Prehistoric VR Simulations as educational content

R25-056

Project Proposal Report

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

Department of Information Technology

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Supervisor: Mr. Ishara Gamage

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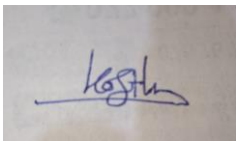
DECLARATION

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.

Group Member Name	**Student ID**	**Signature**
Kodithuwakku A K	IT21231582	

Signature of the Supervisor
(Mr. Ishara Gamage)

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Date

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ABSTRACT

This study proposes the development of a Virtual Reality (VR) system that simulates the lifelike behaviors of prehistoric animals through Artificial Intelligence (AI). Traditional simulations and museum exhibits often rely on static animations or scripted behaviors, which fail to represent the complexity and autonomy of real animal interactions. This limitation reduces engagement and does not adequately reflect scientific perspectives on survival behaviors such as hunting, avoidance, or herd dynamics. The proposed system focuses on modeling realistic animal behaviors fear, aggression, escape, and social interaction using machine learning integrated into Unity 3D. Unlike rule-based methods such as fuzzy logic, machine learning offers adaptability and context-driven responses, enabling animals to react differently depending on environmental cues and user interaction. The system will be designed for VR platforms such as Meta Quest to maximize immersion and user presence. By providing autonomous, dynamic simulations, this project bridges the gap between visual reconstructions and authentic behavior modeling. The outcomes will support museums, exhibitions, and educational institutions by offering interactive experiences that engage learners of all ages, encourage curiosity and improve scientific understanding of prehistoric ecosystems. This proposal specifically focuses on the **Prehistoric Animal Behavior Simulation** component.

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LIST OF ABBREVIATIONS

Abbreviation	**Description**
AI	Artificial Intelligence
VR	Virtual Reality
ML	Machine learning
SDK	Software Development Kit

1. INTRODUCTION

1.1 Background & Literature survey

Conventional museum exhibits and digital reconstructions of prehistoric life often rely on animations or scripted behaviour loops. While visually appealing, these approaches lack autonomy and interactivity, making them less engaging for educational use. Previous studies have explored AI-driven behaviour modelling, including fuzzy logic and rule-based systems, but these methods are limited in adaptability.

Machine learning integrated with VR presents a powerful alternative, allowing animals to display behaviours influenced by factors such as health, confidence, group dynamics, and environmental conditions. Recent applications of VR in museums and projects such as *Dinosaurs* demonstrate the demand for immersive prehistoric experiences, but few focus on autonomous, adaptive behaviours.
This project builds on these foundations by introducing AI-driven behaviour simulation for educational engagement.

1.2 Research Gap

Existing VR applications in museums and educational platforms primarily focus on **visual immersion**, offering static 3D models or scripted animations of prehistoric animals. While these methods provide engaging visuals, they lack **autonomous, adaptive behaviors**, resulting in limited interactivity and educational depth. Previous research has explored fuzzy logic and rule-based systems for animal simulation, but these approaches struggle with scalability and realism. Furthermore, extinct species' behaviors are rarely modeled through **machine learning**, leaving a gap in creating lifelike, context-driven interactions. Addressing this gap, the proposed system integrates AI-driven behaviors in VR, enhancing both credibility and learner engagement.

1.3 Research Problem

Virtual Reality (VR) has emerged as a powerful tool for education, particularly in subjects where direct observation or experimentation is not possible, such as prehistoric studies. Museums and educational institutions have adopted VR to present extinct animals and ecosystems, but most current implementations rely on static models or scripted animations. These approaches offer visual immersion but fail to capture the complexity of animal behaviour, leading to experiences that are more passive than interactive. Without adaptive and autonomous behaviours, prehistoric animals appear artificial and predictable, reducing the credibility of the simulation and limiting its educational impact.

Previous research has attempted to introduce AI into animal simulations through rule-based and fuzzy logic systems, which provide some behavioural variety but remain restricted in scalability and realism. These systems cannot effectively model context-dependent behaviours, such as fleeing, aggression, or social interactions, which are crucial for creating believable ecosystems. Moreover, there is little evidence of machine learning being applied to extinct species in VR, leaving a significant gap in both scientific accuracy and user engagement. The research problem, therefore, is to design a VR system that integrates **AI-driven, adaptive animal behaviour** to provide scientifically plausible, interactive, and educationally effective prehistoric simulations.

2. OBJECTIVES

2.1 Main Objectives

- To develop a VR-based prehistoric animal behavior simulation that demonstrates realistic, autonomous interactions driven by AI.

2.2 Specific Objective

- Model lifelike behaviors such as escape, avoidance, fear, and aggression using machine learning.
- Enable real-time user interaction with AI-driven animals in VR
- Create immersive prehistoric ecosystems that reflect ecological and survival dynamics.
- Test and evaluate user engagement, learning outcomes, and system performance.

3. METHODOLOGY

3.1 Understanding the key pillars of the research domain.

3.1.1 Implementing Prehistoric Animals and Environment

High-quality 3D models and environments will be created and optimized for VR. Animals will be designed with AI controllers that allow autonomous responses to environmental changes and user actions.

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3.1.2 Behavior modeling with Machine learning

Unlike scripted animations, animals will use machine learning (e.g., Unity ML-Agents) to adapt behaviors based on health, environmental triggers, and group dynamics. This ensures unpredictability and realism.

3.1.3 Immersive User Interaction

The system will allow users to observe, trigger, or influence animal behaviors through VR, creating a sense of presence and participation in prehistoric ecosystems.

3.2 System Architecture Diagram

The high-level architecture diagram illustrates the overall system design of the *Prehistoric Animal Behavior Simulation*. It highlights how users interact with the system through a **VR headset (Meta Quest)**, which connects them to the **Unity VR application**. Inside Unity, the **Ecosystem Runtime** manages perception, behavior, and physics, while **AI inference models** (trained using Unity ML-Agents) control the autonomous behavior of prehistoric animals.

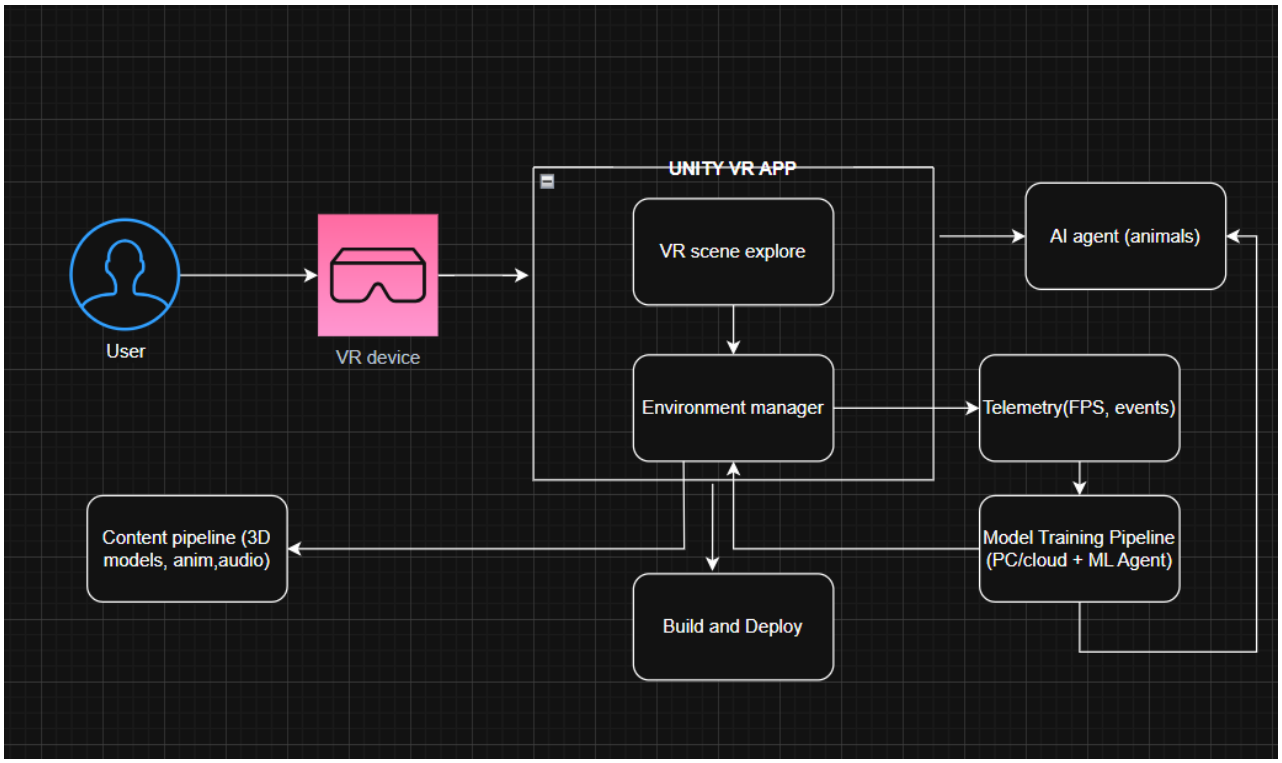

Figure 3. 1: High Level Architecture Diagram

3.3 Project Requirements

3.3.1 Functional Requirements and Non-Functional Requirements

Table 3. 1: Functional and Non-functional requirements

Functional Requirements	**Non-Functional Requirements**
Animals Should autonomously Demonstrate different behaviors.	State-of-the-art VR on independent headsets (such as Meta Quest).
Users should be able to trigger behaviors through interaction.	Scientifically credible animal behaviors.
Systems should simulate ecological interactions between species.	Easy-to-use, intuitive user interface.

3.3.2 System Requirements

- Software requirements
    - Unity
    - Blender
    - Unity ML-Agents Toolkit (machine learning)
    - Meta Quest headset (VR hardware)

3.4 Software Solution

High-quality software design, development, and testing are outlined in the Software Development Life Cycle (SDLC). Nonetheless, one of the simplest and most effective ways to produce a top-notch product is using the agile software development technique.

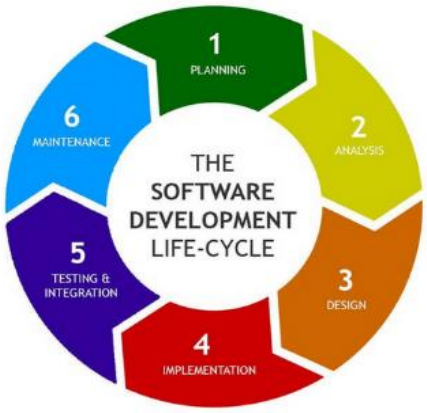

Figure 3. 2: Agile Software Development Cycle

3.4.1 Requirement Gathering and Analysis

- **Requirements gathering**

Needs were gathered through a bibliography of books, videos, and web resources and supplemented by field expert advice. The materials guaranteed scientific validity, accuracy in history, and pedagogical appropriateness. Research aimed to determine user needs, learning objectives, and technical feasibility to create an interactive and pedagogically valid VR timeline experience.

3.4.2 Feasibility study

- **Technical Feasibility**

  Unity 3D and ML-Agents provide strong support for VR and AI integration.

  Main challenges include real-time performance optimization and balancing realism with computational limits**.**

- **Market Feasibility**

  Target users include museums, educational institutions, and VR-based learning platforms. Studies show strong interest in VR-based prehistoric experiences, with AI-driven behavior adding unique market value.

- **Operational Feasibility**

  The system will feature guided interaction and intuitive controls, making it accessible to non-technical users such as students and museum visitors.

- **Scheduling Feasibility**

  The component will be completed in scheduled phases: prototype development, AI training, VR integration, and testing.

3.4.3 Implementation

The implementation phase consisting of sub functionalities as below,

- Create Accurate prehistoric environments, Optimized them for maximum efficiency
- Creating animal activities
- Create interactions for users

3.4.4 Work breakdown chart

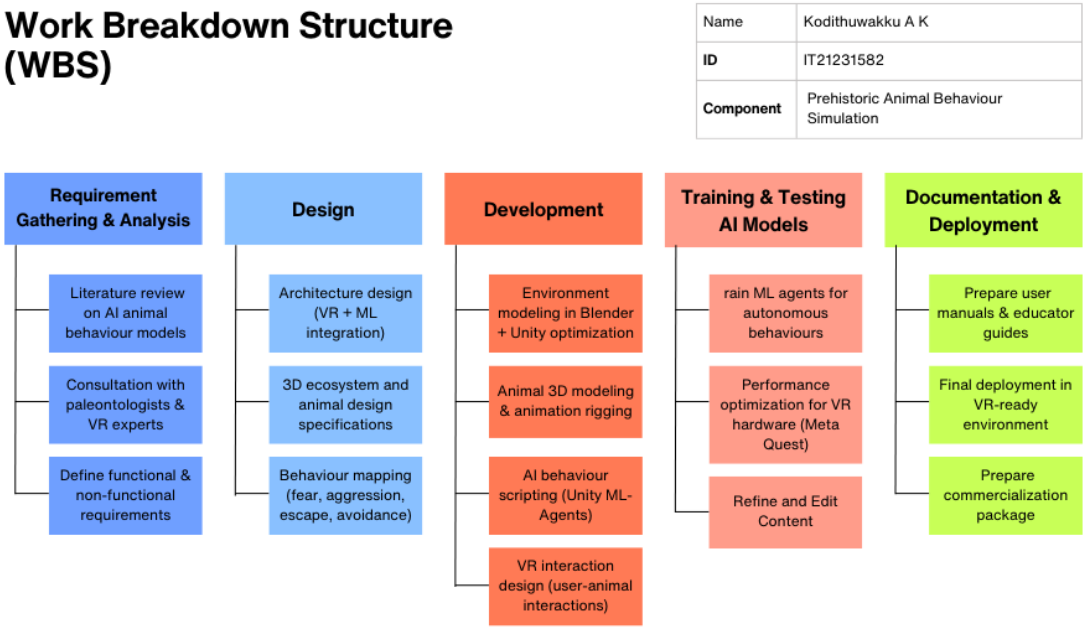

Figure 3. 3: Work breakdown chart

4. GANTT CHART

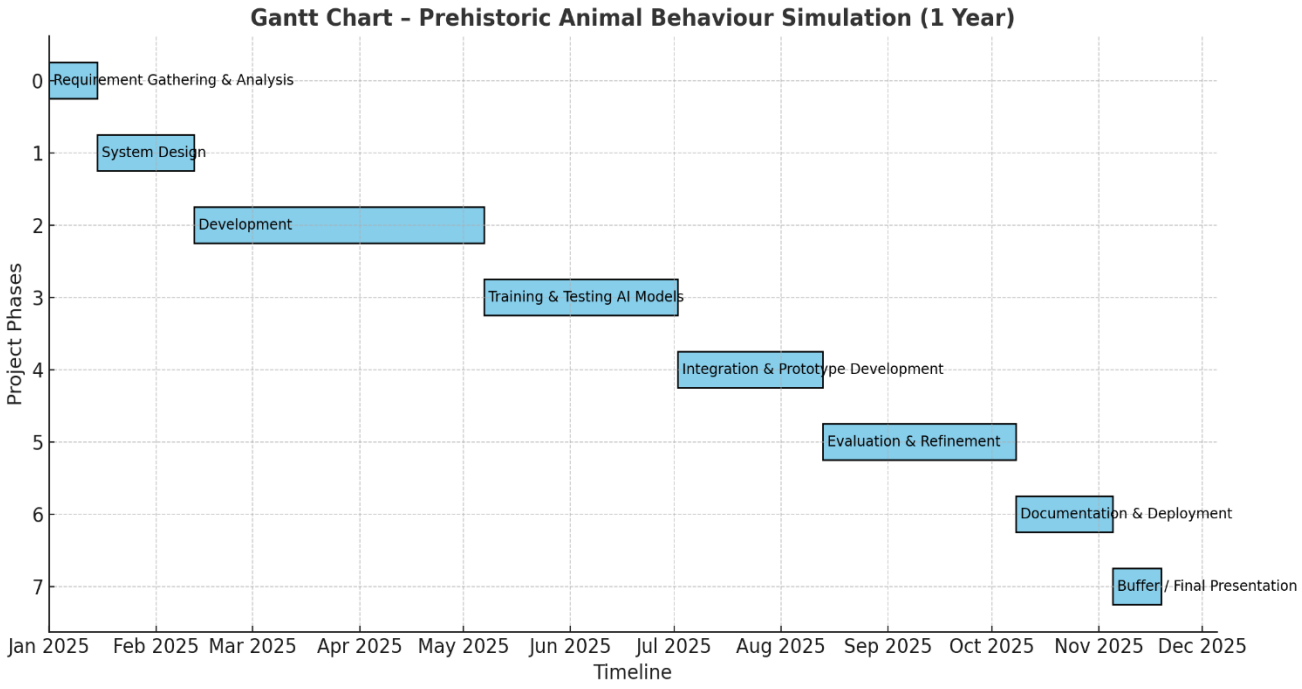

Figure 4.1: Gantt chart

5. DESCRIPTION OF PERSONAL AND FACILITIES

- Facilitators:

  Mr. Ishara Gamage – Sri Lanka Institute of Information Technology (SLIIT).

  Mr. Nushkan Nizmi – Sri Lanka Institute of Information Technology (SLIIT).

6. BUDGET AND BUDGET JUSTIFICATION

Table 6. 1: Budget Plan

Requirement	**Cost (Rs.)**
3D animal models	5000-10000
VR Headset (Meta Quest)	160,000
AI & VR software tools	20,000
Total	180,000 – 190,000

7. COMMERCIALIZATION

7.1 Target Audience and Market Space.

- **Target Audience.**
  - Museum visitors (12+)
  - Students in schools and universities
  - Science enthusiasts
  - Museums and cultural institutions seeking modernization

- **Market Space.**

  The project positions itself within the growing edutainment sector, offering immersive learning that combines entertainment with scientific accuracy. Unlike existing VR museum systems, this simulation emphasizes AI-driven animal autonomy, providing a novel selling point.

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