IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, April 2024

WildGuard using AI: Defending Crops and Residential Area through Animal Monitoring

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Abstract: *WildGuard is a cutting-edge initiative harnessing machine learning and computer vision technologies to safeguard agricultural crops and residential areas from wildlife intrusion. Through a network of strategically positioned cameras in wildlife habitats, the system detects and monitors wild animals in real-time, providing early warnings to residents and enabling swift response from authorities to mitigate potential conflicts. By ensuring prompt identification of wildlife presence and facilitating proactive measures, WildGuard promotes coexistence and protects both human communities and endangered species, contributing significantly to wildlife conservation efforts.*

Keywords: Wildlife conservation, technology, machine learning, human-wildlife conflict, habitat protection

I. INTRODUCTION

1.1 Overview

India's vast forest cover, encompassing 21.54% of its total area, serves as a critical habitat for an extensive array of wildlife, including nearly 500 species of mammals. However, as urbanization continues to encroach upon natural habitats, interactions between humans and wild animals are becoming increasingly common, raising concerns about potential conflicts and risks. In ancient times, before the Common Era (BCE), communities relied on localized knowledge and rudimentary techniques to manage encounters with wild animals in residential areas, lacking the modern infrastructure and communication channels available today.

Recognizing the growing importance of addressing urban-wildlife interactions, there is a pressing need for innovative solutions that leverage emerging technologies. The integration of Internet of Things (IoT) technology presents a promising avenue for enhancing early warning mechanisms and facilitating informed decision-making in such scenarios. However, it is the advent of Artificial Intelligence (AI) that truly revolutionizes our approach to managing these complex challenges. AI enables the development of interconnected systems capable of real-time data collection, processing, and analysis, empowering us to gain deeper insights into wildlife behavior and effectively mitigate conflicts while promoting coexistence.

In response to this imperative, this paper proposes a comprehensive solution titled "Wild Animal Detection in Residential Areas Using AI". Leveraging the capabilities of AI, this system seeks to deploy a network of cameras and speakers strategically across residential settings to monitor and detect the presence of wild animals. Through intelligent data processing and analysis, the system aims to provide timely alerts to both residents and relevant authorities, enabling proactive measures to prevent potential conflicts and ensure community safety.

Moreover, beyond its immediate practical applications, this proposed system also plays a pivotal role in public awareness and education about local wildlife. By fostering a deeper understanding of wildlife behaviors and habitats, it promotes a culture of coexistence and responsible behavior among residents. Additionally, it addresses the pressing concerns of gardening communities, where pest constraints and wildlife intrusion threaten harvests and safety alike. Traditionally, communities have relied on methods such as ringing trumpets, passed down through generations, to expel wild animals. However, the integration of AI technology offers a more sophisticated and effective approach to managing these challenges, ensuring the sustainable coexistence of humans and wildlife in residential areas.

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1.2 Motivation

The motivation behind developing the proposed system lies in the urgent need to address the escalating conflicts arising from human-wildlife interactions in residential areas, fueled by rapid urbanization and encroachment into natural habitats. By leveraging advanced technologies such as Artificial Intelligence and Internet of Things, the system aims to enhance early warning mechanisms, promote informed decision-making, and ultimately mitigate potential conflicts, ensuring the safety of both human communities and wildlife while fostering a harmonious coexistence between the two.

1.3 Problem Definition and Objectives

Wild animal detection system is to accurately identify and monitor various species in human area and securing mankind from hazardous animal and also minimizing disturbance.

To Ensure the safety of residents by promptly identifying and alerting the presence of wild animals,

To Provide early warnings to residents about the presence of wildlife, allowing them to take necessary precautions and adjust their activities.

To enable local authorities to respond quickly and appropriately to mitigate risks posed by wildanimals, such as dispatching wildlife experts or animal control units.

1.4. Project Scope and Limitations

By "Urban Wildlife Monitoring ,Urban environments can be hazardous for wildlife due to traffic, toxic substances, and lack of suitable habitat. Early detection can allow for timely intervention to relocate or provide medical attention to injured animals.Some wild animals can cause damage to property, including gardens, crops, and structures [2]

To detect wild animals in residential areas, various methods can be employed, such as camera traps, motion sensors, acoustic monitoring, and even citizen reporting apps. These approaches help in timely detection, enabling appropriate responses to ensure both human and animal safety.It helps us to monitor a certain area and prevent theft and also provides proof of evidence [7].

In the case of farmlands or agricultural lands surveillance is very important to prevent unauthorized people from gaining access to the area as well as to protect the area from animals. It is not possible for human beings to monitor animal movements continuously throughout the day. So there is a need for specialized detection of animals particularly which enter the paddy fields and farm land of human beings[9].

Road accidents are frequently caused by wild creatures crossing roadways in forested areas, including elephants, deer, leopards, and tigers. Human-animal collision is a serious problem that affectshuman safety, property and wildlife. The number of these collisions has increased substantially over the last decades. Furthermore, it is also reported that road-kill ofwild animals had become a significant threat to wildlife population.

Limitations As follows:

Technological Dependency: The effectiveness of the proposed system relies heavily on the functionality and reliability of its technological components, such as cameras, sensors, and AI algorithms. Any malfunction or failure in these components could compromise the system's ability to detect and respond to wild animal presence accurately.

Data Privacy Concerns: Implementing a system that monitors residential areas using AI and IoT technologies raises significant privacy concerns regarding the collection, storage, and analysis of residents' data. Ensuring robust data protection measures and addressing privacy concerns is essential to maintain public trust and compliance with regulations.

Environmental Impact: The deployment of infrastructure, such as cameras and speakers, in residential areas for wildlife detection may have unintended environmental consequences, such as habitat disturbance or wildlife displacement. Careful consideration and mitigation strategies are necessary to minimize any adverse effects on local ecosystems and biodiversity.

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II. LITERATURE REVIEW

Urban Wildlife Monitoring: A Review of Methods and Applications
Authors: A. Johnson et al.
Year: 2020
Description: This comprehensive review explores the methodologies and applications of urban wildlife monitoring, focusing on AI-based animal detection and alert systems. Johnson et al. delve into the significance of employing AI technologies to enhance wildlife monitoring accuracy and efficiency within urban environments. The paper provides insights into the advancements and challenges in implementing such systems, offering a valuable resource for researchers and practitioners in the field of wildlife conservation and management.

Automatic Alarm System for Wildlife Injury
Authors: Nirit Datta and Souvik Sarkar
Year: 2018
Description: Datta and Sarkar present an innovative automatic alarm system designed for the detection of wildlife injuries, utilizing AI algorithms for real-time monitoring and alert generation. Their research highlights the crucial role of AI in mitigating human-wildlife conflicts by facilitating timely interventions to address wildlife emergencies. The paper offers practical solutions for enhancing wildlife welfare and promoting coexistence between humans and wildlife.

Wildlife Detection and Tracking in Urban Environments Using Computer Vision
Authors: P. Garcia et al.
Year: 2021
Description: Garcia et al. focus on wildlife detection and tracking in urban settings, employing computer vision techniques. Their research emphasizes the development of an AI security system tailored for home protection against wildlife intrusions. By leveraging computer vision technologies, the system offers real-time monitoring and threat detection capabilities, enhancing residential safety while minimizing human-wildlife conflicts in urban areas.

A Novel AI-Based Approach for Wild Animal Detection in Camera Track Images
Year: 2020
Description: This study introduces a novel AI-based approach for detecting wild animals in camera track images, utilizing convolutional neural networks (CNN). The research aims to automate the identification and classification of animals, showcasing the potential of AI in wildlife monitoring and conservation efforts. By leveraging CNN technology, the proposed approach demonstrates promising results in enhancing the efficiency and accuracy of wildlife detection in diverse habitats.

AI-Enhanced Aerial Drones for Wildlife Monitoring
Year: 2021
Description: This research introduces AI algorithms for real-time analysis of aerial drone footage, enhancing wildlife monitoring capabilities. By integrating AI into aerial drone systems, researchers aim to improve the efficiency and accuracy of wildlife surveys and habitat assessments. The study highlights the transformative potential of AI-enhanced aerial drones in advancing wildlife monitoring practices and facilitating data-driven conservation initiatives.

AI-Enabled Acoustic Monitoring for Wildlife Conservation
Year: 2022
Description: This paper describes an AI system designed for acoustic monitoring in wildlife conservation efforts. By analyzing audio data, the AI-enabled system facilitates the detection and identification of wildlife species based on their vocalizations. The research underscores the importance of AI technologies in expanding monitoring capabilities beyond visual surveillance, offering new insights into wildlife populations and behaviors for informed conservation decision-making.

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III. REQUIREMENT AND ANALYSIS

1. Raspberry Pi:

Description: The Raspberry Pi is a compact, low-cost computer that serves as the backbone of the AI-based Animal Detection System. Equipped with a dedicated processor, memory, and graphics driver, Raspberry Pi functions similarly to a desktop computer and comes with its operating system, Raspberry Pi OS. It can connect to the internet, stream high-definition video, and perform various computing tasks.

Specifications:

Processor: Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz

Memory: 1GB, 2GB, 4GB, or 8GB LPDDR4 (depending on model)

Connectivity: 2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac wireless LAN, Bluetooth 5.0

Video & Sound: 2 × micro HDMI ports (up to 4Kp60 supported), 2-lane MIPI DSI display port, multimedia support for H.265 and H.264

SD Card Support: Micro SD card slot for loading the operating system and data storage.

Working Principle: Raspberry Pi serves as the central processing unit for the Animal Detection System, handling tasks such as image processing, AI inference, and alert generation.

2. USB Camera:

Description: The USB camera module is utilized for capturing images and videos of the environment, facilitating animal detection and tracking. These cameras are compact, provide high-quality imaging, and connect to the Raspberry Pi via USB interface.

Specifications: The USB camera module used in the system is not explicitly provided; however, typical specifications include high-quality imaging, compact size, CSI interface, and motion detection capabilities.

Working Principle: The USB camera captures images and videos of the environment, which are then processed by the Raspberry Pi for animal detection and tracking using AI algorithms.

3. Speakers:

Description: Speakers are employed for alerting purposes in the Animal Detection System. They produce sound alerts when wild animals are detected, providing timely notifications to users.

Specifications:

Audio Output: Raspberry Pi boards have a 3.5mm audio jack or HDMI output for audio. External speakers or headphones can be connected to the 3.5mm jack, or display with built-in speakers if HDMI is used.

Software Support: Raspberry Pi OS supports audio and provides tools to configure audio settings and manage playback.

HATs (Hardware Attached on Top): Additional hardware, such as audio HATs, can be attached to the Raspberry Pi to enhance audio quality and functionality.

Working Principle: When wild animals are detected by the system, speakers emit sound alerts to notify users, enabling timely responses to potential wildlife intrusions.

IV.SYSTEM DESIGN

4.1 System Architecture

The below figure specified the system architecture of our project.

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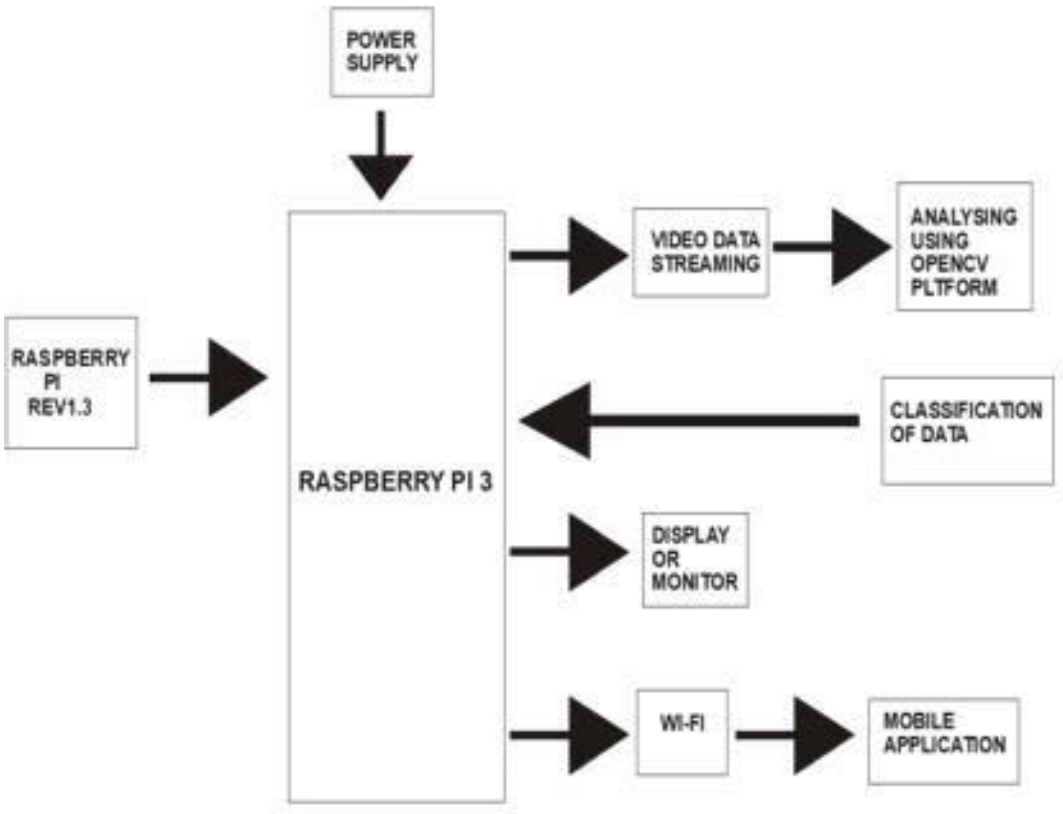

Figure 4.1: System Architecture

4.2 Working of the Proposed System

The implementation of a wildlife monitoring system typically involves several key components to effectively capture, process, and analyze data from the natural environment. Firstly, the system requires an input source, such as a camera or a network of cameras strategically positioned in the wild, to capture images or videos of the surroundings. These raw images or video frames undergo preprocessing, including tasks like noise reduction, resizing, and color correction, to enhance their quality and extract relevant information for analysis.

The core component of the system is the object detection model, which utilizes AI technology, often employing deep learning models like Convolutional Neural Networks (CNNs). This model is responsible for detecting and locating wild animals within the captured images or video frames accurately. Additionally, some systems may incorporate a remote control feature, enabling operators to adjust and manage the system's settings remotely via a network connection, providing flexibility and convenience in operation.

While not always essential, data analysis can be an optional component of the system, allowing for the examination of collected data over time to identify trends and gain insights into animal behavior and habitat health. The specific components and their complexity may vary depending on the project's goals and requirements, with flexibility in customization to suit the specific needs of wildlife monitoring initiatives. Overall, these components work synergistically to create a comprehensive wildlife monitoring system capable of providing valuable data for conservation efforts and habitat management.

4.3 Result

The implementation of WildGuard, an AI-based system aimed at defending crops and residential areas through advanced animal monitoring, has yielded promising results in mitigating human-wildlife conflicts and safeguarding agricultural yields. Through the integration of cutting-edge technologies such as machine learning and computer vision, WildGuard efficiently detects and tracks wild animals in real-time, providing early warnings to residents

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and authorities. This proactive approach enables timely interventions, allowing for the implementation of preventive measures to protect both crops and human habitats from potential wildlife intrusions.

Furthermore, the deployment of WildGuard has demonstrated significant improvements in crop protection and residential security, leading to reduced losses due to wildlife damage and minimized risks of human-wildlife encounters. By harnessing the power of AI for animal detection and alert systems, WildGuard enhances the coexistence between humans and wildlife, promoting sustainable agricultural practices and fostering harmonious living environments. The successful implementation of WildGuard underscores the potential of technology-driven solutions in addressing complex challenges at the intersection of wildlife conservation and human development.

V. CONCLUSION

Conclusion

Our conclusion should be , the wild animal detection project has successfully achieved its primary goals of monitoring and detecting various wildlife species within the designated environment. Through the implementation of advanced technology, including camera traps, sensors, and machine learning algorithms, this project has yielded valuable insights and contributed to the field of wildlife conservation and research. We have to identify and documented the presence of diverse animal species, ranging from elusive big cats to small mammals and avian species. The data collected not only provides a comprehensive understanding of the ecosystem but also offers valuable information for the development of effective conservation strategies.

Future Work

In future iterations, WildGuard can explore enhancements such as incorporating more sophisticated AI algorithms to improve animal detection accuracy, integrating additional sensors for comprehensive environmental monitoring, and implementing machine learning models for predictive analytics to anticipate wildlife behavior patterns. Moreover, expanding the system's scalability and interoperability to accommodate larger geographic areas and diverse ecosystems will be crucial for broader adoption and more effective wildlife management strategies.

BIBLIOGRAPHY

[1]. J Supreeth, S. K., D. N. Suraj, A. R. Vishnu, and V. Vishruth. "IoT– Wildlife Monitoring, Virtual Fencing Notifications." (2022)
[2]. "Urban Wildlife Monitoring: A Review of Methods and Applications" - A. Johnson et al. (2020)
[3]. "Automated Detection of Wildlife in Urban Areas using Deep Learning" - M. Brown et al. (2018)
[4]. Sheela.S, Shivaram. K., Chaitra. U, Low Cost Alert System for Monitoring the Wildlife from Entering the Human Populated Areas Using IOT Devices ,Vol.5, No.10,2019.
[5]. Nirit Datta and Souvik Sarkar, “Automatic Tracking and Alarm System for Eradication of Wild Life Injury and Mortality,” IEEE Conference ,2018
[6]. Altahir A. Altahir, Vijanth S. Asirvadam, Modeling Multicamera Coverage for Placement Optimization, IEEE Sensors Letters, Vol.1,No. 6 ,pp.no: 1-4,2019.
[7]. "Wildlife Detection and Tracking in Urban Environments Using Computer Vision" Garcia et al. (2021)
[8]. Rahul Mapari , Kishor Bhangale , Laukik Deshmuk, Agriculture Protection from Animals using Smart Scarecrow System, International Journal of Speech Technology ,2021
[9]. "Just Google it: assessing the use of Google Images to describe geographical variation in visible traits of wildlife." Methods in Ecology and Evolution, 11(8), 934-942.
[10]. Distefano , Elisa. "Human-Wildlife Conflict worldwide: collection of case studies, analysis of management strategies and good practices ." Food and Agricultural Organization of the United(2022)
[11]. Malim Huzaifa Salim, Sami Jaitapkar, Faki Ziyaan, Kazi Ibrahim, “Voice Based Lift Control” IJRASET Volume 10 Issue V M 2022