DETECTION OF ANIMAL INTRUSION IN AGRICULTURALFIELD USING RECURRENT NEURAL NETWORKS

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***Abstract*- The escalating global concern over the environmental impact of roads underscores the need for comprehensive wildlife management strategies. Roads contribute to habitat loss, fragmentation, and degradation, posing direct and indirect threats to wildlife, especially larger mammals like the Bengal tiger, Indian elephant, and Giraffe, known for their extensive ranges and seasonal movements. While roads play a crucial role in facilitating human connectivity and globalization, their negative consequences on biodiversity, particularly in modified landscapes with a history of intensive land use, warrant urgent attention. In this context, our project focuses on addressing the challenges posed by elephant intrusions, a pervasive issue leading to crop damage, human casualties, and economic losses. Traditional surveillance methods often fall short, especially during nighttime intrusions, necessitating the development of an advanced system for effective elephant detection, alert generation, and repulsion to safeguard human habitats and agricultural lands.**

The proposed system serves as a vital tool for wildlife management, specifically targeting areas where human infrastructure intersects with natural habitats. By comparing Convolution Neural Network (CNN) and Recurrent Neural Network (RNN) algorithms, our research demonstrates the superiority of RNN in terms of accuracy, offering a more robust solution for the detection and repulsion of elephant intrusions. This project aligns with the broader goal of mitigating human-wildlife conflicts, establishing safer passages for animals across transportation infrastructures, and protecting vital agricultural resources from wildlife intrusion.

Keywords: **CNN, RNN, Machine learning, Deep Learning, Animal Intrusion Detection.**

The proposed system serves as a comprehensive solution to threats posed by both wild animals and human intruders. Its implementation aims to safeguard property, and human lives, and contribute to wildlife conservation. Various methods, such as rifle guns, electric fences, beehives with live bees, and scarecrows, have been employed in Indian farmlands historically to deter wild animals and intruders. Unfortunately, many of these methods have caused significant harm to both humans and animals. With technological advancements, non-lethal solutions have been explored, but their effectiveness has often been compromised by oversights in physical, technological, and climatic factors.

Facing challenges posed by large-sized threats, like elephants, conventional protection methods fall short, necessitating a deeper understanding of their behavior. In response to these challenges, and as an integration of various systems into a singular protective mechanism for farmlands, the concept of virtual fences has been developed. This innovative approach seeks to provide a humane and effective solution, considering the psychological aspects of wildlife behavior and accounting for physical, technological, and climatic variables. The virtual fence system emerges as a holistic and practical response to the intricate issues surrounding human- wildlife conflicts and the safeguarding of agricultural resources.

OBJECTIVE

Develop and implement an innovative wildlife management system utilizing advanced detection algorithms, specifically focusing on elephant intrusion, to mitigate human-elephant conflicts, protect agricultural lands, and ensure the safety of both wildlife and humanpopulations in forest border areas.

INTRODUCTION

The wildlife population faces significant threats due to changing human behavior, including extensive natural resource exploitation and alterations in topography. This has led to heightened conflicts between humans and wildlife, resulting in the compromise of valuable resources and an increased demand for compensation. Effectively managing these challenges has become a major obstacle in both resource management and wildlife conservation. Additionally, the prevalent theft of farm produce, livestock, and equipment further exacerbates the situation. To address these complex issues, the development of a system capable of identifying culprits and promptly alerting property owners to the presence of intruders is imperative.

LITERATURE REVIEW

[1]Normally, camera traps are the standard tools used in the forest to study wildlife species. However, the innovation here involves utilizing the principles of bioacoustics and image processing to mitigate the escalating issue of human-wildlife conflicts, which is rampant due to human encroachment and diminishing green spaces. By employing high-frequency sound waves specific to each animal's auditory range and utilizing image processing to identify and target particular animals, we aim to deter these animals from causing harm. The field of bioacoustics, combining biology and acoustics, plays a crucial role in understanding animal communication through sound. For instance, birds use their early morning calls to establish territories, while mimicking calls is a strategy for food competition. Leveraging sound frequencies tailored to each species' hearing capabilities and implementing an animal identification system through camera traps and image processing, we can effectively manage human-wildlife conflicts and protect both agricultural lands and animal habitats.

[2]In India, the rise in the human population due to industrial and agricultural expansion has led to the transformation of forest lands into human habitats. Animals that linger near the border between forests and villages, awaiting nightfall to feed on crops, have been reported to attack or injure people. As a result, there is a critical need to protect human lives while also safeguarding animal populations by establishing a suitable monitoring system. By creating a monitoring system to detect elephant intrusions, it is possible to monitor animal presence in forest-prone areas and prevent any potential harm to humans. The identification of animals is carried out by comparing the current captured image using a vision-based camera with the template image available. This pattern matching process helps in recognizing specific parts of the elephants such as tusks, trunk, and ears. The image processing algorithm used is based on Machine Vision using LabVIEW. Cameras are strategically placed in areas where animals frequently enter villages, and wireless systems are utilized to transmit images for processing. When a match is found with the template, warning signals are generated. This approach significantly reduces the time required to detect animal presence, making it an effective and preferred solution to implement. Forest officials and villagers are promptly alerted about potential elephant incursions, providing an early warning system for managing situations. Therefore, this technology offers a solution for autonomous species identification,particularly for elephants.

[3]The conflict between humans and animals is prevalent nationalwide, manifesting in various ways like urban monkey disturbances and wild pigs raiding crops. Addressing this challenge effectively has become a significant global concern. This study employs a wireless sensor network utilizing UWB technology for intrusion detection. Through the analysis of UWB signal attributes, a convolutional neural network is employed to autonomously learn these characteristics. Ultimately, the SVM or Softmax classifier distinguishes between humans and animals. Numerous experiments conducted in cornfields demonstrate the effectiveness of the proposed method in detecting human and animal intrusions. The results indicate a detection accuracy improvement of nearly 16% compared to traditional manual extraction methods.

[4]Image processing and IoT-based monitoring network have elevated sensor technology to a new level. The clashes between humans and animals have emerged as a significant issue in the agricultural sector, posing risks to human life and substantial resource losses. To address these challenges, a system for detecting animal intrusion has been developed using wireless sensors to automatically alert both landowners and forest officials with an image. This system provides an early warning signal to prompt appropriate action depending on the intruder type. The sensors will identify animal movement and the camera will capture an image. Subsequently, the image will be analyzed by a microcontroller, following which the GSM module will send an alert message to the forest authorities and landowner. This study delves into the various techniques, tools, and experimental setups utilized to safeguard human life from animal intrusions.

[5]Orchard face a high risk of being damaged by wild and animals, leading to significant harm to the harvest with just one peck. Hence, it is crucial to be vigilant of the nearby presence of these creatures. Subsequently, various deterrent devices should be activated to keep these harmful animals at bay.Conventional techniques have been extensively

utilized based on the type of produce and the threatening wildlife.

Proposing an Enhanced Protection Method

A novel approach is suggested to safeguard orchard produce from the interference of wild animals and birds through the deployment of ubiquitous sensor network (USN) devices. These cutting-edge devices are incorporated alongside traditional methods to elevate the level of protection. Enhancements include the addition of microphone and camera modules to the fundamental sensors on the USN nodes. The camera footage is scrutinized for comprehensive area surveillance, while audio signals collected by the microphones help in monitoring the surroundings near a node. Infraredmotion sensors play a key role in detecting animal intrusion from the outer boundaries of orchards.The innovative monitoring system proactively offers early warnings regarding potential intrusion and harm caused by wild animals and birds by leveraging USN nodes in conjunction with conventional devices.

[6]Animal intrusion detection plays a vital role in safeguarding human settlements such as institutions and agricultural areas, protecting both lives and valuables. This study introduces a novel image processing technique for identifying animals based on their skeletal structure, employing the Line Model Approach. The method involves initially implementing background subtraction and a rapid Star Skeletonization algorithm to extract the object's skeletal framework. A unique Line Model is then formulated from this skeletal structure to categorize the object as either animal or human. Notably, this approach is specifically designed to operate effectively with low-quality images and deliver swift results when handling intermittent frames, making it suitable for real-time animal intrusion detection scenarios.

[7]A surveillance infrastructure using seismic sensors to identify instances of elephants breaching forest borders. This endeavor is fueled by the pressing demand to tackle human-wildlife conflicts, notably in areas where elephants and humans inhabit the same territories. Elephant intrusions frequently result in property destruction, agricultural losses, and potential dangers to human lives. Therefore, establishing an efficient surveillance system for early detection is vital in mitigating conflicts and fostering peacefulcoexistence between humans and wildlife.

Seismic sensors are specifically designed to detect vibrations caused by elephant movements, such as footsteps or other activities. These sensors are strategically positioned along forest borders and known elephant migration pathways. Early detection of elephant presence enables authorities and conservationists to swiftly respond by alerting nearby communities, implementing preventive measures, or guiding elephants back to their natural habitats. This proactive approach aims to minimize conflicts, reduce damage, and contribute significantly to wildlife conservation efforts without jeopardizing human safety or livelihoods.

EXISTING SYSTEM

Convolution Neural Network (CNN):

During the realm of deep learning, there exists a form of deep neural networks referred to as Convolutional Neural Networks (CNNs or ConvNets), which are predominantly utilized for analyzing visual content. They are labeled as shift invariant due to their shared- weights structure and translation invariance attributes. Convolutional neural networks (CNNs) have diverse applications spanning image and video recognition, recommender systems, image classification, segmentation, medical imaging analysis, natural language processing, brain-computer interfaces, and financial time series analysis.

In comparison to multilayer perceptrons, CNNs are viewed as regularized versions. Multilayer perceptrons typically refer to fully connected networks, where each neuron in one layer establishes a connection with all neurons in the subsequent layer. The excessiveconnectedness of these networks makes them highly susceptible to

Disadvantages of Existing System:

1. Classifying the segmented areas is not accurate.
2. Low accuracy in prediction.
3. Cannot be implemented in all images.
4. Time consumption is high.
5. Complex model.

PROPOSED SYSTEM

Recurrent Neural Network (RNN):

A Recurrent Neural Network (RNN) stands as a pivotal class within the realm of artificial neural networks, distinguished by its unique structure that forms a directed graph along a temporal sequence. This characteristic empowers the RNN to exhibit temporal dynamic behavior, setting it apart from its feedforward counterparts. The defining feature of RNNs lies in their ability to leverage internal states or memory to process sequences of inputs with variable lengths. The versatility of recurrent neural networks (RNNs) makes them highly suitable for tasks like continuous handwriting recognition and speech recognition without explicit segmentation.

The term "recurrent neural network" encompasses two broad categories with a shared structural foundation, delineated by their impulse nature—finite impulse and infinite impulse. In both instances, these networks manifest temporal dynamic behavior. A finite impulse recurrent network embodies a directed acyclic graph that can be unfolded and substituted with a strictly feedforward neural network Conversely, an infinite impulse recurrent network is characterized by a directed cyclic graph that resists unrolling.

Finite impulse and infinite impulse recurrent networks possess the capability to integrate supplementary stored states under direct neural network control. The management of these states may involve replacement by another network or graph, introducing time delays or feedback loops. These controlled states are generally referred to as reopened states or reopened memory, integral components of memory networks like Long Short-Term Memory overfitting. In contrast, CNNs adopt a distinct approach to regularization by capitalizing on the hierarchical data patterns to form more intricate patterns using simpler ones. Thus, CNNs lean towards the lower extreme concerning connectedness and complexity.

The concept of convolutional networks draws inspiration from biological processes, mimicking the connectivity patterns between neurons observed in the visual cortex of animals. Each cortical neuron responds exclusively to stimuli within a limited area of the visual field, termed the receptive field. Notably, the receptive fields of various neurons intersect partially to encompass the entire visualfield.

CNNs require minimal pre-processing compared to alternative image classification algorithms. Consequently, the network acquires the ability to learn filters that were manually created in traditional algorithms. These shift towards independence from previous knowledge and human intervention in feature design represents a significant advantage for CNNs.

(LSTM) and gated recurrent units. This concept is also known as aFeedback Neural Network (FNN).

In essence, the Recurrent Neural Network, with its temporal awareness and memory utilization, represents a powerful paradigm in artificial neural networks, finding applications in diverse fields such as pattern recognition, language modeling, and sequential dataanalysis.

Advantages of Proposed System:

1. Classifying the segmented areas is accurate.
2. High accuracy in prediction.
3. Can be implemented in all images.
4. Time consumption is low.
5. User friendly model.

SYSTEM ARCHITECTURE

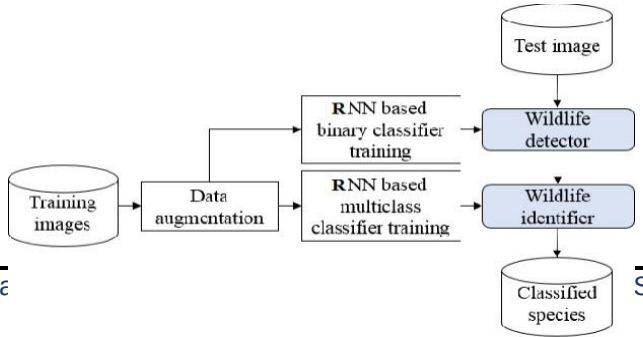

Fig. 1 Architecture of Animal intrusion detection

MODULES:

There are 5 components in the system. They are

(i) Image Acquisition
(ii) Image Preprocessing
(iii) Image Segmentation
(iv) Feature Extraction
(v) Classification.

MODULE DESCRIPTION:

Image Acquisition:

The process of gathering images involves downloading them fromthe online dataset provider Kaggle.com.

Image Preprocessing:

Image preprocessing encompasses the conversion of RGB images to Grayscale, aiming to enhance the dataset. This transformation improves result accuracy, reduces noise, neutralizes backgrounds, and enhances image brightness. Data augmentation is employed togenerate additional data, mitigating overfitting risks and expandingthe dataset.

Image Segmentation:

Image segmentation divides grayscale images into meaningful regions using Recurrent neural networks, distinguishing objects for further inspection from their surroundings. The goal is to simplify or alter the representation for a more meaningful interpretation.

Feature Extraction:

Feature extraction involves highlighting segmented image portions to facilitate classification. Extracted features play a crucial role in differentiating between images, serving as a fundamental step in various machine vision algorithms. The objective is to represent segmented objects in a way that effectively captures their main features and attributes.

Classification:

The classification module utilizes Tensor Flow and machine learning algorithms. Tensor Flow, an open-source library for numerical computation, streamlines machine learning processes. It enables the creation of dataflow graphs, describing how data progresses through nodes representing mathematical operations. This approach enhances the efficiency and simplicity of machine learning tasks, contributing to the classification of images in this context.

ALGORITHM OF PROPOSED WORK

Step 1: Loading training information involves various images ofdifferent wildlife species.

Step 2: Conduct Data preprocessing,it may include adjustments like resizing images, converting them to a particular layout, or standardizing pixel values.

Step 3: Generate new training data from existing images can be done by techniques such as cropping, flipping, or rotating.

Step 4: The model's training process includes providing the preprocessed data to the RNN and modifying the model's weights to enhance its ability to differentiate between diverse wildlifespecies.

Step 5: Assessing the model might entail examining it on a separatedataset of labeled images to determine its accuracy

Step 6: Adjusting hyperparameters or architecture can fine-tune themodel if its accuracy is unsatisfactory.

Step 7: After training, the model is ready for detecting Animalintrusion into fields.

Stop.

FLOWCHART

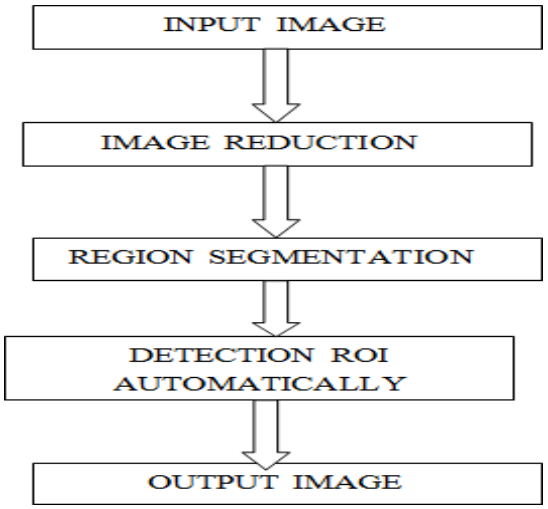

Fig. 2 Flowchart of proposed system

COMPARATIVE STUDY OF EXISTING AND PROPOSEDSYSTEM

In this analysis, two algorithms are under evaluation: the Convolution Neural Network (CNN) as the current system and the Recurrent Neural Network (RNN) as the suggested method. Our experiments showcase that RNN surpasses CNN in accuracy.

The main drawback of the current CNN system is its dependence solely on edge data. This limitation results in decreased accuracy when predicting numbers and characters. Focusing solely on edges can lead to subpar performance in distinguishing intricate data details.

Our suggested overcomes these limitations by employing advanced categorization techniques. Through the utilization of these intricate methods, the suggested RNN-based model shines in precisely pinpointing animal figures, consequently boosting overall precision, particularly in the realm of numeral recognition. This strategy guarantees a more in-depth grasp of the information, hence contributing to improved accuracy and efficiency in the categorization procedure.

In essence, our proposed RNN-based system showcases greater precision in comparison to the current CNN model, presenting a sturdier solution for duties encompassing the identification of numbers and characters amid animal forms.

OUTPUT SCREENSHOTS:

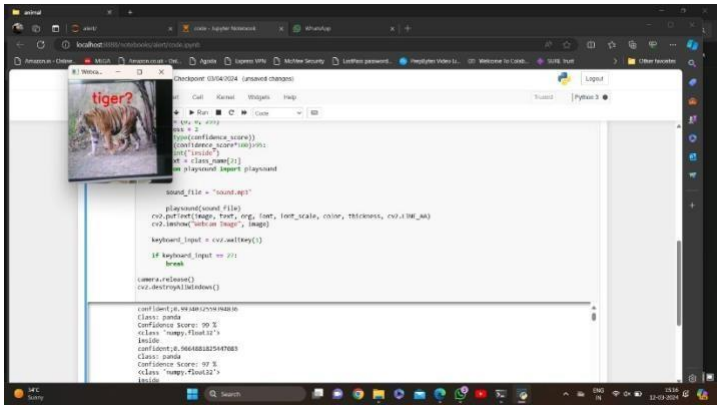

Fig. 3 Screenshot of Detection of tiger in video

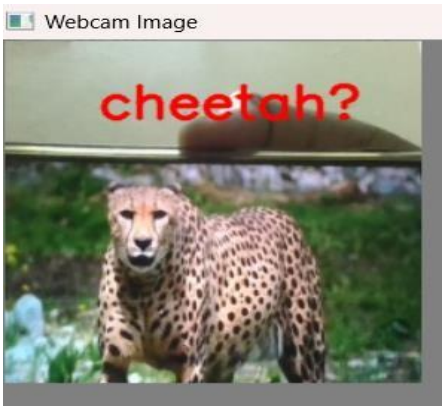

Fig. 3.1 Detection of Cheetah

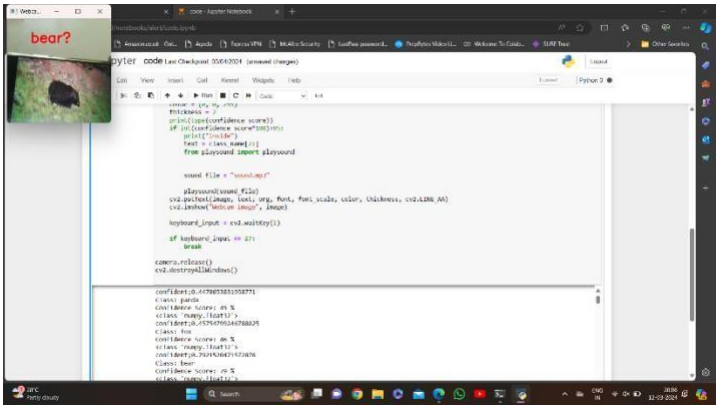

Fig. 4 Screenshot image of Detection of Bear

Fig. 4.1 Detection of Bear

CONCLUSION

Our Animal Intrusion Detection System has taken a major step forward in protecting agricultural areas and human habitats from potential wildlife threats. By utilizing advanced image processing techniques, the system can quickly detect animals and set off alarms to notify the appropriate authorities. Our focus on developing a repellent system in the future demonstrates our dedication to finding proactive solutions that promote peaceful coexistence between humans and wildlife. Through the implementation of innovative technologies, we not only increase the safety of farmers and safeguard valuable crops but also contribute to discussions about sustainable living and wildlife preservation.

Within a specific context, our Animal Intrusion Detection System introduces an added layer of sensitivity with vibration sensors, improving the accuracy of threat detection. The incorporation of image processing technology also confirms the presence of elephants, allowing for swift and targeted responses to potential intrusions. As we progress, the ongoing improvement of these technologies is crucial, with the main objective being to not just prevent conflicts but also to promote understanding and cohabitation between humans and elephants. This project embodies a comprehensive approach to wildlife management, blending cutting-edge technologies with a proactive outlook for a more secure and sustainable future.

FUTURE SCOPE

The future vision for this project includes expanding towards creating an advanced repulsion mechanism aiming to discourage diverse animals from invading human living spaces. An innovative strategy involves the use of audio signals, like mimicking the sound of a honey bee which is known for its ability to deter animals. When an intrusion is detected, the mechanism can automatically trigger loud playback of these aversive sounds, effectively driving away the animals and preventing potential conflicts. This dynamic solution not just enhances the safety of human environments but also supports broader conservation endeavors by advocating for non-intrusive approaches to addressing wildlife interactions. Implementing such repulsion systems opens up a promising path for sustainable coexistence, highlighting the significance of technological progress in managing human-wildlife conflicts.

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