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DETECTION OF ANIMALS IN AGRICULTURAL LAND USING CNN

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Abstract - The agricultural sector faces significant losses due to animal assaults, which damage crops and property, particularly in regions where farmed land extends into former animal habitats. Traditional methods to prevent such damage are often ineffective and labor-intensive, making it difficult for farmers to monitor vast areas continuously. This problem exacerbates human-animal conflict, affecting both human and animal safety. To address this, we propose an automated system that uses deep learning, specifically convolutional neural networks (CNNs), to detect animals entering agricultural lands. The system employs real-time surveillance through cameras that monitor the farm throughout the day. When an animal is detected, the system categorizes it using the YOLO algorithm and triggers sound-based scare tactics to deter the animal without causing harm. Additionally, geo-location data and images are sent to farmers and forest officials to help them take further action if needed. This approach not only reduces crop damage but also minimizes human-animal conflicts, providing a humane and efficient solution. By automating the monitoring and response process, the system reduces the need for human intervention, ensuring the safety of both crops and animals while enhancing agricultural productivity.

Key Words **:** Convolutional neural network, real-time surveillance, YOLO Algorithm, sound-based deterrents, crop protection.

1.INTRODUCTION

Agriculture has long been the cornerstone of India's economy, with the majority of the population relying on it for their livelihoods. However, farmers face numerous challenges, including deforestation, which leads to the loss of forest resources and forces wild animals to encroach upon agricultural lands. This results in significant human-animal conflicts, with animals like elephants and wild buffalo causing substantial crop damage, property destruction, and even human casualties. As human populations grow and agricultural lands expand into wildlife habitats, the frequency of these conflicts has increased, further threatening farmers' livelihoods. Traditional methods, such as scarecrows, chemical repellents, and electric fences, are either ineffective, costly, or harmful to both humans and animals. Moreover, many of these methods are environmentally damaging or difficult to implement on a large scale. To address this, we propose an AI-based system that utilizes deep learning to detect animal intrusions in farmlands through real-time monitoring using cameras and Passive Infrared (PIR) sensors. The system classifies the animals and uses sound-based deterrents to drive them away without harm. This non-lethal approach minimizes the need for manual labor, reduces costs, and ensures the safety of both animals and humans, offering a sustainable and efficient solution to the rising human-animal conflict in agriculture. By integrating automated monitoring, real-time alerts, and automated deterrents, this system enables farmers to protect their crops effectively while reducing human-animal conflicts, offering a significant step forward in agricultural protection. Ultimately, this technology helps improve crop yield and ensures the safety of farmers and wildlife alike, contributing to long-term agricultural sustainability.

2. Proposed Method

The proposed method involves 24-hour surveillance of farmland, utilizing camera modules to cover the entire area. Images are captured as frames, which are then processed to detect and classify animals. The sound-based scare tactics could be a pre-recorded sound that is played through speakers or a device that generates loud, sudden noises that are known to scare animals. Finally, if an animal is detected, the system will send an alert message to the farmer, notifying them of the animal's presence and the action taken by the system.

A. ANIMAL DETECTION AND CLASSIFICATION

To detect and classify animals, the "You Only Look Once" (YOLO) algorithm is employed. YOLO uses neural network technology to achieve real-time object recognition. Due to its speed, high precision, and strong learning capabilities, YOLO is selected for detecting and categorizing animals in the surveillance footage.

The YOLO algorithm works using three key techniques:

1. **Residual Block**
   In the Residual Block technique, the frames are divided into **SxS grids**. Each grid cell is responsible for detecting the object that appears within its boundaries. If the center of an object falls within a specific grid cell, that cell takes responsibility for detecting and classifying the object. Each grid cell predicts the bounding boxes around objects and calculates their confidence scores. Bounding boxes are defined to highlight objects in the image and include attributes such as width, height, center coordinates, and class label.

2. **Bounding Box Regression**
   YOLO uses **Intersection over Union (IoU)** to determine the output box that tightly fits the objects.

This technique helps remove unnecessary bounding boxes that do not match the object's characteristics. If the IoU score equals one, the predicted bounding box matches the actual bounding box perfectly. The final output includes unique bounding boxes that accurately fit the detected objects, ensuring precise and reliable object detection.

If an object is detected in more than one grid, the grid with the center of the object is responsible for classification. This ensures that the grid with the object's center point is considered the correct one for detection.

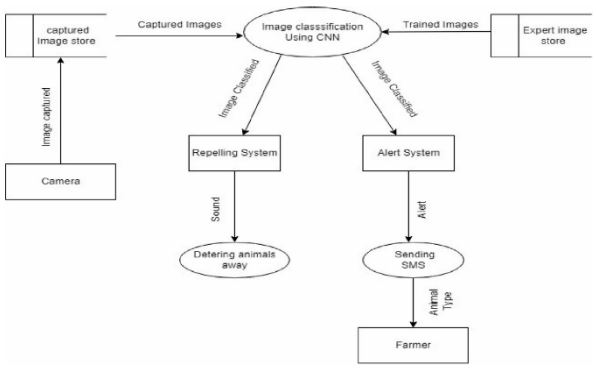

Fig -1: Data Flow Diagram

The Fig-1 depicts a smart animal intrusion detection system for farmland using a Convolutional Neural Network (CNN). A camera captures images, which are stored and analyzed by the CNN-based classification system using trained image datasets from an expert image store. When an animal is detected, the system either activates a repelling mechanism to deter the animal or sends an alert via SMS to the farmer, specifying the animal type. This system automates farmland protection by combining image processing, machine learning, and response mechanisms.

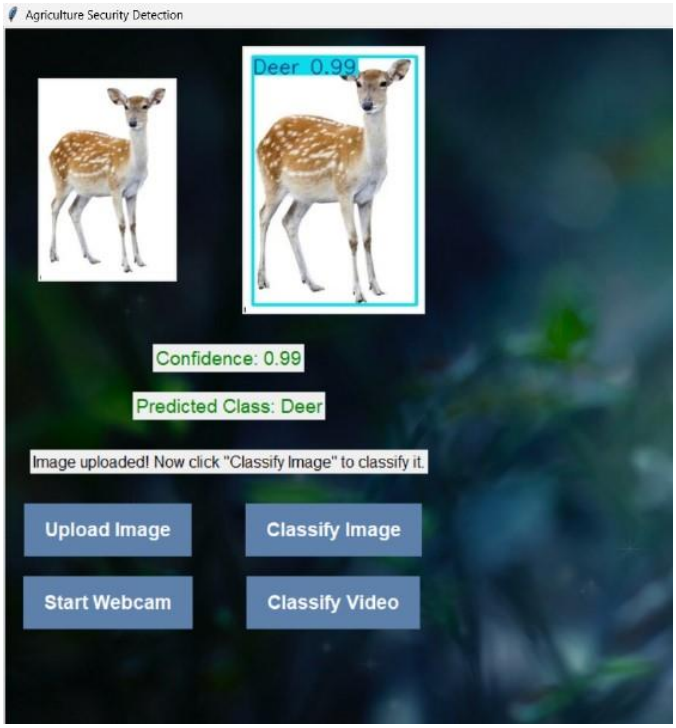

Fig -2: Animal Detection Output Using YOLO Algorithm

Fig. 2 demonstrates how animals are detected and classified using the YOLO algorithm. The detected animal type is listed along with the probability of classification and the inference time. The inference time refers to the duration it takes for the system to detect and classify the animal.

B. APPLING SUITABLE REPELLENT TECHNIQUE

After animals are detected and classified suitable repellent techniques are used based on type of animal intruded. Some repellent techniques used are creating sounds, applying gases, liquids and smoke. For Elephants bee sounds are created which will drive away them. On the same hand notifications are sent to farmers with image, type and location of the animal detected. After animals are detected and classified using the CNN-based image classification system, sound-based deterrents are exclusively employed to repel the intruding animals. These deterrents are carefully designed to match the behavior and sensitivity of the specific animal identified, ensuring precise and effective results without causing harm. For example, elephants, which have a natural aversion to bees, are deterred using bee buzzing sounds. Similarly, ultrasonic sounds, predator calls, or distress signals are used to drive away other animals such as deer, wild boars, or birds that threaten crops.

Sound-based deterrents provide an eco-friendly, humane, and non-invasive solution compared to physical barriers, chemical repellents, or harmful traps. They are cost-effective, easy to implement, and can cover large areas with minimal environmental impact. These systems can operate autonomously, detecting intrusions and triggering appropriate sound responses instantly. This automated approach minimizes the need for constant human presence, saving time and labor for farmers.

In addition to activating the sound deterrents, the system sends real-time notifications to farmers via SMS or mobile apps. These alerts contain detailed information, including a captured image of the animal, its classification, and its exact location. Such proactive communication keeps farmers informed and enables them to monitor their fields remotely, allowing for quick intervention if necessary.

This integrated approach ensures efficient crop protection by combining advanced detection technology with targeted sound deterrents. It not only safeguards agricultural produce but also promotes coexistence with wildlife by avoiding physical harm to animals. This system represents a sustainable and modern solution for managing human-wildlife conflicts on farmlands.

Table : Suitable Actions taken to drive animals

INTRUDER	SOUNDS MADE	MESSAGE RECEIVED
Elephant	Buzzing Noise of Bee	Elephant came into our field
Bear	Critter Gitter Carnivore Alarm	Bear came into our field
Dear	Tiger Roaring Sound	Dear came into our field
Gaur	Tiger Roaring Sound	Gaur came into our field
Monkey	Gun Shooting Sound	Monkey came into our field

The table demonstrates a sound-based animal deterrent system paired with real-time notifications to protect agricultural fields. It assigns specific sounds to different intruders, such as a bee buzzing noise for elephants, tiger roaring sounds for deer and gaur, and gunshot sounds for monkeys. These sounds mimic natural threats, effectively driving the animals away without harm.
Additionally, the system sends farmers an automated message detailing the type of animal detected and its presence in the field. This proactive approach ensures timely action, minimizing crop damage and promoting human-wildlife coexistence.

3. CONCLUSIONS

The project proposes the use of a Convolutional Neural Network (CNN) for animal detection and scare-based tactics, such as scarecrows and loud sounds, to deter animals from entering agricultural lands. The results of the project showed that the use of the proposed system could detect animals accurately and efficiently, and the scare tactics effectively reduced animal interference in agricultural lands. Furthermore, the project's proposed system has the potential to significantly reduce losses due to animal damage, resulting in an increase in crop yield and higher profitability for farmers. It is also a sustainable and humane solution to animal interference in agricultural lands, as it avoids the need for harmful animal control practices. Overall, the project demonstrates the effectiveness of integrating animal detection technology with scare-based tactics for enhancing crop yield and reducing animal damage in agricultural lands, which can benefit farmers and the agriculture industry as a whole.

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