Wildlife Spotting and Sharing System for Kenyan Safari Game Drives

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ABSTRACT

Traditional wildlife spotting on Kenyan Safari Game Drives, rooted in visual scouting and sporadic communication, encounters challenges in animal detection efficiency and environmental preservation. In light of rejuvenating post-pandemic tourism and enhancing safari experiences, this study proposes a wildlife spotting and sharing system. The methodology melds wildlife detection and sharing technologies, anchored by three core principles: preserving chance of encounters, regulating information accessibility, and endorsing environmental conservation. The system architecture employs sensors, GPS, and tablet terminals for real-time data acquisition, animal identification, and information propagation. This approach aims to nurture an engaging, efficient, and eco-conscious wildlife spotting and sharing experience, potentially setting a benchmark for sustainable wildlife tourism in similar wildlife-rich regions.

CCS CONCEPTS

• **Networks** → **Location based services**.

KEYWORDS

Game drive, Navigation, Animal protection, Entertainment

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1 INTRODUCTION

Kenya's wildlife tourism sector thrives significantly on its game drives, presenting a unique gateway into the wild realm where visitors can encounter a diverse range of wildlife. Game drives, hallmarks of Kenyan tourism, unravel in natural wildlife habitats such as nature reserves and wildlife sanctuaries. In this venture, tourists board specially-designed vehicles to observe wildlife first-hand in their natural milieu, guided by seasoned guides elucidating the behaviors and habits of the wild fauna. The expedition, often stretching over several hours, offer a chance to witness the spectacular array of wildlife including lions, elephants zebras, giraffes, and others, while savoring the natural beauty and diversity of the ecosystem. The allure of game drives in safari is often heightened by unexpected encounters with wildlife, traditionally hinged on visual scouting by guides and sporadic sharing of sightings information between vehicles.

The global tourism landscape, including Kenya, grappled with a substantial downturn post the COVID-19 pandemic. Revitalizing game drives has emerged as a linchpin in the endeavors toward reviving Kenya's tourism industry. However, the existing manual methods of animal spotting and information sharing during game drives harbor inefficiencies. There are instances where tourists spend extensive hours on drives with minimal wildlife sightings. Moreover, the clustering of numerous vehicles around a spotted animal could induce stress in the wildlife,spotlighting the need for a more organized information-sharing mechanism that also factors in animal welfare. As examples of tourists having a negative impact on wildlife, Ranaweerage et al.[8] argue that the presence of tourists during elephant-watching activities in protected areas of Sri Lanka significantly increases the frequency and duration of alertness, fear, stress, and aggressive behaviors among different age and sex groups of elephants. Additionally, Kays et al.[5] mention the potential for tourist behavior to lead to a decrease in the population of wild animals and a disruption in the activity patterns of these animals. Striking a balance between enhancing the detection and share of animal sightings and preserving the quintessential thrill of unexpected wildlife encounters presents a complex challenge awaiting resolution.

The primary aim of this study is to design, develop, and evaluate a wildlife spotting and sharing system on Kenyan game drives. We have named this system SafariCast. This initiative delves into the potential effectiveness, efficiency, and engagement levels such a system could usher in this unique setting. Additionally, it explores how this system could meld the enhancement of animal detection and information sharing among tourists with the preservation of the authentic safari experience of unexpected wildlife encounters.

This study carves a unique and crucial niche, especially in a post-pandemic scenario where rejuvenating tourism is imperative for Kenya's economic resurgence. The insights to be gleaned could potentially delineate a framework for harnessing technological integration in wildlife conservation efforts, tourist engagement, and the sustainable management of game drives. This could set a

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precedent not only for Kenya but possibly extend to other wildlife-rich nations, highlighting a sustainable pathway towards enhancing wildlife tourism experiences.

2 RELATED RESEARCH

The confluence of animal detection and location sharing systems propels a novel interdisciplinary approach towards enhancing wildlife spotting experiences on game drives. The exploration of related research in these domains elucidates the evolution of methodologies and technologies, forming a robust foundation for the proposed study. As examples of studies monitoring tourists and wildlife in protected areas, Kim et al.[6] argue that monitoring and predicting tourists' spatial movement patterns from mobile phone data have the potential to contribute to biodiversity management Additionally, Barros et al.[1] predicted peak visitation periods by tourists using geotag data and verified the potential utility of visitors' time patterns as surrogate indicators for visitation rates.

2.1 Animal Detection

Park et al.[7] explore a cloud-based system used in a Smart Farm environment for real-time animal monitoring and detection. This system is designed to oversee the health and behavior of animals, providing alerts in case of abnormalities, ultimately ensuring the welfare of livestock. Karlsson et al.[4] focus on the tracking and identification of animals within a digital zoo context. The study is geared towards monitoring the location and behavior of animals, with a digital platform developed to disseminate information to visitors, thereby enriching their zoo experience.

2.2 Wildlife Communication Systems

The ZebraNet project[3], as explored by Jones et al., investigates energy-efficient computing techniques for wildlife tracking. This research outlines the design tradeoffs entailed in developing a system that optimizes energy efficiency while effectively tracking wildlife, offering early experiences and lessons from the ZebraNet deployment. Nisrine et al.[2] delve into a smart system for the collection and sharing of real-time vehicular mobility traces. Although the context differs, the methodologies and technologies explored could be relevant to devising an information-sharing system between vehicles during safari drives, ensuring efficient communication about wildlife sightings while minimizing environmental impact.

These studies collectively constitute a mosaic of methodologies, technologies, and experiences that could inform the design, development, and evaluation of SafariCast in the distinctive setting of Kenyan Game Drives. The gleaned insights from these studies could potentially steer the harmonization of animal detection enhancements with the preservation of authentic safari experiences, aiming towards a sustainable and engaging wildlife spotting and sharing endeavor.

3 SAFARI CAST

The proposed method—SafariCast—encompasses an integrated approach aimed at enhancing the game drive experience while being cognizant of environmental preservation and the ecosystem's natural dynamics. The approach is built around three core elements: maintaining chance, limiting information, and environmental conservation.

3.1 Requirements

Encountering wildlife during a game drive is inherently thrilling. Our approach aims to preserve this excitement while implementing a structured information-sharing system.

3.1.1 Providing the necessary information to encounter animals. In the current game drive, the primary mode of communication is one-on-one information sharing among local guides, which is not an efficient method of information sharing. Our proposed method aims to collect location information of animals from all participants, distribute it appropriately, and maximize participant satisfaction.

3.1.2 Preserving the enjoyment of the game drive itself. To avoid overwhelming tourists with excessive information that may diminish the element of surprise and potentially harm the environment, we will establish a system to limit tourists' access to information. The location information of animals is first shared to participants with lower satisfaction levels. The shared animal location information is displayed on the vehicle's tablet terminal as a circle with a 1 km radius centered around the point where the animal was spotted. This ensures that the excitement of finding animals is not compromised, makes it easier to spot animals, and prevents vehicles from clustering around animals. Additionally, limits on information disclosure help to restrict and control the number of vehicles within the 1km range around the animal, thus maintaining a situation where congestion is less likely to occur.

3.1.3 Environmental Conservation. Given the tendency for vehicles to cluster around rare wildlife sightings, notably the Big 5 (Elephant, Buffalo, Lion, Leopard, and Rhinoceros), and spectacular events such as the mara river crossing, a mechanism will be instated to regulate vehicular approach when a threshold number of vehicles are in proximity to a target animal or area, thereby prioritizing animal welfare and impact on habitat.

3.2 Assumed Equipments

3.2.1 Hardware Components. Tablet terminals will be deployed, displaying a map of the safari, current location, vegetation, and a probabilistic range of animal presence based on prior encounters. Also, the sensors used by the terminals are as follows. Within the safari area, vehicles can connect to the network through the tablet devices.

- GPS: To obtain precise location data of the vehicles and potentially sighted animals.
- Camera: Using camera images to recognize animals.

3.2.2 Software Components.

- Image Analysis: To identify animals from captured photos.
- GPS Acquisition: To capture real-time location data.
- Current Time Acquisition: To timestamp wildlife sightings.

3.3 Information Sharing Procedures

The details of SafariCast's information sharing procedures are explained here. The flow of information sharing in SafariCast is shown in Figure 1: SafariCast calculates the level of satisfaction based on

Table 1: Examples of Satisfaction Tables

Vehicles ID	Satisfaction	Qualifications
6	15.5	×
7	34.4	1 ✓
4	53.7	2 ✓
2	65.4	3 ✓
3	71.3	4
0	81.2	Discoverer
1	91.2	5
5	98.3	×

the number and rarity of animals encountered, and decides whether to share information based on that. Once the information is shared, the location of the animal is displayed on the tablet screen, and participants can rely on that information to determine their course of action.

3.3.1 Calculation of Satisfaction Level. To evaluate the goodness of a game drive, satisfaction level should be calculated. Satisfaction is not a value for each participant, but for each vehicle. The satisfaction, for example, can be defined as

$$\text{Satisfaction} = \frac{\sum(R_A \times N_A)}{\text{elapsed time}}$$

where R_A is rarity of the animal and N_A is number of animals encountered.

Actually, satisfaction should be change based on what is prioritized. For the people who want to see an animal in a close distance, the formula should include such elements.

3.3.2 Animal Discovery. When an animal is found, the finder takes a picture and uploads it to Safricast, which estimates the type of animal, the total number of animals, and the distance to the animal from the uploaded picture.

Based on the values, SafariCast updates the satisfaction of the finder's vehicle. SafariCast also evaluates the impact of the image to the other people and shares the information. In the example in Figure 1 and Table 1, vehicle 0 has spotted an animal.

3.3.3 Conditions for receiving notifications. Following conditions are applied to determine whether a vehicle can receive a notification or not.

To receive:

- The vehicle is within 3km from where the animal is spotted.
- The vehicle ranks low in the satisfaction level.

Not to receive:

- The vehicle is already exploring an animal based on previous SafariCast notification.
- The vehicle has already explored the area (following the previous SafariCast notification) within 1km of the location in upcoming SafariCast notification.

In the example in Figure 2 and Table 1, vehicles 1, 2, 3, 4, and 7 are within 3km. As Table1 shows, vehicles 2, 4, and 7 are low in the ranking therefore they can receive the notification.

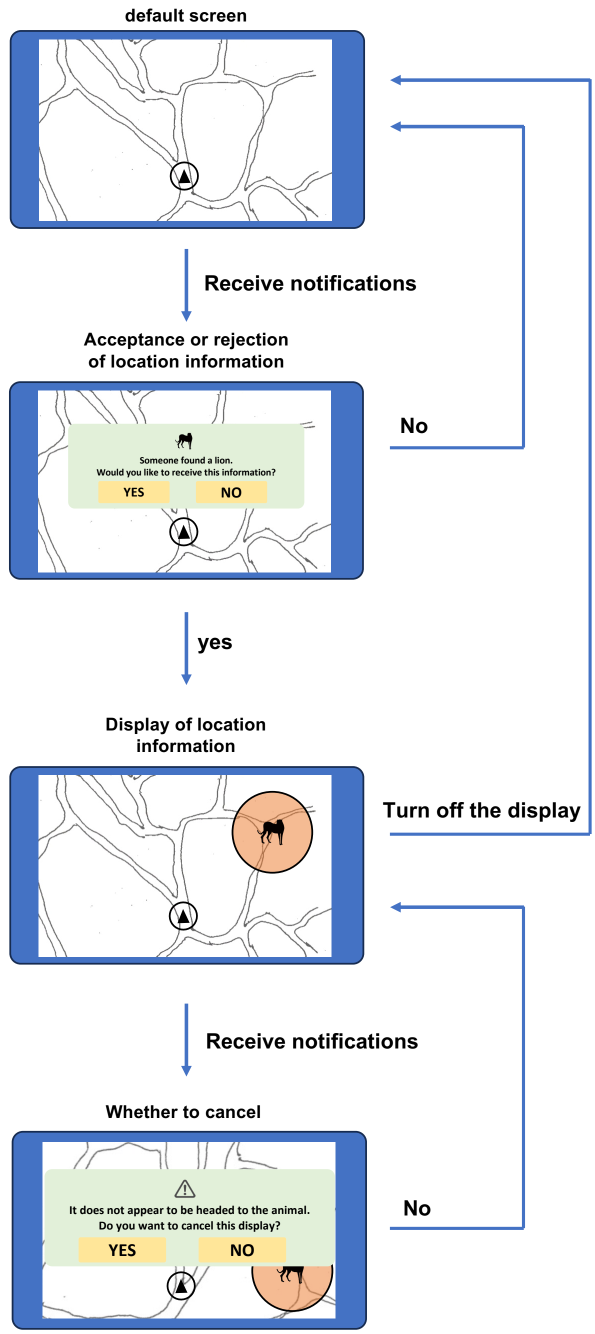

Figure 1: Screen transitions on tablet devices

3.3.4 Sharing Restrictions. When the total number of vehicles that have received the animal's location information and the total number of vehicles within 1 km of the desired animal (restricted admission zone in Figure 2) reaches the capacity (5 vehicles), notification distribution will be halted. Notification distribution will resume when it falls below the capacity limit. When counting the capacity limit, the vehicle that has first spotted the animal is also included. If

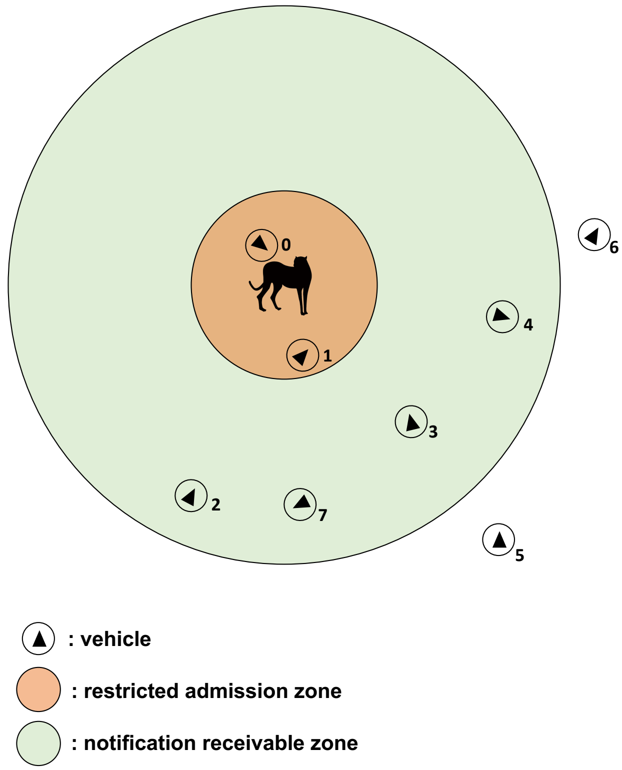

Figure 2: Information Sharing Coverage and Vehicle Restrictions

a rarer animal is found within a 1 km radius of the animal that has already been spotted, notification is updated to tell about the rarer one. When there is no update to the sighting information within the same zone for 15 minutes, the distribution of the notification will cease.

Once a vehicle enters the designated area, the people on the vehicle can choose to whether to show the animal location information on the tablet display. If the people choose to eliminate the animal location information, new notifcation cannot be shown in 10 minute as cooldown, whereas the notification itself is received by the terminal.

3.3.5 Notification. Figure 1 shows the screen transitions of each vehicle's tablet device. Each vehicle's tablet terminal will be notified as "Lion sighting. Do you want to get this information?" This notification can be declined. If one declines the notification, it will be sent to the next participant. Once received, the notification cannot be arbitrarily cancelled by the vehicle until it enters the zone of the desired animal. If the vehicle receiving the animal's location is clearly not heading for the desired animal's zone, a message will be sent to the participant saying "It appears that you are not heading for the desired animal. Do you want to cancel?" The user is notified and can choose whether or not to cancel. If the search is interrupted in this way, no cool time is imposed.

4 CONCLUSION

SafariCast, proposed in this study, embodies a modern approach aimed at revitalizing the wildlife spotting and sharing experience on Kenyan safari drives. By intertwining real-time detection and information sharing technologies, it seeks to overcome the inefficiencies of traditional spotting methods while preserving the thrilling unpredictability of wildlife encounters. The system holds promise in enhancing tourist engagement, promoting environmental conservation, and contributing to the post-pandemic recovery of Kenya's tourism sector. The potential scalability of SafariCast could also pave the way for similar innovations in other wildlife-rich regions, thereby broadening the horizons for sustainable wildlife tourism. Through continued research and stakeholder collaboration, we aim to enhance wildlife tourism through SafariCast.

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