Virtual Reality for Immersive Training on Handling and Identifying Venomous Snakes in Sri Lanka

24-25J-087

Project Proposal Report

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

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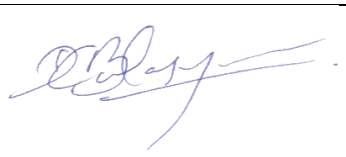
I. Declaration

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
Balasuriya B.L.D.C	IT21171024	

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

There is a significant menace of snakebites even today, particularly in areas where snakebite cases are frequent, and initial treatment is not easily available. Given the complexity of how venom influences the human body, enhanced understanding, and more effective ways of instruction for medical practitioners and emergency services personnel must be developed. The developments of this paper entail the design of the new-generation complex VR application that mimics the multi-faceted pathophysiologic impact of snake venom in the human body on a cellular level. The purpose is to combine the result of traditional education and the possibilities of encyclopedic VR values.

Furthermore, this VR platform has elaborate learning activities ranging from trivial first aid protocols to complex programs on how to perform medical management, weaning and long-term rehabilitation for poisonous snake bites. Further, these modules are helpful in terms of informing the users about the activities that transpire in vivo owing to toxicity of venom and the readiness to make exigent decisions during times when they are most needed. The social aspect in the platform enables the instructions to be followed step by step, giving the user an opportunity to test their knowledge and skills in a controlled but very real environment.

The research also looks at the feasibility of this VR application in diverse learning institution including the medical colleges, continuing education and professional development for practicing health workers with the ultimate view to reduce mortality and morbidity arising from venomous snake bites through enhanced training of the medical personnel through virtual learning.

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1. Introduction

1.1. Background & Literature Survey

Snakebites are a very severe threat to global health, so people in tropical and subtropical regions where snake bites are frequent but medical facilities often unavailable. Statistics by the WHO reveal that new cases of snakebites run to hundreds of thousands every year with considerable rate of mortality and morbidity. Some of the physiological effects that may be caused by venom of different kinds of snakes include paralysis, tissue necrosis, hematoma and organ affect. To provide the best possible treatment for venom affected patients and to comprehend how venom affects human tissue on a basic biological level, it is crucial to comprehend the biological nature of how venom works.

The physiological action of snake venom is a multiple one with the participation of numerous toxic factors in human organ systems. For instance, these toxins can affect the nervous system, the cardiovascular, musculoskeletal system among others. Neurotoxins reduce neurotransmission resulting in paralysis; the other big threat is hemotoxins which interfere with blood coagulability, leading to severe internal hemorrhage. Therefore, the variance in the composition that exists according to the type of snake serves to complicate the understanding of its effects, because it is a process running across a biochemical pathway still to be investigated in depth.

Despite all the efforts of scientists who study snake venom, there is a great issue with translating this research into practical training aids for physicians and nurses. The conventional mode of teaching common in medical schools involves books and talks besides non-movable models. While these methods may provide a passable representation of how venom interferes with structures in a body, they do not do a very good job. This issue is patented in the regions where healthcare workers are most likely to encounter snakebite but may not have access to the best simulating platforms.

In the few years more innovation has led to new ways of learning, for instances VR training of doctors. As real as it gets the VR transports you into a reality that allows users perform actual life medical simulations without risk. Another array of studies prove that VR contributes to learning much better in complex and risky fields such as surgery and emergency. But we have

not yet considered what possibilities of using VR in the treatment of snake bites or in the simulation of snake venom.

This research is therefore aimed at addressing this gap by developing a VR platform that demonstrates the impacts of snake venom to the body and a learning tutorial is provided. Using detailed 3D models of human anatomy and real-time simulation of effects of venom, the platform turns into an interesting tool for teaching doctors, students, and employees of the emergency services. It also contains special timelines and learning tools where the patient can trace the development of symptoms and learn why a fast treatment is crucial. This does make the platform even more useful.

Finally, it is established that lots of progress has been made in understanding how snake venom impacts the body. However, there is still the fact that we can have better and easier training tools. That type of VR platform is rather innovative in the context of teaching doctors and nurses, to which we are now turning. It applies ICT as a tool of reconciling academic angle with practical ‘feel’ or touch. In this case, this type of platform can make the simulation look more real life and appeal to the healthcare workers hence preparing them to handle snake bites. In the long run, this could imply that a fewer number of people are affected or killed by snake bites in different parts of the world.

1.2. Research Gap

Research A [3]:

The study by Kasturiratne et al. (2008) sheds light on the huge worldwide problem of snakebite poisoning in places where medical help is hard to get. This research shows we need better ways to train people, but there aren't many good, hands-on learning tools to get healthcare workers ready in these dangerous areas. Old-school training like books and talks just don't cut it when it comes to teaching about the fast-paced often urgent nature of treating snakebites. We still don't have a good way to simulate real-life situations to improve how ready medical staff are in places where snakebites happen a lot.

Research B [4]:

Casewell et al. (2013) talk about how snake venoms have evolved to become complex and varied, which makes it hard to understand and treat snakebites. The paper goes into detail about the chemistry of venom, but there's a gap in turning this knowledge into useful educational simulations. The tools we have now for teaching don't show the different ways various venoms affect the human body, and they don't let users explore these effects hands-on. This gap points to a real need for a VR system that can show how the body reacts to different types of venom giving people a chance to learn and train more.

Research C [5]:

Reed and colleagues (2020) look at the pros and cons of VR in medical education. They spot a gap in using VR for specific high-risk medical emergencies such as snakebite poisoning. Most current VR apps focus on surgical training or teaching patients, with little exploration into simulating complex biochemical and physiological processes. This opens a chance to expand VR technology into new areas for training in snakebite management. The ability to simulate real-time venom effects and treatment responses could improve learning outcomes.

Research D [6]:

Lopardo and colleagues (2015) talk about using VR to teach patients and doctors about different health conditions. The existing VR tools do not adequately address the educational needs related to the urgency and complexity of snakebite management. The VR tools we have now don't do enough to teach about the rush and tricky parts of handling snakebites. Creating a VR system just for practicing these situations would fill this gap. It would give us a useful tool to educate and train people.

The following are the primary features that will be compared to my research component.

Feature	Global Burden & Training	VR in Venom Complexity on human body	VR in Medical Training	VR for Snakebite Education	Interactive Timelines
Research A [3]	✓				
Research B[4]		✓			
Research C [5]			✓		
Research D [6]				✓	
Proposed system	✓	✓	✓	✓	✓

Table 1. 1: Table of Research Gap

1.3. Research Problem

Treating snakebite poisoning is tricky because snake venoms vary and affect different parts of the body in many ways. Books and classes give doctors the basics about these effects, but they don't show how venom can change the way the body works. This gap in learning is bad for doctors and emergency workers, who need to figure out and treat snake bites when the patient's life and recovery are on the line.

The training tools we have now don't let users jump into a lifelike situation where they can see and interact with symptoms as they unfold. This shortcoming makes it tough to really get how time-critical venom treatment is where waiting too long to give the right medical care can cause serious problems or even kill someone. What's more, the simulation models we use today aren't flexible enough to show how different venom affects various organs, and they don't give users a hands-on way to practice treatment plans.

The research problem revolves around a state-of-the-art Virtual Reality (VR) system that will attempt to simulate the effects of snake venom on a human subject. Its value is that it must paint a comprehensible and realistic picture of how venom circulates in the human body, affects various tissues, and creates symptoms. Furthermore, the system should include objects that are to be dismantled for understanding, like a timeline or the treatment plan. These features would allow the consumers to reuse it, see what happens due to choices they make and feel how emergent and complex it is to treat snakebite victims.

2. Objectives

2.1. Main Objective

The intended goal of this study is to design and implement an extremely realistic and life like 3D Virtual Reality (VR) model depicting the impact of snake venom on various human organs and systems. This model intends to match the model offering a life-like model that mimics the intricate chemical reactions in the human body occasioned by snake bites.

2.2. Specific Objectives

1. Create Interactive Timelines

The first specific aim is to create engaging timelines of different symptoms that develop in VR due to venom in the chosen platform. These timelines will make it easy for the users to be able to see how the symptoms evolve from the moment the venom is introduced in the body to the time complications set in.

• **Symptom Progress Display:** Even the acceleration of the disease's symptoms such as paralysis formation or how dead tissues occur, or the initial stage of bleeding will also be demonstrated using the interactive timelines. Concerning these timelines, the users can manipulate them forward or backward to review body transformations during varied venom impact phases.

• **Urgency of Treatment:** The timelines will equation how fast medical help is required by focusing more on the instances that could benefit from prompt assistance. By this feature, the users will know how urgent a snakebite treatment is and what consequences may occur due to lack of the treatment.

• **Interactive Learning:** People can click on various points of the timeline and get to see how intervention might alter disease symptoms providing a practicable learning approach.

2. Create Educational Modules

The second specific goal is to create a set of training lessons in the created VR environment, which will introduce all the necessary actions and measures already at the stage of reception of the bite, as well as in subsequent stages, including therapeutic manipulation and rehabilitation. These modules will inform users on the right way to treat the effects of the venomous snake bite and on managing the internal condition of the patient.

First Aid Training: The first aid modules will demonstrate to the users the actions they should first take after being bitten by a snake. This involves how to reduce the motility of the affected limb, manage venom dissemination and prepare the patient for evacuation to the health facility. This module will simulate various first aid situations which will enable the users to train themselves on what they have learnt.

Long-term Recovery: The recovery modules will educate the users on the post-snakebite poisoning outcomes such as tissue damage, which may persist, or pain, or PTSD. These modules will provide information on the rehabilitation procedures and the subsequent management plan to facilitate the understanding of the user on the fact that it is going to take time.

3. Methodology

3.1. System Architecture Diagram

The approach for this research part involves a detailed plan comprising the development of a comprehensive Virtual Reality (VR) system that models how snake venom impacts human life. The first procedure is to accumulate a great amount of information concerning the effect of venom from snakes of various types on the body. This means understanding what venom is composed of, how it affects the human tissue and how effects such as paralysis dying tissue and bleeding become progressive in nature. This basic knowledge is useful to establish the VR-System in the next steps.

The next stage involves the creation of three-dimensional models of parts of the human body which venom impacts on. These models intend to mimic how major organs of the body physically and function: Like the heart, lungs, and nervous system. This provides a realistic image of how venom transports and invades various body parts and their effects.

When the 3D models have been placed, then the creation of VR scenarios begins. These scenarios involve demonstration of venom on real subjects exposing the mechanism of action of venom on tissues and onset of symptoms. This virtual reality is an active one, as it provides the users with a life like looking at the changes as they happen in physiology. The VR setting has also the interactive timelines in this problem that have the animations to depict how that symptoms progress so that users can manipulate time, gain better understanding of why timely treatment may be necessary and how fast such venom-related issues can develop.

Also, the platform offers training in first aid medical treatment, and the subsequent long-term rehabilitation. These modules provide tutorial contents, which elaborate to the user on how to best deal with snakebite incidents. It ranges from aspects that involve first aid immediately after a snake bite to aspects that are centered on post snake bite medical interventions such as antivenoms, and aspects of patients' healing. In this way, all these parts contribute to synthesis of a robust approach. This ensures the quality of the VR platform as well as make it to be applicable in the field as a teaching and learning facility for medical practitioners and students.

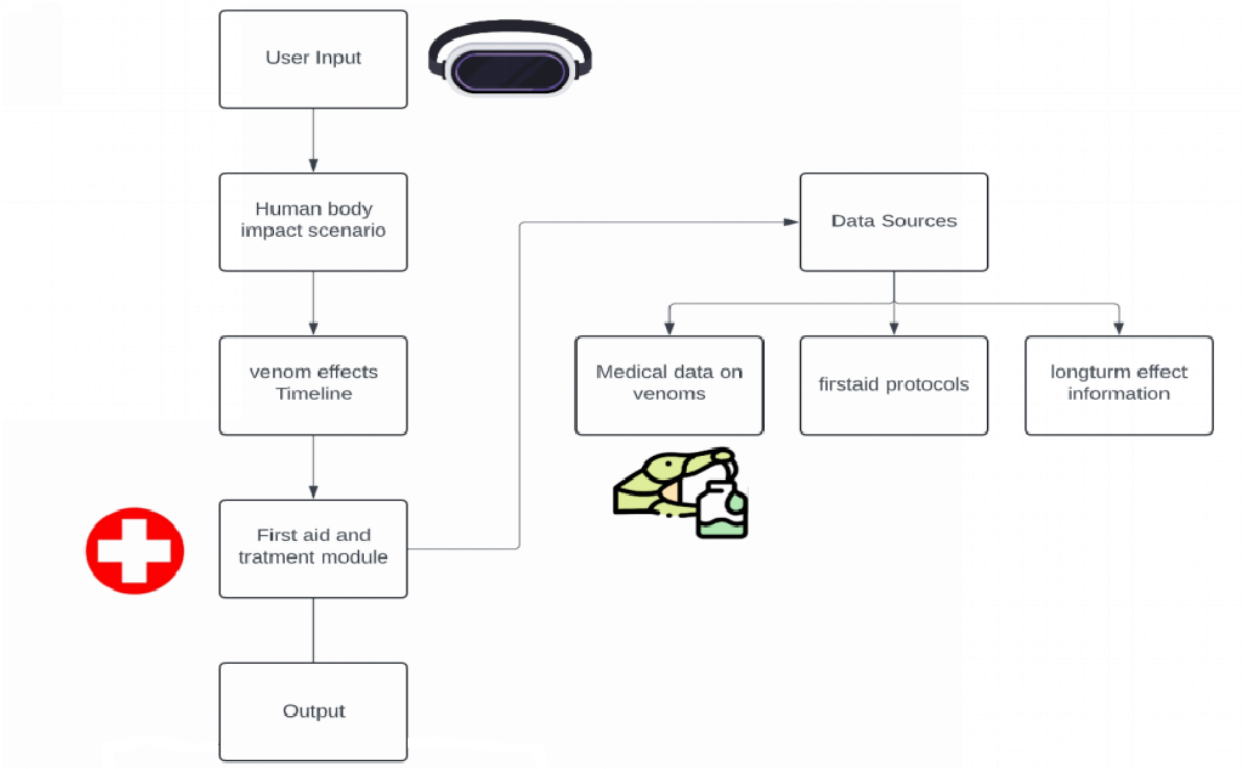

Figure 1 : System Architecture Diagram

3.2. Technologies to be used

Unity3D - Develop the VR environment

VR Headsets - for testing and deploying your VR platform

Blender - creating detailed 3D models and animations

Substance Painter - For adding realistic textures to your 3D models

3.3. Work Breakdown Structure

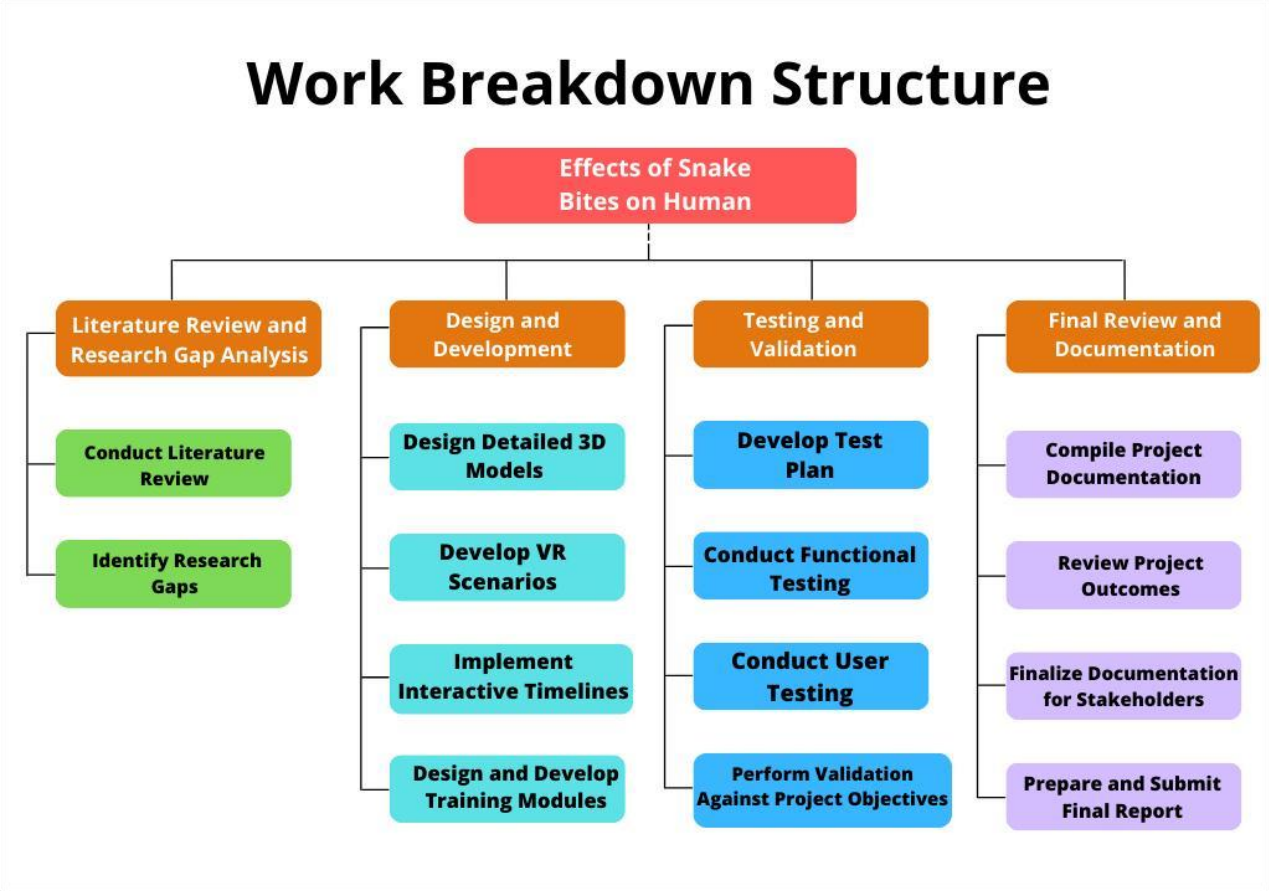

Figure 2: Work Breakdown Structure

4. Project Requirements

4.1. Functional Requirements

- Accurate and detailed 3D models of human organs and systems
- Real-time visualization of venom's impact within the VR environment
- Interactive timelines of symptom progression
- Comprehensive training modules on first aid and medical treatment

4.2. Non-Functional Requirements

- High realism and accuracy in visual representations
- User-friendly and intuitive VR interface
- Reliable performance and low latency in VR simulations
- Scalability to include various snake species and extraction scenarios

4.3. Test Cases

1. **3D Model Accuracy**

Make sure the 3D models of human organs and systems look just like real human anatomy.

2. **Real-Time Venom Impact Simulation**

The VR platform should show how venom spreads and affects organs as it happens.

3. **Interactive Timelines Functionality**

Users need to interact with the timeline to see and grasp how symptoms get worse over time.

4. **User Interface (UI) Navigation**

The VR platform should let users move through different parts and tools with ease.

5. **User Interaction with 3D Models**

Make sure users can play around with the 3D models (like spinning them around or zooming in and out).

5. Gantt Chart

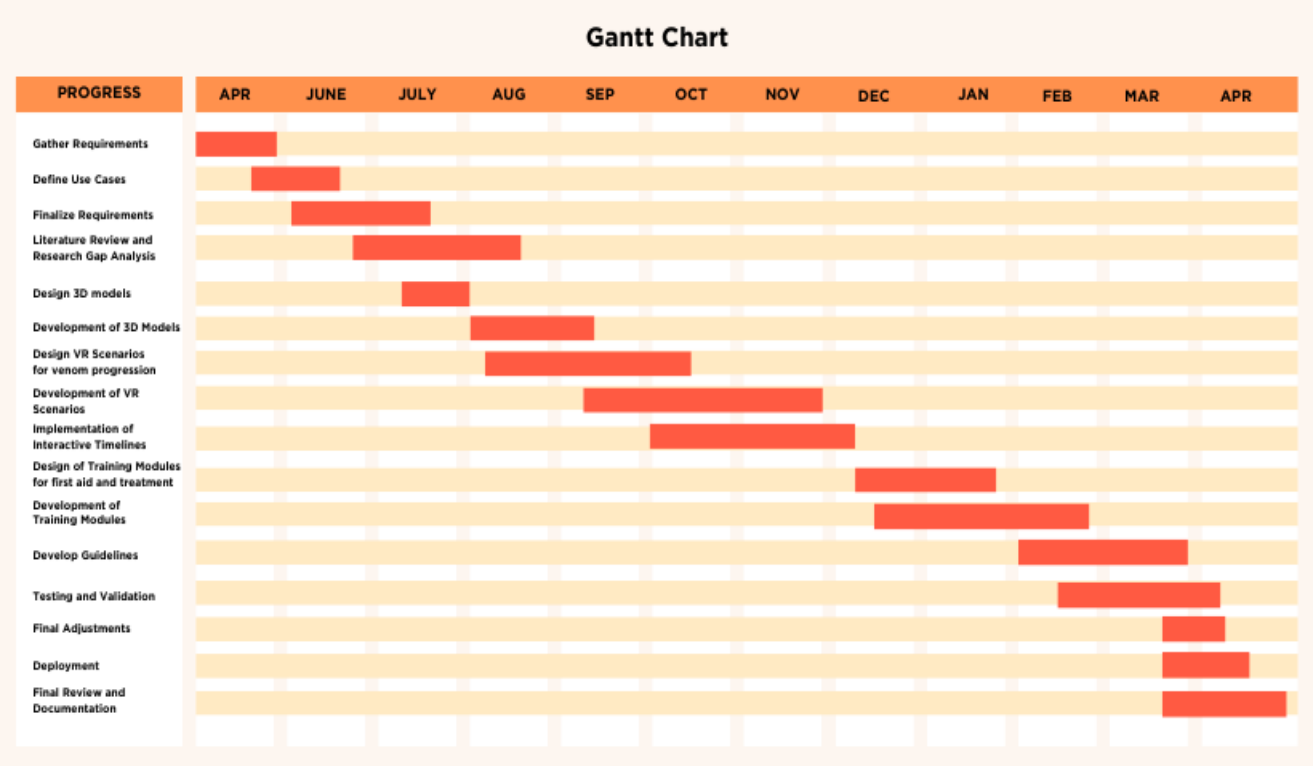

Figure 3: Gantt Chart

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7. Appendices

Overall System Architecture Diagram

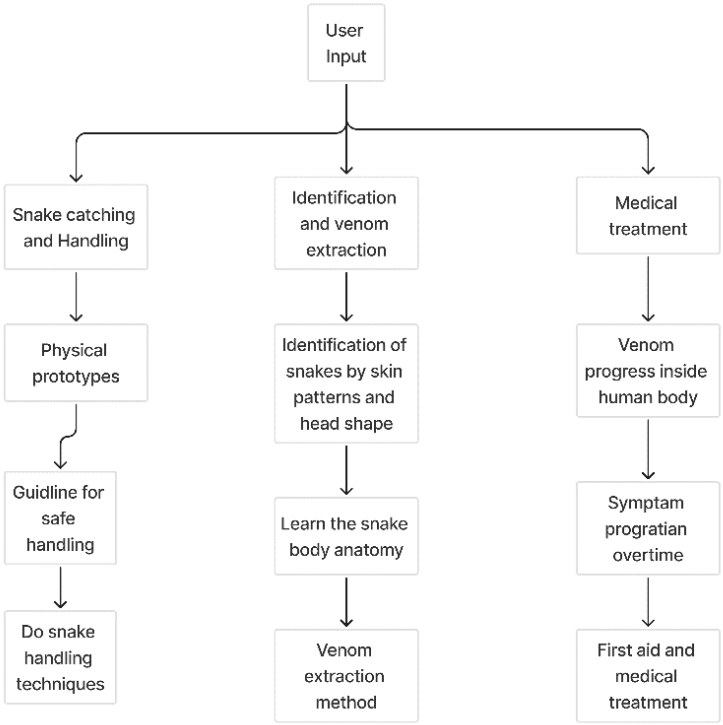

Figure 4: Overall System Architecture Diagram