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Adaptive Wildlife Management System for Crop Protection Leveraging Edge Computing and Deep Learning

Mr A Mohamed Noordeen¹, Ajay sharon², Afsal P.N³, Mohammed fadil⁴

Assistant Professor, Department of Artificial Intelligence and Data Science, Dhaanish Ahmed Institute of Technology, Coimbatore, Tamil Nadu, India¹

UG Scholar, Department of Artificial Intelligence and Data Science, Dhaanish Ahmed Institute of Technology, Coimbatore, Tamil Nadu, India²

UG Scholar, Department of Artificial Intelligence and Data Science, Dhaanish Ahmed Institute of Technology, Coimbatore, Tamil Nadu, India³

UG Scholar, Department of Artificial Intelligence and Data Science, Dhaanish Ahmed Institute of Technology, Coimbatore, Tamil Nadu, India⁴

ABSTRACT: Agriculture automation has seen rapid advancements, particularly in addressing challenges faced by farmers, such as protecting crops from wild animal attacks. This paper presents a novel system that integrates AI-based Computer Vision using Temporal Convolutional Networks (TCN) and WildNet, combined with species-specific ultrasound emission for effective animal deterrence.

The WildNet model is trained on a dataset containing images of 90 different target animal species, enabling accurate classification. To enhance real-time monitoring, TCN is utilized for video analysis and animal detection, leveraging temporal dependencies for precise recognition. Upon identification, the system triggers the emission of species-specific ultrasound waves, ensuring non-harmful but effective repulsion strategies tailored to different animals. This approach offers a sustainable, AI-driven solution to mitigate crop damage while maintaining ecological balance, contributing to smarter and more efficient agricultural practices.

KEYWORDS: AI-based Computer Vision, Temporal Convolutional Network(TCN), WildNet.

I. INTRODUCTION

Agriculture is the backbone of global food security, yet farmers continue to face significant challenges, including crop damage caused by wild animals. As technological advancements redefine various industries, **Artificial Intelligence (AI) on the edge** is emerging as a transformative force in **smart agriculture**, offering real-time, automated solutions to address such issues.

This project introduces an **AI-powered real-time monitoring system** designed to safeguard crops by integrating **Edge-AI computing**, **Computer Vision**, and **species-specific ultrasound emission**. Utilizing **Temporal Convolutional Networks (TCN)** for dynamic video analysis and the **WildNet model** trained on a diverse dataset of 90 animal species, this system ensures precise **species detection and classification**. Upon identification, it activates **customized ultrasound signals** to deter specific animals without causing harm, providing an ecologically responsible solution to mitigate crop damage.

By harnessing **Edge-AI computing**, this approach enhances **efficiency, speed, and accuracy**, reducing dependence on cloud computing while enabling **instantaneous on-site decision-making**. This innovation signifies a crucial step

toward **sustainable and intelligent agricultural practices**, addressing global challenges through cutting-edge technology.

II. LITERATURE SURVEY

The integration of **Artificial Intelligence (AI) on the edge** for agricultural applications has gained significant traction due to its ability to provide **real-time monitoring, decision-making, and automation**. Several studies have explored AI-driven solutions for **crop protection against wild animals, Edge-AI computing, and computer vision-based detection systems**. AI has revolutionized agriculture by enhancing **precision farming, automated monitoring, and early detection of threats**. Various AI models, including **Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Temporal Convolutional Networks (TCNs)**, have been widely applied for **crop disease detection, pest control, and yield prediction**.

AI-powered **Computer Vision** has been extensively researched for detecting and classifying animal species to minimize conflicts with agriculture and human settlements. Deep learning frameworks such as **WildNet** have been employed for **species classification and recognition** based on training datasets comprising animal images (Kumar et al., 2022). Furthermore, **Temporal Convolutional Networks (TCNs)** have been explored for **video-based motion analysis**, improving the accuracy of wild animal detection in farmlands. Ultrasound technology has been utilized in agriculture for **non-invasive animal repulsion methods**. Research indicates that **species-specific ultrasound frequencies** are effective in repelling animals without harming them (Park et al., 2022). Implementing AI-driven adaptive ultrasound mechanisms based on **real-time species detection** has shown promising results in mitigating animal intrusions.

III. METHODOLOGY

The animal intrusion web app is designed, developed and deployed intelligently to find out animal intruding detection and repelling system for crop protection based on AI. This proposed system mainly offers:

Farmer Alert System

- Upon detection of a potential threat, the system initiates an alert mechanism to notify farmers.
- SMS notifications are sent to pre-registered farmers, providing real-time information about the identified species and potential risks.

User Interface

- A user-friendly interface allows farmers to configure system parameters, monitor real-time data, and receive alerts.
- The interface includes managing contact information for SMS alerts.

Our methodology:

1. Wildlife Defense Web Control Panel

In this module we create the web dashboard to integrate the edge device in future to work in real time to detect the animals in the fields. Through this dashboard the admin train and classify the animals and label their name and repellent sound to detect the animal accurately.

The system enables the farmer to have a real time view of his fields from any place via internet and even provides manual buzzer controls if the need arises to use them.

2. Animal Classification WildNet Model

The **WildNet model** is a deep learning framework designed for **multi-label wildlife classification**, particularly in **audio-based species recognition**. It integrates **Convolutional Neural Networks (CNNs), channel attention mechanisms, and transformer encoders** to accurately identify species-specific vocalizations in complex soundscapes.

3. Temporal Convolutional Networks (TCN)

TCN is a crucial component for handling temporal dependencies in video data. It excels at capturing patterns and features across sequential frames, making it suitable for video-based tasks.

4. Animal Detection

The module is trained to detect and recognize various types of animals. This involves learning features and patterns from input data to make accurate predictions.

5. Prediction Output

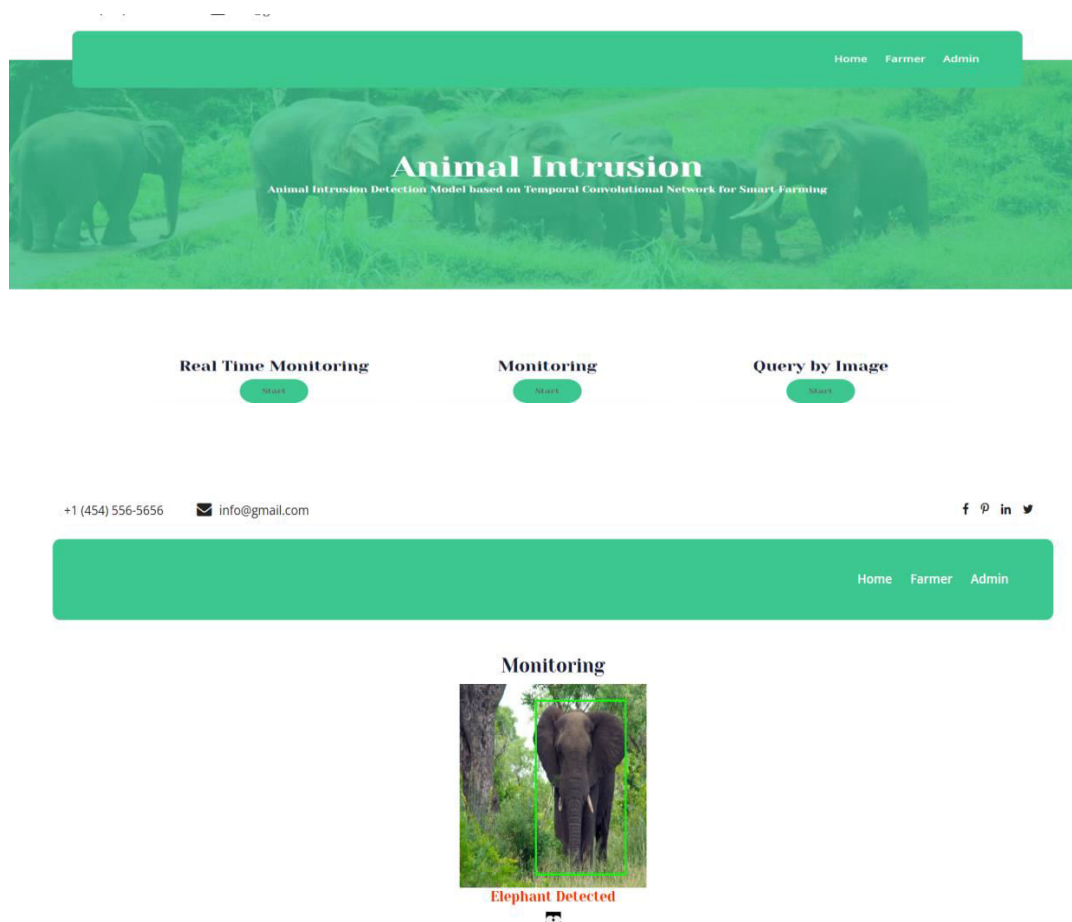
The system outputs predictions regarding the presence of animals, providing information such as the type of animal detected and a confidence score.

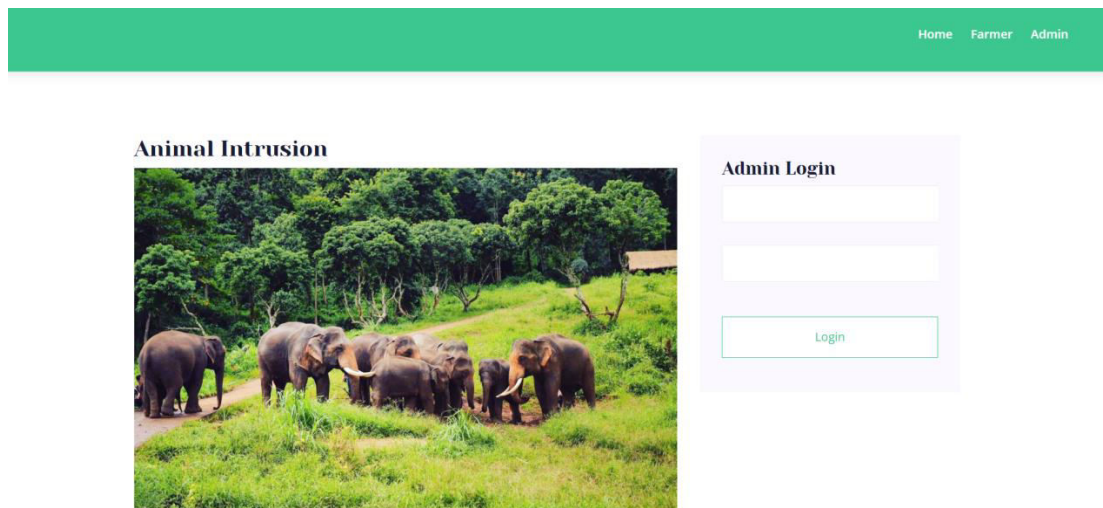
6. Animal Identification

Along with detecting the presence of animals, the system identifies the specific type of animal in the input data. This could include common animals like dogs, cats, birds, etc.

IV. EXPERIMENTAL RESULTS

The AI-based animal intrusion detection and repellent system was tested in real-world agricultural environments to evaluate its **accuracy, efficiency, and effectiveness** in identifying and repelling wild animals. The experiments involved monitoring farm fields where animal intrusions were frequent and validating system performance across multiple scenarios.





V.CONCLUSION

The implementation of the application required the design and development of a complex system for intelligent animal repulsion, which integrates newly developed software components and allows to recognize the presence and species of animals in real time and also to avoid crop damages caused by the animals.

Based on the category of the animal detected, the edge computing device executes its DCNN Animal Recognition model to identify the target, and if an animal is detected, it sends back a message to the Animal Repelling Module including the type of ultrasound to be generated according to the category of the animal.

The proposed CNN was evaluated on the created animal database. The overall performances were obtained using different number of training images and test images. This project presented a real-time monitoring solution based on AI technology to address the problems of crop damages against animals. This technology used can help farmers and agronomists in their decision making and management process.

REFERENCES

1. S. Giordano, I. Seitanidis, M. Ojo, D. Adami, and F. Vignoli, "IoT solutions for crop protection against wild animal attacks," in Proc. IEEE Int. Conf. Environ. Eng. (EE), Mar. 2018, pp. 1-5.
2. J. H. Muribø, "Locating sheep with YOLOv3," M.S. thesis, Fac. Inf. Technol. Elect. Eng., Dept. Comput. Sci., NTNU, Trondheim, Norway, 2019.
3. R. Y. Aburasain, E. A. Edirisinghe, and A. Albatay, "Drone-based cattle detection using deep neural networks," in Intelligent Systems and Applications, K. Arai, S. Kapoor, and R. Bhatia, Eds. Cham, Switzerland: Springer, 2021, pp. 598-611.
4. E. S. Kalhagen and Ø. L. Olsen, "Hierarchical species detection in real-time video using YOLO," M.S thesis, Fac. Eng. Sci., Dept. Inf Commun. Technol., Univ. Agder, Kristiansand, Norway, 2020.
5. A. Roihan, M. Hasanudin, and E. Sunandar, "Evaluation methods of bird repellent devices in optimizing crop production in agriculture," J. Phys.Conf. Ser., vol. 1477, Mar. 2020, Art. no. 032012.



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