**“ A digital platform that educates about wildlife's importance and ways of conserving species”**

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Course: Mission Capstone

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Year 3

**Declaration**

I, Marie Beline Mugisha Ahujabe , declare that this research proposal entitled Ecoguard is my original work and has not been presented for a degree or any other academic award in any university or institution of learning. All sources of information have been duly acknowledged.

Signature: Beline Marie Mugisha Ahujabe
Date: 11,September,2024

## List of Figures

**CHAPTER ONE: INTRODUCTION**

# 1.1. Introduction and Background

The continent of Africa is inhabited by a variety of species that differ from one another, but the number of these species is being threatened by various factors such as habitat destruction, climate change, poaching and human-wildlife conflict. In order to deal with such challenges, digital platforms and technology have appeared on the scene to help in conserving endangered species, increase environmental monitoring and get local people involved in preservation programs. Therefore, this provides new opportunities for efficient wildlife management throughout Africa since data-driven technologies are combined with community-based initiatives.

In the realm of wildlife conservation, technological advancements have entailed how to monitor species, manage protected areas and mitigate against illegalities such as poaching. The Geographic Information System (GIS) mapping and Global Positioning System (GPS) tracking are some of the notable technologies that are being used in Africa. These tools play a significant role in tracking movement patterns of wildlife, monitoring habitats and also identifying threats such as poaching (Rands et al., 2010). For example, GPS collars placed on elephants in kenya helped conservationists understand their migration patterns while decreasing human-wildlife conflicts (Blake et al., 2009).

Equally important is the introduction of camera traps which allow for collecting information about wild life without human interference. A case at hand is the Zooniverse platform that allows members of the public to tag photographs taken by camera traps; thus generating precious data on species behavior and distribution (Swanson et al., 2016). Furthermore, this has been used to identify rare species within secluded parts of Africa that are hard to survey through conventional means.

Real-time aerial monitoring of protected areas has been ensured by the adoption of drones and unmanned aerial vehicles (UAVs) in Conservation. These mechanisms are especially beneficial in extensive reserves where monitoring by foot or vehicle is unfeasible. Therefore, a reduction in poaching cases was attained through tracking rhinos from space using drones in South African parks such as Kruger National Park that is one of the largest game reserves globally, hence enhancing policemen’s reaction speed to illegal activities (Pimm et al., 2015).

The active involvement of local communities is often the key to the success of digital platforms in wildlife conservation. Many conservation organizations in Africa have developed mobile applications and SMS-based platforms that allow community members to report illegal activities and view wildlife sightings. For instance, rangers and community members in South Africa use this mobile platform, CyberTracker, to observe wildlife and keep track of poaching activities (Liebenberg et al., 2017).

Such involvement from the community contributes significantly to ensuring sustainability and appropriateness culturally in conservation efforts. With the help of digital tools, local people are empowered not only in gathering information but also feeling personally responsible for maintaining biodiversity. Studies indicate that conservation initiatives which include local people have higher chances of having lasting impact (Brooks et al., 2013).

Wildlife conservation in Africa has been given fresh life by the introduction of artificial intelligence (AI) and machine learning. More and more, AI algorithms are being applied to vast datasets that include satellite imagery and camera trap data, to detect trends in species populations and identify illegal operations (Christin et al., 2019). For example, Wildbook is an AI-powered platform that uses pattern identification techniques to recognize single animals such as zebras or giraffes from their photographs so that population dynamics can be monitored without any tagging (Schofield et al., 2019).

Moreover, predictive models use environmental variables and past poaching incidents to forecast poaching hotspots enabling more effective deployment of anti-poaching patrols (Critchlow et al., 2015). Poaching continues to pose a serious danger for wildlife populations; thus these tools have helped improve on their law enforcement effectiveness especially in countries like Kenya and Tanzania.

In spite of the digital technologies' supremacy, there are many hindrances for its massive usage on African landscape preservation activities. The infrastructure required for advanced technologies like surveillance vehicles or artificial intelligence based platforms is missing in most remote areas. Besides, the price of both introducing and running these technologies may be unaffordable for tiny conservation organizations (Art et al, 2015).

To bridge digital gaps on nature conservation means creating a capacity-building program alongside infrastructural enhancement aimed at making digital equipment accessible to local people. Moreover, it is necessary that cooperation between environmental movements with governments and private sectors be established so that such technologies can be obtained without any difficulties or high costs. In some parts where internet services are not available, SMS powered mobile platforms like M-Pesa in Kenya have been useful substitutes used during data collection and community involvement (Donner, 2007).

The need for intelligent and original conservation solutions is exceptionally high. Superior technology now gives new chances to protect animal life and educate people about why biodiversity is essential. The World Wild Fund for Nature's "Living Planet Report 2020" puts forward the urgency and potential technology to meet conservation goals of protecting our living planet. ("WWF Living Planet Report 2022").

## 1.2. Problem Statement

Despite the significant strides in wildlife conservation, many protected areas in Africa are struggling to maintain biodiversity due to limited access to accurate, real-time data and the inefficiency of current monitoring systems. These challenges have led to ineffective management of protected areas, loss of endangered species, and inadequate responses to human-wildlife conflicts. Human activities and climate change are seriously threatening the rich wild animals of Africa. These challenges have shown that more than traditional approaches to conservation are required. Modern technology should be used to create new strategies to protect wildlife and teach people about its significance. This proposal aims to bridge this gap through a technology-embedded means of promoting wildlife preservation and knowledge of it.

## 1.3 Project's main objective

To establish an elaborate system to create awareness on the importance of wildlife conservation and also showcase sophisticated technologies to track and safeguard endangered species.

### 1.3.1 list of specific objectives

I. Gathering community data

II. use the data to create beneficial platform

III. Developing a broad platform to sensitize individuals about the value of wildlife preservation.

IV. Integrating advanced technological approaches in monitoring and securing endangered species.

V. Promoting sustainable tourism and eco-friendly practices as a viable source of income from wildlife conservation in Rwanda

VI. Cooperating with communities around to enhance the effective implementation of conservation measures.

## 1.4 Research Questions

I. How can the technology be iterated to save more wildlife in Africa?
II. What are the significant dangers to biodiversity in Africa, and what are the ways to lessen the impact?

III. What is the way to make wildlife conservation more attractive to people and, in turn, increase citizens' engagement?
IV. What are the intrinsic economic gains of wildlife preservation, and how can they be environmentally feasible?
V. What do communities think about wildlife conservation?

# 1.5 Significance and Justification

The research is crucial because of its extensive ability to deal with the fundamental concern of African wildlife loss. The proposal intends to attain a considerable positive effect on wildlife conservation efforts by setting up a platform that gives education and uses technological alternatives. The above-mentioned is one of the 14 global challenges - the one responsible for keeping the balance in the environment and representing the Earth's very biodiversity. Additionally, sustaining wildlife conservation as a source of revenue can be an aspect of the economic development of the local communities, which will build a cooperative relationship between the people and the environment.

# 1.6 Scope

Endangered Animals in Rwanda’s Akagera National Park is the particular focus of the study and it will be undertaken in partnership with local communities, nature care organizations as well as experts. Wildlife conservation matters that will be included in the project are different such as; The integration of digital platforms with education for improving wildlife conservation techniques, Technological innovations towards species protection and how economically viable all these are. This project intends to blend training with technology so that it can augment nature protection activities while being a model for replication in areas that happen to be facing similar wildlife conservation issues. The estimated duration of the study is between 6 to 12 months comprising research phase, development phase, community involvement phase and outcome tracking period. Local Rwandan community will be the main focus in terms of population alongside other stakeholders like local governments, NGO’s, conservationists as well as international wild-life bodies who are all coming together for sustainable conservation solutions.

**CHAPTER TWO: LITERATURE REVIEW**

## 2.1 Introduction

The historical evolution and current state of digital platforms in wildlife conservation, specifically in Africa are examined in this chapter. A review of relevant literature, current practices, and existing systems is undertaken with an emphasis on strengths and weaknesses. The assessment will shed light on the effectiveness of digital platforms and technological solutions in wildlife preservation.

## 2.2 Historical Background of the Research Topic

Conservation activities for wildlife in Africa are characterized by the protection of endangered species, formation of national parks and global cooperation. For a long time, conservation strategies were primarily based on legal frameworks and manual monitoring techniques that proved ineffective due to their limitations in efficiency and coverage. However, the introduction of technology such as satellite imagery, GPS, and mobile applications marks a turning point in the management and monitoring of conservation efforts. The adoption of these technologies is important for improved real-time monitoring of wildlife populations, detection of illegal activities and community participation in conservation (Adams & Hutton, 2007).

The use of drones, AI, and big data analytics has enabled conservationists to cover larger areas with fewer resources, resulting in more frequent and accurate data. A program such as

SMART (Spatial Monitoring and Reporting Tool), which is increasingly being adopted by African wildlife reserves for monitoring illegal poaching activities, is an example of the success of these technologies (Zafra-Calvo et al., 2019). This historical shift towards digital platforms in conservation has opened new avenues for protecting endangered species.

## 2.3 Overview of Existing Systems

There are several digital platforms for wildlife conservation in Africa ranging from mobile applications to sophisticated AI based monitoring systems. The most common ones include:

- SMART (Spatial Monitoring and Reporting Tool): A software platform that facilitates better management of protected areas through data driven monitoring;
- Wildbook: An AI based platform used to identify and keep track of individual animals using pattern recognition;
- Zooniverse: this is a citizen science platform that uses the public in tagging and classifying wildlife data gathered using camera traps.
- CyberTracker is a mobile application designed for field data collection by rangers and community members, enabling real-time wildlife monitoring.

In addition, these platforms make use of GPS, remote sensing technologies and mobile communication systems for tracking wildlife populations as well as their threats with much detail and precision. While they are efficient in detecting illegal acts and monitoring populations, they also have disadvantages like being dependent on internet access or having weak technological structures especially in the rural areas (Pimm et al., 2015).

## 2.4 Review of Related Work

Digital conservation technology research has shown that changing the way we do things is very important for overcoming old limitations. One way is through drone use in monitoring large conservation areas whose terrain are difficult to access (Mulero-Pázmány et al., 2014). For example, droning is quite useful in surveillance and anti-poaching campaigns within countries like South Africa where there are still plenty of rhinos being killed by poachers (Pimm et al., 2015). Moreover, the introduction of AI in camera traps has enhanced species identification as well as monitoring populations in large ecosystems such as Serengeti (Schofield et al., 2019).

According to a research by Liebenberg et al. (2017), mobile applications like CyberTracker allow local communities and rangers to report wildlife sightings and illegal activities. This deliberate participation is essential for conservation in remote regions where state and non-state actors cannot always be found.

Research conducted by Arts et al. (2015) examines the challenges and opportunities of using digital platforms in conservation, pointing out the need for improved infrastructure and training on technology usage for the community. Other studies have also pointed to an emerging trend where Artificial Intelligence (AI) and machine learning are becoming increasingly important in conservation, especially in predictive modeling of poaching hotspots and animal migration patterns (Christin et al., 2019).

### 2.4.1 Summary of Reviewed Literature

The literature reviewed shows that there is a need for integrating digital platforms into wildlife conservation programs, especially in Africa where vast areas with insufficient resources could not be served adequately through traditional means. A few successful approaches have included use of GPS tracking devices; AI; camera traps among other mobile

Apps (notably) which improved on conservation outcomes. However, obstacles still exist especially regarding access to technology and infrastructure development in rural areas (Brooks et al., 2013).

## 2.5 Existing Systems' Strengths and Weaknesses

Current digital platforms possess several strengths:

• Data collection and monitoring in real-time: Wildlife movement and poaching activities can be observed immediately on SMART and CyberTracker, for example.

• Involving local communities: Participatory approaches are adopted in hunting platforms such as CyberTracker that encourage ranger participation among other people to enrich conservation efforts.

• Accuracy and coverage improvement: Unmanned aerial vehicles (UAVs) powered by AI have made it possible to monitor larger areas with more precision even remote or hard-to-reach locations compared to traditional methods.

However, they also have some weaknesses:

• Infrastructure constraints: Most rural regions of Africa do not have adequate technological infrastructures needed for advanced digital tools' complete use including internet connectivity and electric supply.

• Cost: Smaller conservation organizations cannot afford drones, AI systems, or any other technological apparatus because of their expensive nature.

• External funding dependency: According to (Critchlow et al., 2015), many systems require continuous external funding which may become unstable and subject to the changes in donor priorities.

## 2.6 General Comments

Digital platforms' part in safeguarding wildlife has increased immensely giving rise to fresh answers for age-old problems. Even though such platforms have exhibited superlative promise especially on enhancing data credibility and encouraging local participation-they are still hemmed by constraints like expenses, physical set-up and sustainability among others. In order to break those boundaries; funding systems, capacity development for communities as well as advancements into rural technological structures will be the primary focuses of upcoming studies.

**CHAPTER THREE: SYSTEM ANALYSIS AND DESIGN**

# 3.1 Introduction

In this section, we will discuss how we designed and developed a platform aimed at educating local communities on conservation of wildlife. The system promotes user interaction by allowing them to exchange thoughts in forums and even give money through a donation feature. The platform embraces a participatory approach to species preservation while concentrating on new conservation techniques and involving different stakeholders.

# 3.2 Research Design

The Agile methodology of development allows for totaling continuous feedback and modification to user interactions. This methodology emphasizes flexibility, velocity and the need for re-designing in response to the different community members' demands because it takes an iterative approach. (what data and collection methods and the target group)

# 3.3 Functional and Non-functional Requirements

Functional Requirements:

- Login and Signup System: A secure system for users to create accounts and log in to access personalized features, such as saved content, discussion participation, and donation tracking.

- Educational Modules: Interactive educational materials that teach users about the importance of conservation and innovative technology in wildlife preservation.

- Community Forum: A space for users to discuss local conservation challenges, share ideas, and engage in dialogue with stakeholders and experts.

- Donation Feature: A payment gateway for users to contribute financially to wildlife conservation projects.

- Event Calendar: A tool for stakeholders to post and promote conservation-related events like training, workshops, and awareness programs.

- Feedback Mechanism: A system allowing users to provide feedback on the platform's content and functionality, ensuring continuous improvement.

Non-Functional Requirements:

- Usability: Minimal technical skills will be needed for an easy-to-use system with an intuitive interface.
- Security: HTTPS protocol, encryption and secure payment gateways will be used to ensure that user data and transactions are safe especially in the donation feature.
- Scalability: Increasing number of users, educational resources and forum discussions will be managed by the system.
- Accessibility: Support for local languages and device compatibility ensures that urban and rural users in different parts of the country can access it.

## 3.4 System Architecture

The platform has a three-tier architecture defined as follows:

- Presentation Layer: Includes web and mobile interfaces where users access educational content, take part in forum discussions, and make donations.
- Application Layer: This is the logic that manages user accounts including delivering content, processing donations and facilitating discussions on forums.
- Data Layer: It includes databases that contain user information such as personal records, educational materials as well as financial statements kept securely in cloud storage service which is also highly scalable.

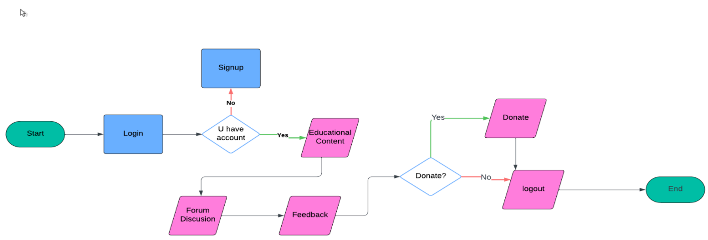
## 3.5 Flowchart, Use Case Diagram, Sequence Diagram, and Other Diagrams

Flowchart:

The flowchart outlines the user experience:

Login/Signup → Access Educational Content → Join Forum Discussions → Provide Feedback → Make Donations → Logout. Each action interacts with the system's back end for content delivery, user data updates, and transaction handling.

Figure 1.Flow Chart




Use Case Diagram:

The use case diagram presents three primary actors:

- ➔ User: Logs in, accesses educational content, posts in the forum, provides feedback, and donates.
- ➔ Admin: Manages content, moderates forums, and monitors donations.
- ➔ Guest: Can browse limited content but must sign up to participate in discussions or donate.

Sequence Diagram:

The sequence diagram illustrates the interaction of a user who logs in, views educational content, participates in a forum, and makes a donation. Each action sends requests to the server, which processes and responds by updating the user interface and database.

Other Diagrams:

- ➔ ER Diagram: Represents relationships between users, donations, forum posts, educational content, and events.

- ➔ Deployment Diagram: Shows the cloud-hosted deployment model, with user access via web and mobile interfaces.

## 3.6 Development Tools

The development of this platform will require development tools are:

Programming languages:

- ➢ Backend: Flask framework using Python.
- ➢ Frontend: ReactJS for web, React Native for mobile in JavaScript.

Database:

- ➢ Relational database (PostgreSQL) for storing user and donation details.
- ➢ NoSQL database (MongoDB) for storing forum text contributions and interactive multimedia sources of education.
- ➢ Cloud Hosting: Google Cloud would be the other reliable and scalable hosting options.
- ➢ Version Control: source code management with git & GitHub.
- ➢ Payment Gateway: stripe or PayPal to enable secure retrieval of donations.
- ➢ User Authentication: Firebase Authentication enables login and sign up features safely.

The platform focuses on user experience as well as security so as to offer an all-in-one solution that caters to both wildlife conservation education as well as community engagement that can be expanded over time.

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