PRIEE Literature Review

1. Title: Review on Robotic Systems for Environmental Monitoring

Abstract:

The issue with respect to sustainability regarding environmental monitoring has always generated interest. The research is intended to demonstrate how robotic systems coupled with sophisticated sensors and networking features are revolutionizing environmental monitoring. Different types of sensors like air, temperature, humidity, and wind sensors have been tested and grouped based on their primary units of functions. Electrochemical, metal oxide, and optical are other divisions of generally used sensor types.

The research work also examines some robotic structures like wheeled robots, legged robots, and drones that capture wildlife, habitats, atmosphere, and aid in disaster recovery. Such robotic systems overcome barriers with respect to time, reduce manual effort needed to capture data, and break spatial constraints related to data coverage. The paper also provides a communication improvement in remote regions of sensor networks focus on LoRa WAN and Wi-Fi technologies.

The research points out the different arguments of different researchers on the efficiency of energy with respect to utilizing robotic systems for environmental monitoring. Other issues like sensor integration problems, energy supply issues, and even cost constraints pose challenges that remain to be addressed in subsequent researches are discussed as well.

2. Title: A Prompt and Precise Animal Species Recognition System for Embedded Devices

Abstract:

Human-animal encounters are increasing, mostly along roads and urban areas. This paper discusses an improved animal species detection system specifically designed for embedded systems fueled by a change YOLOv2 deep learning model. The goal is to present a wildlife detection method in real time that is efficient and accurate enough to be employed in systems with the aim of avoiding accidents and human-wildlife conflicts.

The authors changed the original YOLOv2 model using multi-level feature fusion, elimination of duplicate convolutional layers, and incorporation of deformable conutional layers (DCLs) which enhance performance for images with non-uniform shapes and poses of animals. These changes attained 5% accuracy and 12% faster detection compared to the original YOLOv2. The system

tested on a six-species dataset and was efficiently able to identify and track wild animals even when there were stringent environmental conditions in the form of low light as well as occlusion.

Through this study, it is being shown how a new application can be made out of AI-enpowered animal recognition systems in everyday life to control road accidents as well as the movement of wildlife.

3. Title: Automated Animal Recognition in the Wild using Deep Learning Methods

Abstract:

Automated monitoring of wildlife becomes unavoidably unavoidable in the modern era in order to be able to manage human wildlife interfacing challenges effectively. The latest technologies have the ability to manage these problems, though conventional techniques are laboriously slow, produces excessive unwanted information, boosts labor, and is expensive. In this study, we propose an automated learning method to estimate wildlife N species from still images and videos.

The database contained 8,368 photographs of wild and domesticated species at a farm environment. Binary classifier was modeled to detect badgers and the six-class model that distinguished among six different types was created. The badger against the remainder of the types model attained 98.05 accurate against the validation set while the six classes model attained 90.32 accuracy. The system was also tested using video footage cane, which is the most innovative technique for real time wildlife detection.

From smooth and efficient processing of data in wildlife surveillance to increased precision, AI has been a game-changer as far as enhancements are concerned. The models yield good results, but further fine tuning through the extension of data sets, enhancing real time processing, and overcoming environmental conditions such as lighting and blockage can be accomplished.

4. Title: Deep Learning Approach To Detect Wild Animal Intrusions

Abstract:

To ensure efficient management of human-wildlife conflicts and proper attention towards wildlife monitoring, detection systems should be advanced and automated. Human-based methods such as observation and camera traps are expensive and prone to inaccuracies. This research focuses on establishing accuracy and efficiency through deep learning based wild animal alert detection system.

The system implements Convolutional Neural Networks (CNNs) that are driven by a CCTV dataset of wildlife videos, web wildlife videos, and CCTV videos. The object detection models like Deep CNN, VGG, and AlexNet were trained for the recognition of action and classification of animal behavior. The work also includes IoT based sensing devices like ultrasonic detectors to trigger intrusion alerts for authorized restricted areas.

The system also offers animal detection and classification with high precision, along with a new real-time intervention mechanism through email alerts. Through the integration of deep learning and IoT, the systems leverage the email alert feature that can be easily utilized in agricultural areas, highways and other urban regions vulnerable to animal intrusion.

5. Title: Embedded Vision Systems: A Review of the Literature

Abstract:

With the growing demand for systems with instant response times, Minimal power consumption and ease of mobility portable computer systems, embedded vision technologies have gained a new direction. This report offers an insight into low power embedded vision algorithms as well as their implementations in low power Field Programmable Gate Arrays FPGAs and other embedded hardware.

The research explores the fundamental operations of embedded vision systems, such as image acquisition preprocessing object detection, tracking, and classification. Specifically, it investigates the advantages of using FPGAs parallel and reconfigurable computing, which allows for quicker and less power-hungry approaches compared to conventional computing. Some applications are mobile robotics and unmanned vehicles, environmental monitoring, and even public surveillance systems.

Although with the advantages introduced by improved computational efficiency and scalability, vision systems integrated experience issues concerning real-time processing, minimum energy consumption, and algorithm adaptability to varying environments.

6. Title: Accurate And Agile Tracker For UAV Usage While Watching Over Them Tibetan Antelope

Abstract:

Precise and timely monitoring of Tibetan antelopes prevents their poaching and keeps environmental threats at bay. This research established a monitoring solution based on UAVs to safeguard Tibetan antelopes. The system is constructed around a YOLOX object detection model,

and optical flow motion tracking is incorporated for improved accuracy and reduced processing latency.

This new method, independent of the selection of the frame, implements a backtracking tracker that made use of saved motion vectors previously. The center tracker YOLOX is a two-phase estimation method in which the observed bounding box is initially reduced in height, completed, and once more reduced horizontally. Additionally, it carries out ROI-to-centroid tracking that minimizes computational costs further but with high rates of detection. Taking advantage of an On-Line Object Tracking (OLOT) strategy enables the system to dynamically control frame rates in the tracking process; this significantly enhances energy efficiency while offering smoother real-time object tracking.

Experimental findings indicate outstanding performance of the new system. Relative to standard tracking algorithms, the system is 50% less latency-prone while maintaining high accuracy. Edge devices like NVIDIA Jetson AGX Xavier (NX) provide unobtrusive platforms facilitating real-time tracking of the Tibetan antelopes with low power consumption, which is ideal for large-scale wildlife monitoring.

7. Intelligent Animal Repellent System: Applying IoT and Artificial Intelligence for Effective Anti-Adaptive Harmful Animal Repellence

Abstract:

The paper presents a novel way of deterring wild animals from destroying crops without leading to their death. The system entails the use of AI, IoT, and motion sensors to detect animals prior to entering farm lands. When the animal is spotted, a repellent is released, either flashing light or ultrasonic noise, to scare them away. What distinguishes the system from other systems is its adaptability—if an animal begins to habituate to a specific approach, the system will change to another by itself, meaning that the system remains effective in the long term. This method provides a friendly and environmentally friendly substitute for the usual fences and chemical repellents that could possibly harm wildlife and the environment as well.

8. Applications of Ultrasonic Sound Technology in Repelling Wild Boars in Agriculture: A Review of the Literature

Abstract:

Wild boars are the worst nightmare of a farmer, destroying crops at night. This paper elaborates on how ultrasonic sound can be used as an efficient repellent against them. Researchers discovered that it is not enough to just play ultrasonic noise, that after some time the boars get accustomed to

it. But when the frequency of the noise varies constantly, then the repellent works. Scientists went on and tested what contribution different components of the environment, such as terrain and wind, have to what distance the sound will most probably travel. The findings show that combined with an AI-based motion detection system, ultrasonic repellents can be used as a green, sustainable long-term crop protection system without harming wildlife.

9. Wildlife Protection and Monitoring System Using Artificial Intelligence

Abstract:

The paper points out artificial intelligence as an innovator with the potential to make all the difference between tragedy and security where there is human-wildlife conflict. Using cameras and machine learning, the system can also recognize various species in real time and notify farmers or conservationists if an animal enters a conserved area. Aside from restricting animals from reaching crops, the technology assists researchers in monitoring the movement and migration patterns of wild animals. Over time, data that is being accumulated can even indicate where and when animals can next be expected. Rather than using defensive strategies such as fences or traps, this AI system allows for wildlife movement to be advantageous for both humans and animals.

10. Artificial Intelligence System for Protection of Crops from Wild Animals

Abstract:

Farmers have been battling wild animals in farms and destroying crops for decades. The current study suggests an AI-based solution that identifies and deters animals in real-time by using motion sensors and image recognition technology. The system not only identifies the animals—it also assesses the degree of threat they pose and chooses the most effective deterrent, whether ultrasonic sound, strobe light, or scent repellents. More intriguing is that the system is conditioned by previous incidents, thus making farmers more able to withstand threats even before they occur. By minimizing the use of conventional barriers such as fences and traps, this solution provides a humane and sustainable way of crop protection while enabling wildlife to coexist peacefully.

11. Airep: AI and IoT-Based Animal Recognition and Repelling System for Crop Protection

Abstract:

The paper is on a smart farm security system with the integration of AI and IoT technology. Armed with cameras and deep learning software, the system can detect several species of animals and deploy deterrents based on the individual species—either ultrasonic noise, strobe light, or non-

lethal sprays. The best feature of this system is that it improves every time it gets to see animals. The more animals it sees, the more efficient it is in identifying them and selecting the optimum deterrent. It also includes a mobile app to allow farmers to keep an eye on their fields and receive remote alerts. This paper explains how AI turns crop protection into a smart, budget-friendly alternative to fencing and scaring.

12. AI and IoT-Based Solutions to Human-Wildlife Conflict: Making Sustainable Agriculture and Biodiversity Conservation Easier

Abstract:

It's a delicate balance, but one that AI and IoT can make easier, this paper argues. The system described here uses cameras and ultrasonic sensors to detect and deter animals in real-time. New in this research is the application of "recovery zones," areas that are constructed with food and water to divert animals away from farms without harming them. Indian field tests confirmed that this approach greatly minimized crop loss without guaranteeing that animals were forced out of their natural habitat. The research points towards the promise of AI in enabling human-wildlife coexistence that is more conflict-free and harmonious.

13. Artificial Intelligence for Wildlife Conservation

Abstract:

Current research is a thorough analysis of how AI is revolutionizing wildlife conservation efforts. The technology used in the research involves the use of high-definition cameras and machine learning to recognize animals, trace their movement, and even alert the authorities in cases of poaching. Most interestingly, this solution can monitor threatened species and observe how their habitat is transforming over time. Through real-time data, AI provides scientists a great resource for steering clear of habitat loss and protecting threatened species. The research highlights that AI is not just a matter of enhancing security—it's also a useful asset for finding and conserving biodiversity for future generations.

14. Ultrasound for Animal Protection on Highways: Its Impact

Abstract:

In this study, the use of the technology of ultrasound to prevent wildlife-vehicle collisions on highways is examined. Accidents due to animals are a serious problem, which most of the times leads to both animal and driver damage. The use of warning signs and reflectors, the traditional method, is not efficient, and researchers have been looking for an alternative, one being the

ultrasonic wave. The system in question produces high-frequency sound by means of a 555 timer circuit, producing ultrasonic waves above human hearing but distasteful to animals. Animals are therefore incentivized to avoid highways in this way and reduce the number of accidents. Ultrasound is unlike chemical or mechanical deterrents in being cost-effective, eco-friendly, and humane. The technology is designed to activate only if there are animals, and it is energy-efficient. Scientists tried out different frequencies for different creatures and determined the most efficient range. Simulations showed that dogs, sheep, and tigers responded to certain ultrasonic ranges by backing off. Implementing this technology in highways can significantly reduce animal-road accidents. The research emphasizes the necessity to configure sound frequencies in relation to species-hearing limits. The upgrades could also include AI-based detection devices that will identify animals approaching in real time. The research suggests that ultrasonic repellents could usher in road safety and wildlife conservation revolutions.

15. Synergistic Enhancement of Adaptive IoT-based Animal Repellent Systems for Sustainable Agriculture in Rajasthan, India

Abstract:

The objective of this study is the increasing trend of wild animal crop raids to agriculture in Rajasthan, India, where crop damage of up to 40% is caused by animal raids. Conventional methods such as pesticides and scarecrows are ineffective or harmful to the ecosystem. The study investigates IoT-based adaptive animal repellent systems using ultrasonic sensors, infrared detection, and deep learning algorithms. They could identify animal motion and trigger deterrents like sound alarms, light beacons, or pheromone repellents. Deep learning model YOLO was mentioned as the most suitable for real-time detection of animals. Various sensor-based methods with motion as well as resistance sensors were investigated to evaluate levels of accuracy and efficiency. The study also alludes to battery and solar-powered means of ensuring purpose. The study also speaks to the use of AI-based surveillance systems where farmers can receive notifications in real-time and monitor intrusions remotely. The study also speaks to the need for changing deterrent frequencies depending on the hearing capacity of animal species for it to be effective. The system outlined herein is a toxic-free, low-cost, and environmentally friendly option as opposed to traditional animal repellents. More less dependent upon toxic agri-practices, the system reduces man-animal conflict and sustains agriculture. Future artificial intelligence-optimized models of behavior predictions can make it more effective.

16. Farm Safety System for Animal Intrusion Detection and Repellence using IoT

The present research suggests an IoT-based system for detecting and preventing animal intrusions into farms aiming to minimize crop loss and man-wildlife conflict. Traditional methods, including the use of guards or manual repellents, are ineffective and even harmful at times. The system in

question uses infrared (IR) sensors, cameras, and relays for automating field monitoring for detecting animals and providing responses accordingly. YOLO (You Only Look Once), a deep learning algorithm, is used for real-time detection of animals. When an animal intrudes into the field, a relay switch is triggered to activate a sprayer that drives the intruder away safely without causing any harm. If the animal is identified as wild, an alert message is sent to the farmer and forest authorities for further action. Computer vision and neural networks are utilized by the system to enable detection across species. In comparison to the traditional buzzers, the sprayer-based deterrent is non-intrusive and environmentally friendly. The article further states the use of IoT for real-time monitoring and coordination of the response. The accuracy in the detection of different animals is enhanced through the use of the YOLO model trained on COCO datasets. The system minimizes human intervention, enhances efficiency, and facilitates sustainable agriculture. Innovations in the future are realizable with AI-based behavior forecasting for enhancing methods of deterrence. The research shows IoT and AI potentiality to revolutionize farm security, minimize economic loss, and enable coexistence between wildlife and agriculture.

17. Artificial Intelligence of Things-Based Automatic Wild-Animal Intrusion Alert and Repellent System

Abstract:

The conflict between wildlife and humans is on the rise, and the conflict between human and wildlife is leading to damage to crops, harm to people, and kill animals. Traditional protection techniques like trenches and electric fences are inefficient, expensive, and poisonous to humans and animals. This paper suggests an AI-driven intrusion detection and repellent system based on IoT and deep learning for the purpose of identifying and keeping away wild animals in a safe manner. Raspberry Pi, PIR motion sensors, and the YOLO object detection algorithm are utilized by the system to monitor human settlements around forests. Once the animal is identified, live video is captured by the camera, and a bazzer and strobe light are triggered to scare it off without injury. YOLOv3 model is trained on Microsoft's COCO dataset with accurate detection of various species. Automated detection and deterrence reduce false alarms and initiate intervention in a timely manner. Artificial Intelligence of Things (A IoT) technology improves data collection, processing, and decision-making. The green and non-toxic method renders it better than conventional barriers. YOLOv3 is better than Faster RCNN and SSD models because it does not compromise on speed or accuracy, thereby making it real-time viable. Behavior prediction models and including GPS tracking for enhanced monitoring are some of the future enhancements possible. This paper proves the capability of AI in transforming wildlife protection and human security.

18. Cascaded YOLOv8 Novel Animal Detection System With Adaptive Preprocessing and Feature Extraction

Abstract:

We propose in this paper a novel animal detection system using Cascaded YOLOv8, a deep neural network that has been optimized to detect wildlife. The system can be imagined for use in the monitoring of biodiversity, animal intrusions deterrence, and conservation. The research starts with adaptive histogram equalization to improve contrast in images and continues with Fast Fuzzy C-Means (FCM) segmentation for enhanced object separation. ResNet50, DarkNet19, and Local Binary Patterns (LBP) are used to extract relevant features for accuracy detection. The advanced features are fed into the Cascaded YOLOv8 model, which boasts an amazing 97% accuracy for animal detection. The method surpasses the conventional CNN and YOLOv7 models by far, especially when it comes to detecting camouflage or small animals. The platform is especially effective in wildlife tracking, road safety, and reducing human-wildlife conflict. The study also highlights the use of deep learning to enhance species identification and behavior detection. With additional AI-driven feature extraction and segmentation, the model is trained to adjust to numerous diverse environments and changing lighting conditions. Real-time deplayment and larger datasets would be utilized in future enhancement to further enhance detection robustness. The work would be useful in facilitating improvement in animal conservation and effective wildlife-related risk avoidance

19. CE-Retina Net: A Channel Enhancement Approach to Infrared Wildlife Detection in UAV Images

Abstract

This paper introduces CE Retina Net, a deep network for enhancing wildlife detection from thermal infrared (TIR) images captured using drones (UAVs). Traditional monitoring is labor-intensive and expensive, manned planes being normally unreliability-insensitive. The authors' system includes a Channel Enhancement (CE) module to significantly enhance infrared image feature extraction. Furthermore, the Batch-Norm Stochastic Channel Attention (BSCA) module is used to filter out noise and select important pixels from various channels. To localize more accurately, a Path Augmentation (PA) technique is paired with a Feature Pyramid Network (FPN) to facilitate feature representations. Authors developed a self-trained TIR wildlife dataset (ISOD) of 2,534 train and test images. Extensive experiments confirm that CE-RetinaNet surpasses existing state-of-the-art object detection models by improving average precision (AP) and recall by 11.3% and 11.6%, respectively. The model significantly minimizes the errors resulting from

fog, image jitter, and wildlife overlap compared to existing methods. The system enables cost-effective and scaleable real-time wildlife monitoring technology for harsh environments. Future directions can involve AI-based tracking and integration into wildlife conservation to minimize human-wildlife conflict.

20. Gaj Gamini: Prevention of Man–Animal Conflict with Locomoting Elephant Detection through Ground Vibration-Based Seismic Sensors

Abstract:

Elephant-human conflict ranks among the largest issues, particularly when human settlements are encroaching on the habitats of animals. In this article, there is a presentation of Gaj Gamini as a seismic sensing system on an artificial intelligence foundation to monitor the movement of elephants from ground vibration. In comparison to GPS collars, drones, and camera traps with their limitations by cost, invasiveness, and environmental noise, seismic sensors offer a non-invasive, cost-effecient, and highly reliable alternative. Seismic sensors recorded eight hours of ground vibration data on elephant and human activity using subsurface sensors. It was trained to detect elephant steps, human, and background noise with a staggering 98.03% accuracy using an 1D Convolutional Neural Network (1D-CNN). The proposed approach effectively decouples elephant movement and natural disturbances to offer early warning systems and real-time tracking. Compared to conventional methods, the model minimizes false alarms by staggering percentages and detects more accurately. Seismic sensing is the scalable and effective solution to wildlife conservation and human security as exemplified by studies. Multi-animal detection and behavior forecasting models based on AI are some of the potential prospects. This research is going in the right direction towards sustainable coexistence among humans and wildlife.

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