addresses the specific challenges faced in Sri Lanka. By comparing this approach to existing research, it becomes clear that this study will provide a unique and valuable solution to an urgent problem, ultimately contributing to improved public safety and conservation efforts.

Aspects	Focus To Sri Lanka	Using Training tools	VR using for Snake handling Education	Physical prototypes integrate in VR	Identify Public safety	Many Snake Handling Techniques
Research A [4]		✓				
Research B [7]		✓	✓			
Research C [10]				✓		
Research D [11]	✓		✓			
Proposed Project	✓	✓	✓	✓	✓	✓

VI. Research Problem

Handling and identifying venomous snakes poses significant risks, making it challenging to provide effective training through traditional methods. In typical educational settings, instructors are limited in their ability to offer hands-on experience with live snakes due to safety concerns. This often results in a gap between theoretical knowledge and practical skills, leaving trainees underprepared for real-world encounters. Additionally, the existing training methodologies do not account for the variations in venomous species, especially those found in regions like Sri Lanka, where snakebite incidents are frequent and often fatal.

One of the primary challenges is the lack of an immersive and safe learning environment that allows for the realistic practice of snake identification and handling techniques. Without the opportunity to engage in practical, risk-free training, individuals are at a higher risk of making critical errors when dealing with venomous snakes in the field. This gap in training is particularly problematic in rural areas where access to immediate medical care is limited, and the consequences of a snakebite can be severe.

Moreover, current educational tools and programs fail to adequately address the anatomical complexities of venomous snakes, particularly the mechanisms involved in venom delivery and extraction. This lack of detailed, practical training increases the likelihood of improper handling, which can lead to life-threatening situations for both the handler and others.

In Sri Lanka, where snakebites are a significant public health issue, there is a pressing need for a training solution that bridges the gap between theory and practice. The problem is further compounded by the absence of a comprehensive, interactive training platform that can simulate real-life scenarios without the associated dangers. This research seeks to address these critical issues by developing a VR-based training platform that offers a safe, effective, and immersive learning experience, ultimately reducing the risks associated with venomous snake encounters.

VII. Objectives

Main Objective

Formulate a precise statement of the main goal: to develop a VR platform that enhances users' ability to identify venomous snakes and understand their anatomy, focusing on the mechanisms of venom delivery and safe extraction techniques. Highlight the aim of providing a safe, interactive, and educational experience that prepares users for real-world scenarios.

Specific Objectives

Under the research component focused on venom extraction and the anatomy of snake fangs, the following specific objectives will guide the development of the VR platform. These objectives are designed to provide users with an in-depth understanding of snake anatomy, particularly the mechanisms involved in venom delivery, all within an immersive and interactive virtual environment.

Develop Detailed and Interactive 3D Models of Snake Anatomy

Create highly detailed 3D models of venomous snakes, with a specific focus on the anatomy of fangs, venom glands, and other critical structures. These models will allow users to explore the internal mechanisms of venom delivery in a controlled and realistic setting. The models should be highly accurate, visually engaging, and designed to facilitate a deep understanding of the biological processes involved.

Design Engaging Educational Modules for Venom Extraction Techniques

Develop VR-based educational modules that simulate the process of venom extraction. These modules will guide users step-by-step through the correct procedures for safely extracting venom from snakes, emphasizing the importance of precision and safety. The modules should include interactive elements that allow users to practice these techniques repeatedly until mastery is achieved.

Create Interactive Simulations of Venom Delivery Mechanisms

Design and implement simulations within the VR platform that demonstrate how venom is produced, stored, and delivered by venomous snakes. These simulations will enable users to visualize and understand the complex biological processes that occur during a snakebite, including the role of fangs and venom glands in the delivery system.

Incorporate Real-time Feedback and Assessment Tools

Integrate real-time feedback mechanisms into the VR environment, allowing users to receive immediate guidance on their performance during simulations. This feature will help users refine their techniques in venom extraction and anatomical studies, ensuring that they are learning effectively and making progress.

Enhance User Engagement Through Gamified Learning Experiences

Incorporate gamified elements within the VR platform to increase user engagement and motivation. By introducing challenges and levels that users can advance through, the platform will encourage repeated practice and deeper learning. These elements will also make the learning experience more enjoyable and rewarding, fostering a greater interest in the subject matter.

X. Methodology

The methodology for this research involves a comprehensive approach to developing and deploying an immersive VR platform focused on the study of venom extraction, snake fangs anatomy, and snake anatomical mechanisms. Initially, detailed 3D models of venomous snakes, emphasizing key anatomical features such as fangs and venom glands, will be created using advanced modeling software. These models will be integrated into the VR environment, allowing users to interact with and explore the internal structures of snakes in a realistic and controlled setting. The development process will involve close collaboration with herpetologists to ensure anatomical accuracy and relevance. Additionally, educational modules will be designed to simulate venom extraction procedures, providing step-by-step guidance and real-time feedback to users. These simulations will be enhanced with interactive elements that allow users to practice and refine their techniques in a risk-free environment. The VR platform will also incorporate gamified learning experiences to boost user engagement, with challenges and levels that encourage continuous learning and mastery of the content. Finally, the effectiveness of the platform will be evaluated through user testing, gathering feedback to refine the system and ensure it meets the educational needs of its target audience. This methodology ensures that the VR platform is not only scientifically accurate but also engaging and effective as a training tool.

Research Design

Define the Research Problem and Research Questions: The research problem focuses on the challenges in accurately identifying venomous snakes and effectively extracting venom in a safe and controlled environment using Virtual Reality (VR). The primary research questions include: How can VR enhance the understanding of snake anatomy and venom extraction techniques? What are the key factors that contribute to the effectiveness of VR in simulating realistic scenarios for training purposes?

Develop a Hypothesis or a Set of Hypotheses: The hypothesis is that a VR-based training platform will significantly improve users' ability to identify venomous snakes

and perform safe venom extraction, compared to traditional training methods. Additional hypotheses may include the effectiveness of VR in increasing retention of anatomical knowledge and reducing the risks associated with hands-on training with live snakes.

Identify the Population and Sample Size: The target population for this study includes herpetologists, medical professionals, and individuals involved in wildlife management in Sri Lanka. A sample size of 50-100 participants will be selected, with a focus on those who have varying levels of experience in snake handling and venom extraction.

Choose the Research Design: The research design will be a mixed-methods approach, combining both qualitative and quantitative research methods. This will involve pre- and post-training assessments, user feedback through interviews and surveys, and performance analysis during VR sessions to evaluate the effectiveness of the platform.

Develop a Data Collection Plan: Data will be collected through user interactions within the VR platform, performance metrics on tasks such as snake identification and venom extraction, and qualitative feedback from participants. The data collection will also include observation of user behavior during VR sessions and the recording of any challenges faced.

Develop a Data Analysis Plan: Quantitative data will be analyzed using statistical methods to determine the effectiveness of the VR platform, while qualitative data from interviews and surveys will be analyzed thematically to identify common patterns and insights. Comparative analysis will be conducted to assess the differences in performance between traditional training and VR-based training.

Data Collection

VR Interaction Tracking: Capture detailed data on user interactions within the VR environment, including movements, decisions, and accuracy in tasks such as identifying snake species and performing venom extraction. This data will help in evaluating the user's learning curve and skill development over time.

Anatomical Focus Studies: Utilize the VR platform to conduct specific studies on user focus areas during training sessions. This includes tracking how users interact with different parts of the snake anatomy, such as the fangs and venom glands, to determine areas where additional training may be required.

Data Processing

3D Model Enhancement: Preprocess and refine the 3D models of snakes to ensure high accuracy in the depiction of anatomical features. This includes optimizing textures, lighting, and animation sequences to enhance the realism of the VR experience and ensure that users can interact with high-quality visual data.

Interactive Simulation Calibration: Calibrate the interactive elements of the VR platform, ensuring that user inputs, such as tool usage and decision-making processes during venom extraction, are accurately captured and processed. This involves adjusting sensitivity settings and ensuring the system can handle real-time data input effectively.

Technologies	Unity, Blender, Python, Unreal Engine, Oculus SDK, Visual Studio Code
Techniques	3D Modeling, Interactive Simulation, Real-time Feedback, Gamification

System Diagram

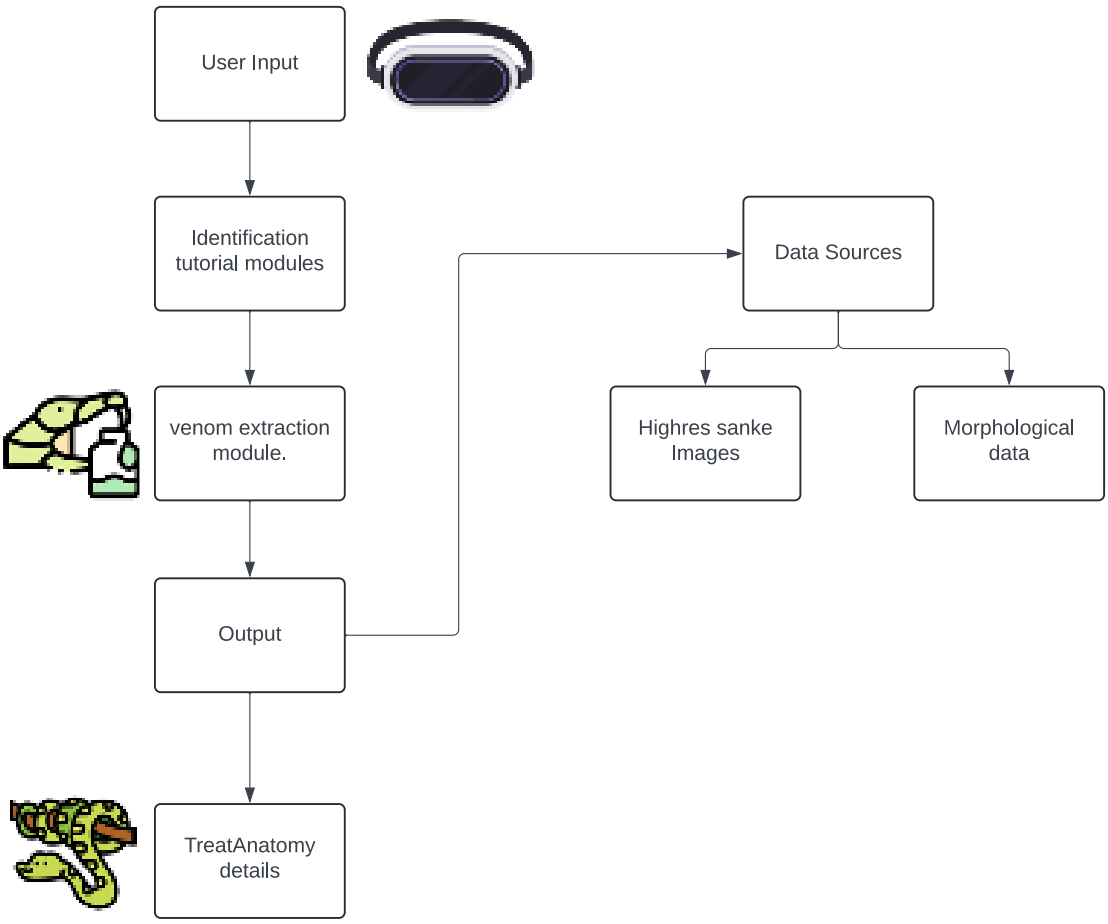

Figure 1 System Diagram

XI. PROJECT REQUIREMENTS

Functional Requirements

The VR platform should allow users to interact with detailed 3D models of venomous snakes, focusing on anatomical structures like fangs and venom glands.

Users should be able to simulate venom extraction procedures within the VR environment, receiving real-time feedback on their actions.

The system must support a variety of training scenarios that include different species of venomous snakes, each with unique anatomical features.

The application should provide educational modules that guide users through the identification of venomous snakes based on visual and morphological characteristics.

Users should be able to access a detailed anatomical breakdown of snakes, including the function of various organs and venom mechanisms.

Non-Functional Requirements

Performance: The VR platform should render 3D models and simulations smoothly, ensuring that interactions are responsive and realistic. The platform should support high frame rates to maintain immersion during training sessions.

Scalability: The system should be designed to accommodate an increasing number of users and content updates, including new snake species and training scenarios.

Usability: The user interface should be intuitive and easy to navigate, allowing users to quickly access training modules and simulations. The VR environment should be designed to accommodate users with different levels of experience in herpetology and VR technology.

Security: The platform must ensure that user data, including performance metrics and progress records, are securely stored and accessed only by authorized personnel.

Reliability: The system should be highly reliable, with minimal downtime, ensuring that users can access training resources whenever needed.

Ethical Considerations: The application must adhere to ethical standards, particularly in terms of accuracy in depicting snake anatomy and venom extraction techniques, and ensuring that the content is educational and responsible.

System Requirements (Technologies)

The purpose of the system requirements is to define the technological resources necessary for the proposed VR platform to function effectively. The software and hardware requirements for this project include:

- Unity or Unreal Engine – to develop the VR environment.
- Blender/Maya – to create detailed 3D models of snakes.
- Python – for scripting and interactive elements.
- Oculus SDK– for VR hardware integration.
- Visual Studio Code – for coding and debugging.
- WebSocket – for real-time data communication and feedback within the VR environment.

Expected Test Cases

1. **Test Case 1: User Interaction with 3D Models**

Objective: Ensure users can interact seamlessly with the 3D models of venomous snakes head in the VR environment.

Procedure: The user selects a snake head model and interacts with it by rotating, zooming, and exploring its anatomical features.

Expected Result: The 3D model should respond smoothly to user inputs, maintaining high visual fidelity without lag or distortion.

2. **Test Case 2: Venom Extraction Simulation**

Objective: Validate the accuracy and functionality of the venom extraction simulation.

Procedure: The user performs a venom extraction procedure using virtual tools provided in the VR environment.

Expected Result: The simulation should guide the user through the procedure with real-time feedback, ensuring that the venom is successfully extracted without errors.

Gantt Chart

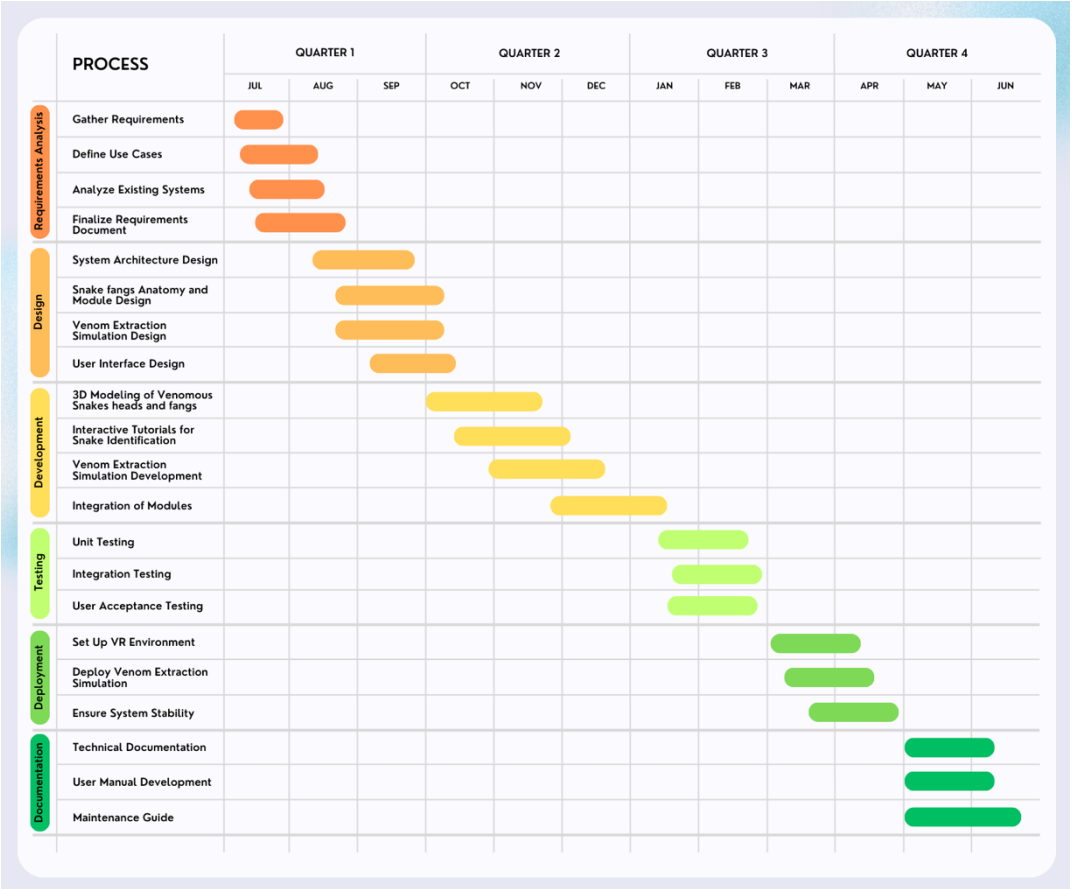

Figure 2 Gantt Chart

IX. Budget

Description	Estimate budget (Rs)
Transportation Cost	10,000.00
Arduino Board	4,000.00
Sensors and other parts Cost	20,000.00
Other Cost	5,000.00
Total budget	39,000.00

Table 2 : Budget Justification Table

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XI. Appendices