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

24-25J-087

Project Proposal Report

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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.

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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

Snakebite envenomation represents one serious health crisis in Sri Lanka; over 80% of the snakes are venomous and occur in areas adjacent to human habitats. Most of the traditional snake handling and identification education techniques are theoretical or impractical or entail dangerous direct exposure to live snakes. The paper describes the design of an educational tool that embeds physical prototypes of snake-handling equipment within a VR environment to improve preparedness and safety. The solution proposed is a way of bridging the gap between theoretical knowledge and practical abilities by proposing a safe controlled space for snake-catching practice. The novelty of this research lies in the combination of the physical creation of tools with immersive virtual reality simulations, complete with real-time feedback and guidelines for emergency procedures. By doing so, risks from snakebites can be greatly reduced, improving public safety and alleviating a huge burden off Sri Lanka's healthcare system.

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1. Introduction

1.1. Background & Literature Survey

This country faces a very high burden of snakebites and lays in the rural areas that host high populations of land habitat venomous snakes, particularly the Russell's viper, cobra, and krait. These snakes often inflict severe bites on the native population, mostly farmers and other people living near natural habitats. In particular, the Russell's viper forms a high percentage of cases of snake bites. Its venom causes serious tissue damage, hemorrhage, and in many cases, if not treated promptly, deaths. Other common causes of high mortality and morbidity attributed to snakebites include the cobra and the krait. Moreover, the lack of access to antivenom and specialized treatment facilities in rural areas compounds this problem further, resulting in unnecessary deaths and long-term disabilities.

The socio-economic impact is also great. A significant number of the victims are from economically poor backgrounds, and the financial costs of treatment, rehabilitation, and productivity losses can be devastating for families. The result is a very overstretched health care system, already overburdened with other public health problems, to adequately and in good timing offer services to snakebite victims. This situation underlines the requirement for an effective educational tool to help prevent snakebite through better awareness and preparedness by people most at risk.

Traditional educational interventions in snakebite prevention and first aid have many disadvantages. Most often, education is imparted through theory in a lecture class or in a community meeting without exposing the individual to practical experience. Such preparation is incomplete and inefficient to handle real situations involving venomous snakes, which require quick and correct responses. Theoretical knowledge alone is frequently inadequate to enable any person to identify dangerous species or to learn the correct techniques of handling or avoiding them.

Other training programs include handling live snakes under supervision. This method offers practical experience but carries its inherent dangers. Any time the handling of live venomous snakes is attempted, mishaps occur, and the result can be a bite with subsequent envenomation. Moreover, these methods are not scalable due to the high requirements of resources in terms of trained handlers, secure facilities, and the availability of antivenom. This indicates the need for novel treatment measures that, while being practical, are free from the dangers of associated risks.

Literature on snakebite education progressively realizes that it requires hands-on training. Practical training in snakebite management substantially lowers the likelihood of such incidents happening in the future. Unfortunately, safe and controlled environments have not been easily available in rural regions, where such training is most crucial. As such, most training programs have not translated into the best results of minimizing the prevalence and severity of snakebites.

Over the past few years, there have been promising applications of virtual reality as a tool for education and training in medicine, military, and disaster response. VR affords an effective environment for immersing and interacting with subjects to practice skills and procedures with zero risks associated with real-world scenarios. With respect to snakebite education using VR, a person would now be able to, in an artificial but real experience, simulate venomous snake encounters for the purpose of learning and practicing safe handling techniques in a safe and controlled environment. For instance, virtual reality has been used to train medical students in performing surgical operations, with outcomes showing much better performance than traditional training. In the training of disaster preparedness, VR could be implemented for first respondents to practice the related emergency procedure, not in real life but in safe environments. The successes of these successes present evidence that it would be easy for VR to help snakebite education, thus becoming a valuable adjunct to traditional methods.

In many learning environments, especially in fields that call for skills to be acquired by practice, physical tools and equipment feature very prominently. In snakebite education, snake handling tools such as snake hooks and tongs are indispensable in the safe handling and capture of venomous snakes. The safe deployment of such tools is, however, accomplished through training and practice, which is rarely provided in the existing curricula. In the absence of training on these tools, people will handle them poorly and end up with accidents and injuries.

Further, the utility of training tools brings forth the base of bridging the theoretical gap into a practical application and thus offers better preparation to individuals in real life. Nevertheless, training using physical tools is not sufficient to provide one with the full spectrum of experiences or challenges that one may be faced with while encountering a venomous snake in real life.

The combination of VR and physical tools is an innovative solution for snakebite education that solves many of the problems in traditional methods. This approach provides an all-rounded training experience both in practical skills and theoretical knowledge through the incorporation of physical prototypes of snake-handling tools and a VR environment. In this setting, one can learn how to capture and handle venomous snakes with snake hooks and tongs and get feedback in real-time.

Such integration will simulate a great deal of scenarios regarding the different species of snakes, various environmental conditions, and emergency situations. For example, trainees will be able to practice how to handle a cobra in a forest environment or how to capture a krait in some dark, narrow space. Another aspect it would bring to VR environments is the simulation of physiological effects from a snakebite to let people understand that quick and correct responses are very important. The existence of physical tools in the VR environment makes the training more realistic and effective.

There has been some very positive prior work in this area, concerning the involvement of virtual reality and physical tools in training. In this regard, for example, it has been found that in surgical training, when VR simulators are coupled with the use of physical instruments, the skill acquisition is better and is retained for longer. Military training has also utilized VR coupled with physical equipment to simulate combat scenarios, hence allowing soldiers to train themselves in a realistic and practical way. Such examples show that the coupling of VR and physical tools can be very effective in snakebite education for safe, scaled-up, and comprehensive training.

It is thereby that literatures point toward the need for more innovative techniques of snakebite education, including both effectiveness of training and safety and accessibility. In that respect, combining physical tool prototypes with Virtual Reality holds an immense scope for improvement toward better preparedness and safety regarding snakebites in Sri Lanka. Such training might significantly reduce snakebites and related major cases, thus yielding better public health outcomes and lessening pressure on the healthcare system.

1.2. Research Gap

Despite the recognized demand for practice in snakebite prevention and management, there is a striking paucity of appropriate, safe, and effective educational resources in this domain. Therefore, current approaches to training are based either on didactic teaching methods that provide no appropriate skills to act in real-life situations or on direct exposure to live snakes, which is extremely hazardous. Furthermore, although virtual reality has already been virtually applied in different training contexts, it has not been exhaustively applied in snakebite education, particularly these physical contexts of tools. By this, the study thereby integrates a lacking element of developing a VR-based training tool with physical prototypes for snake-handling equipment, which would be a rather new approach toward snakebite education.

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 [7]	✓				✓	
Research B [9]	✓				✓	
Research C [10]					✓	
Research D [11]		✓				✓
Web App	✓	✓	✓	✓	✓	✓

Table 1. 1: Table of Research Gap

1.3. Research Problem

Sri Lanka faces a serious public health challenge due to the high incidence of snakebite envenoming. This is added by the sparsely populated countryside, where potentially dangerous species of snakes are abundant, with the Russell's viper, cobra, and krait being almost exclusively responsible for the problem posed by snakes. Poor methods of education in snake handling and identification have further added to this hazard in the rural areas. The traditional training methods are either heavily theorized or involve dangerous exposure to live snakes; none is good enough a tool to train an individual who is likely to come across these killer reptiles.

There is a desperate gap in the preparedness since the effective and complete tools, for training, are not available, hence leaving those at risk from snakebites vulnerable to poor handling, misidentification of snakes, and delay in response to medical emergencies. These are some of the factors that increase the number of severe snakebite cases and the rate of mortality, thereby increasing the burden on the country's health system. Secondarily, the social-economic effects of snakebites on the affected family or community may be high, with medical expenses due to the prolonged treatment and long recovery time causing financial burdens and loss of productivity.

The research proposes an innovative educational solution to tackle these critical challenges: an interactive physical prototype of snake-handling equipment integrated with a VR environment. This hybrid approach has been designed to link theory with practice under the safest possible conditions for practicing snake-catching techniques. For example, by using the VR module, trainees can carry out tasks in a highly simulated environment, in which they practice identifying and handling venomous snakes without running the risks presented by live interactions. The training is even enhanced due to the fact that physical prototypes provide users with practical insight into tools that would be used in reality.

This educational tool will serve to enhance the training experience of the individual in Sri Lanka to a more comprehensive and immersive one, hence reducing the risk of snake bites. Eventually, this approach will make the public safer, reduce pressure on healthcare resources, and contribute yet another dimension to the important field of educational technology, hopefully proving that it provides real value in a high-risk scenario through the use of VR in combination with conventional physical training tools.

2. Objectives

2.1. Main Objective

Such innovative education solutions to improve preparedness and safety when dealing with venomous snakes would be realized through integration of VR technology with the physical prototype of snake-handling gadgets. This will provide immersive, hands-on training in a safe environment with real-time feedback and adaptive learning that ensures a person is well-prepared to handle venomous snakes.

2.2. Specific Objectives

Designing and developing physical prototypes of snake tongs and hooks integrated into the virtual reality setting will provide a novel platform for the training of safe snake-handling techniques. The tools will be designed to give the closest resemblance possible in respect to weight, balance, and functionality as real equipment to allow trainees to develop relevant skills in a no-risk environment. Associating these physical prototypes with the VR environment allows the user to practice highly immersive training sessions for scenarios potentially involving venomous snakes.

Coupled with this are the physical tools—comprehensive safety and emergency procedure guidelines developed and integrated into the VR training. This guarantees that the trainee not only practices the right techniques but is also trained on how to react in case of an emergency.

These VR scenarios, tailored to simulate a great number of snake encounter situations, offer real-time tips and feedback while users practice the techniques for catching snakes. This approach improves learning outcomes and builds confidence—hence, safety—during handling of venomous snakes.

3. Methodology

3.1. System Architecture Diagram

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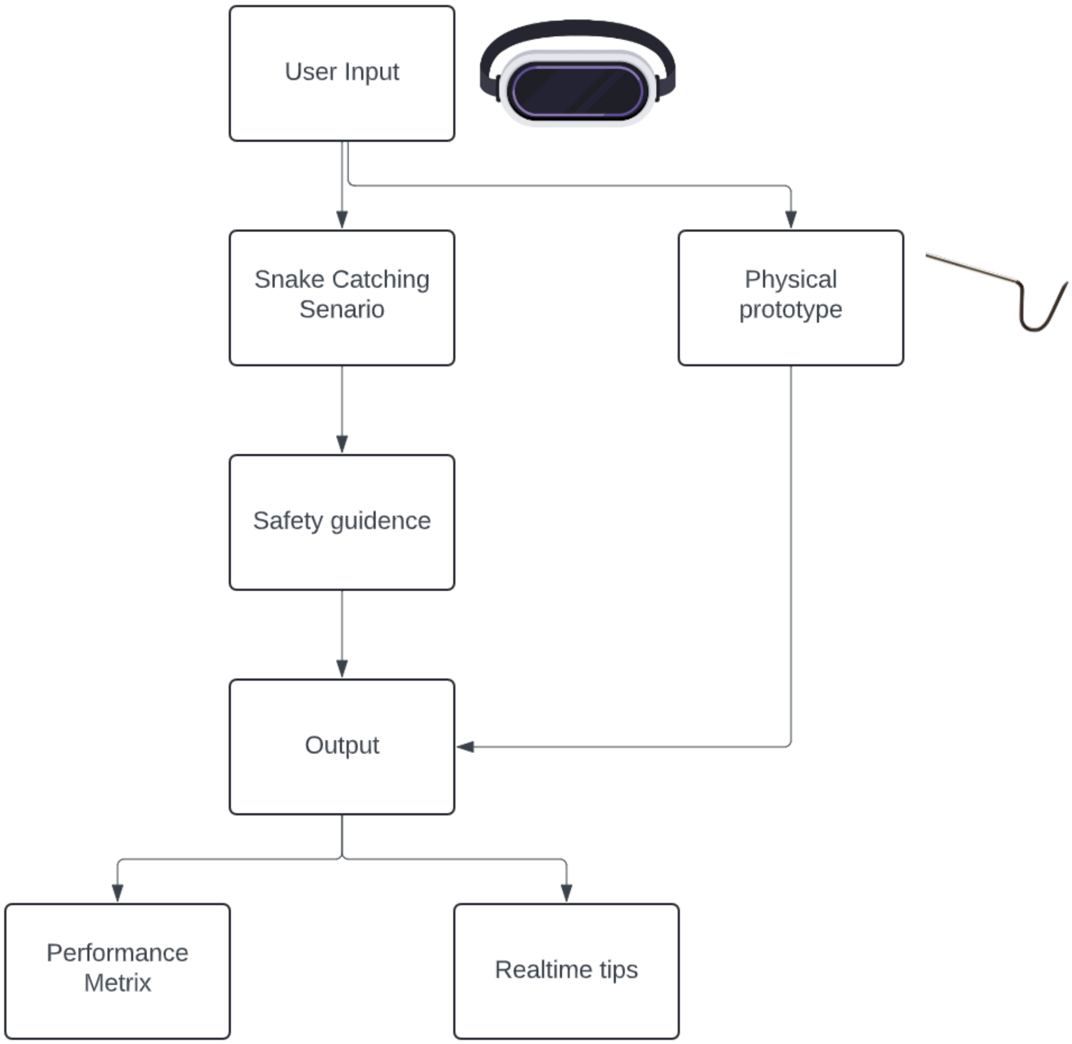

Figure 1. 1: System Architecture Diagram

3.2. Technologies to be used

The success of the project lies in the integration of the latest technologies that seamlessly merge to give a highly immersive and effective training solution. At the core lies Virtual Reality technology, which provides the ability to create ultra-realistic, interactive environments in which users can safely practice snake-handling techniques. Using VR allows simulating a number of scenarios happening in real life, thus providing trainees with a controlled environment without risks and leading them in developing their skills.

In parallel to this will be the use of 3D modeling and prototyping technologies for the design and construction of physical prototypes of snake tongs and hooks. These will be intricately engineered to take into consideration weight, balance, and functionality expected when handling snakes safely.

Sensor devices will also be installed within the constructed prototype tools in order to make the training exercises conducted with them lifelike. These devices will simulate the sensation of touching a living snake, providing instant feedback to the trainee. The VR training modules and scenarios shall be developed on effective game engines, such as Unity or Unreal Engine, together with the relevant SDKs for VR and sensor devices. Such a combination of technologies provides the possibility of developing an extremely interactive and adaptive environment for training, which could be improved in a continuous cycle.

3.3. Work Breakdown Structure

This Work Breakdown Structure of the project outlines major tasks and phases to be covered to achieve successful development and implementation. The project will commence with the Project Initialization phase, where the scope and objectives are defined, and a project team assembled with clearly assigned roles. This will be followed by the Design Phase, during which 3D models for snake-handling tools will be made, and virtual environments and snake models created. It will also include designing UI/UX for the VR application.

Following this will be the Prototype Development phase in which physical prototypes of snake hooks and tongs will be fabricated, integrated with sensor devices, and initial VR training modules will be developed. The scenarios will be developed in Unity or Unreal Engine by Software Development, who will also code the real-time feedback and interaction systems and integrate the physical prototype with the virtual environment. At the end of the development phases, the Testing Phase will be for unit testing of software components and user testing to collect feedback for refinement of the VR experience. Following this, user manuals, safety guidelines, and instructional videos shall be prepared. The output will finally enter the Finalization phase, where final testing and validation will take place before the deployment of the VR training solution and training, accompanied by support to end-users.

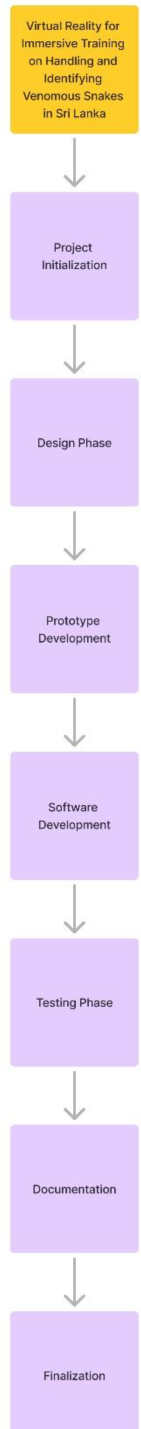

Figure 2 :1 Work Breakdown Structure

4. Project Requirements

Functional Requirements

- Realistic 3D models of snakes and handling tools
- Real-time interaction and feedback within the VR environment
- Comprehensive training modules on safe handling and emergency procedures

Non-Functional Requirements

- High usability and intuitive user interface
- Strong and reliable performance of the VR system
- Scalability to accommodate different scenarios for training purposes, with the extent this details.

Expected test cases

1.Verification of Physical Prototypes in the VR Environment

Ensure that the physical prototypes of snake hooks and tongs function correctly when integrated with the VR environment, allowing for accurate tracking and interaction.

2.Emergency Response Training Scenario

Verify that the VR environment can simulate emergency snake encounters and assess the user's ability to respond appropriately.

3.Usability Testing of the VR Interface

Assess the usability of the VR system interface, ensuring that it is intuitive and user-friendly.

4.Performance Testing of the VR System

Evaluate the performance of the VR system under different scenarios to ensure robustness, reliability, and scalability.

5.Gantt Chart

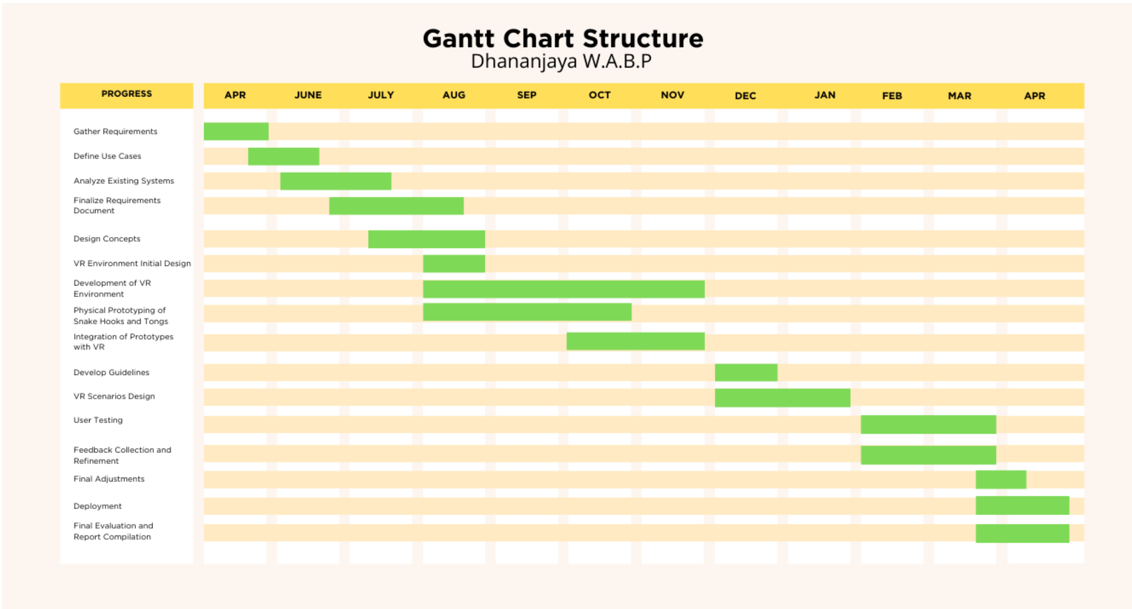

Figure 3. 1: Gantt Chart

6.Budget

The below Table Depicts the overall budget of the entire proposed system.

Requirement	**Cost (LKR)**
Travelling cost for data collecting	10,000.00
Cost for Creating Hook and Tong	20,000.00
Total Budget	30,000.00

Table 2: 1 Budget table

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8.Appendices

<u>Overall System Architecture Diagram</u>

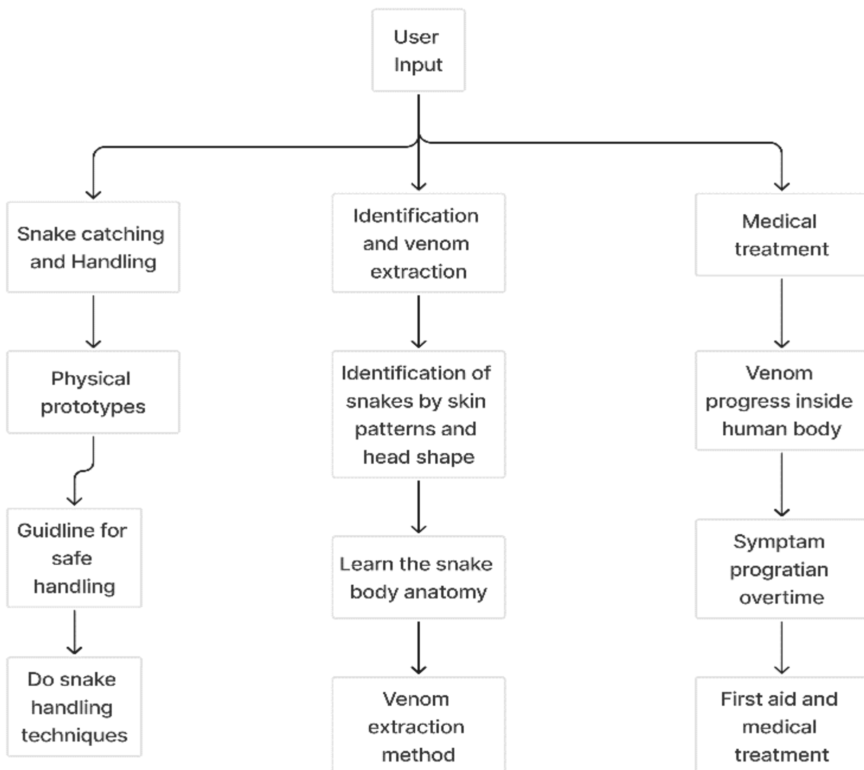

Figure 4.1 system