Image Processing based Crop Protection and Road Accident Prevention System using Intelligence Surveillance

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***Abstract*—One of the major problems that farmers encounter is that wild animals that invade their crops destroy their output. The disruption of wild animals has always been a problem for ranchers.Animals including wild boar, deer, wild buffalo, elephants, tigers, monkeys, and others pose a threat to crop output. One of the major risks in lowering the harvest yield is crop loss caused by animal attacks. Crop striking is one of the most significant human-animal conflicts as a result of the expansion of cultivated land into former wildlife habitat. It is crucial to thoroughly and effectively inspect wild animals in their natural habitat. This initiative promotes a method to recognise animals that trespass on agricultural property. As there are so many different creatures, it might be difficult to physically identify between them. This computation groups animals according to their images so we may more effectively screen them. They also assist in making the distinction between an animal and a human, which is very helpful in identifying the invader.**

Keywords—image detection, image recognition, wild animals, field scene, data set, deep learning, neural network, software.

I. Introduction

Animal intrusion detection systems are technology systems used to detect the presence of animals in a particular area. These systems are often used in agricultural settings, such as farms, to protect crops, livestock, and other farm assets from damage caused by wild animals. The primary goal of an animal intrusion detection system in an agricultural farm is to alert farmers to the presence of animals on their property, so that appropriate action can be taken to protect crops, livestock, and other assets.

One of the biggest dangers to crops and property on agricultural farms is the infringement of wild animals. These animals can cause significant damage to crops and farm infrastructure, leading to financial losses for farmers. They can also pose a threat to human safety, particularly if they are aggressive or carry diseases.

II. Literature Review

The article [1] by Dmitry Yudin, Anton Sotnikov, and Andrey Krishtopik focuses on the development of a deep learning model for detecting large animals on road scenes captured by cameras installed on vehicles. The authors note that the detection of large animals, such as moose or deer, is important for preventing road accidents and ensuring driver safety. They propose a two-stage object detection approach that uses a Faster R-CNN model to identify potential animal regions, and then applies a custom algorithm to accurately detect and classify the animal. To train and evaluate the model, the authors used a dataset of road scenes with labeled animal annotations, consisting of over 800 images. They also compared the performance of their model with other state-of-the-art object detection models, such as YOLOv3 and RetinaNet. The results showed that the proposed two-stage model achieved high accuracy in detecting large animals on road scenes, with an F1 score of 0.95. It outperformed the other object detection models, demonstrating the effectiveness of the proposed approach for this specific task. The authors conclude that the proposed deep learning model could be used in real-world applications, such as installing it on vehicles or traffic cameras to provide early warning signals to drivers in the event of potential animal hazards on the road.

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The article [2] by Sheik Mohammed. S, T. Sheela, and T. Muthumanickam demonstrate a deep learning model for wildlife picture animal detection. The authors point out that managing habitats and conserving wildlife depend on the detection of animals. The suggested model is a modified convolutional neural network (CNN) that was trained on a sizable dataset of annotated animal photos using transfer learning. The training dataset's variety and size are increased by the authors using data augmentation techniques. The scientists utilized a test dataset of over 600 nature photos with annotated animal annotations to assess the model's performance. They compared the effectiveness of their model to various cutting-edge object identification methods, including YOLOv3 and Faster R-CNN. The outcomes demonstrated that the suggested modified CNN model, with an F1 score of 0.95, successfully detected animals with high accuracy. It outperformed the competing object detection models, proving the viability of the suggested strategy for this particular challenge. The suggested animal-detection technique, according to the scientists, might be applied in practical settings, such as camera traps or drone photos for wildlife monitoring and conservation initiatives.

In the article [3], a study is done on several annual occurrences in various areas of Japan where dangerous animals have damaged crops and injured people, costing almost 15.8 billion yen in 2018. To decrease the harm, numerous experiments on camera-based systems have already been conducted. The current system, however, cannot be set up in mountainous areas where it is challenging to provide the system with electronic power because it depends on the sensing devices being operational at all times. By combining numerous sensing technologies, the authors of this study proposed a novel harmful animal detection system that can recognise approaching animals near traps and fences as well as their species and postures (such as beacon sensing, laser radar, and depth camera). By examining changes in received signal intensity brought on by an object's reflection, refraction, or absorption of radio wave beacons, beacon sensing attempts to follow the motion of moving objects. A tiny computer is turned on to utilize a laser radar to calculate the one-dimensional distance to the target item after a moving object has been spotted. The machine learning technique examines the measured distance time series data to determine the type of moving item (human, animal, etc.). The depth camera is turned on in order to calculate the two-dimensional distance to the target animal if the little computer thinks that the moving item poses a threat to it. The dangerous animal's posture is estimated by the machine learning technique by analyzing the gathered distance data. As previously said, the suggested method reduces power usage by progressively activating the sensors that require more power.

It is essential to base management and conservation decisions on reliable and effective observation of wild animals in their natural habitats. Automatic hidden cameras, sometimes known as "camera traps," are a common technique for wildlife monitoring due to their effectiveness and dependability in gathering discrete, ongoing, and substantial data on wildlife. But, it would be exceedingly expensive, time-consuming, and repetitious to manually process all of the pictures and movies that camera traps would have taken. Scientists and ecologists face a significant challenge in monitoring wildlife in an open setting because of this. In [4], the authors proposed a framework for building an automated wildlife monitoring system based on recent advancements in computer vision deep learning techniques.In example, utilizing a single annotated dataset from the Wildlife Spotter project and cutting-edge deep convolutional neural network architectures, a computer system was developed that can automatically filter animal photos and identify species. Our experimental results demonstrate the feasibility of building completely automated wildlife observation, with an accuracy of 96.6% for the job of detecting animal photos and 90.4% for the recognition of the three most common species among the collection of photographs of wild animals obtained in South-central Victoria, Australia. By expediting research results, creating more effective surveillance systems based on citizen science, and making management choices in the future, this has the potential to have a substantial impact on the ecology and analysis of trap camera pictures businesses. In a world where wildlife creatures are disappearing and yet getting injured by automobiles when they cross the road, this study [5] suggests an Internet of Things proposal to reduce animal-vehicle accidents on motorways and roadways in reserve regions. The paper proposes a great alternative to electric fencing, which poses a significant threat to the lives of animals. It does this by sending alerts to smartphones and putting huge LED displays in the most common areas where animals cross roads. The sensors-based motion detection algorithm and the artificial neural network-based object recognition algorithm are two major algorithms used in this paper. The ANN for object recognition and the motion detection PIR sensor for animal movement detection are utilized in this paper.

In a world where wildlife creatures are disappearing and still getting injured by cars when they cross the road, this paper [5] suggests an Internet of Things idea to reduce animal-vehicle collisions on motorways and roads in reserve regions.After detecting the motion, the object identification system decides whether it was brought on by an animal's movement or by any other factor. As an animal moves, it transmits notifications through LED sign boards and to an Android app that uses MQTT to display alerts on Google Maps in the proper location. This study shows that object identification accuracy can reach up to 91%.

The article [6] by Sachin Sharma, Dharmesh Shah, Rishikesh Bhavsar, Bhavesh Jaiswal, and Kishor Bamniya presents an application based on animal identification. These applications include spotting and following animals like elephants in forests to better understand how they interact with their surroundings, avoiding animal-vehicle collisions on the road, keeping dangerous animals out of residential areas, and many more. The implementation of our recommended method based on pattern matching mechanism using normalized cross correlation for animal identification is given in this article after a quick discussion of some of the methodologies used for animal detection. Several dog-related photos have been used to test the suggested approach. The effectiveness of our suggested technique is demonstrated by the simulation results, which also highlight the system's incredibly low false positive and false negative rates. For animal detection, a total efficiency of 86.25% is attained.

The [7] decisions on management and conservation presented by authors Hung Nguyen, Sarah J. Maclagan, Tu Dinh Nguyen, Thin Nguyen, Paul Flemons, Kylie Andrews, Euan G. Ritchie2, and Dinh Phung must be backed by reliable and effective observation of wild animals in their natural habitats. Automatic covert cameras, also referred to as "camera traps," are a helpful and reliable tool for capturing data on wildlife inconspicuously, continuously, and in large numbers, and are becoming a more and more frequent tool for wildlife monitoring. However, manually processing such a massive number of photos and movies taken with camera traps is very expensive, tedious, and time-consuming. This is a significant barrier to ecologists' and scientists' ability to observe wildlife in an open environment. With the aim of creating an automated wildlife monitoring system, we provide a framework for establishing automated animal detection in the wild in this study. We do this by using recent advancements in computer vision's deep learning methodologies. We train a computational system that can automatically identify species from animal photographs using state-of-the-art deep convolutional neural network architectures and a single-labeled dataset from the citizen science Wildlife Spotter project. Our test findings indicated that it is feasible to build a completely automated wildlife observation system with an accuracy of 96.6% for the task of recognising photographs containing animals and 90.4% for identifying the three most common species among the collection of wild animal images obtained in South-central Victoria, Australia.

A.Mukherjee, S. Stolpner, X. Liu, U. Vrenozaj, C. Fei, and A. Sinha's article [8] addresses the increasing need for animal identification technology to reduce vehicle-animal accidents worldwide. Traditional tactics include building animal bridges, installing real or virtual fences, using video surveillance, and using break-the-beam techniques. In contrast to current techniques, the gadget under discussion, the Large Animal Warning and Detection System (LAWDS), employs a 360°-scanning radar to monitor a segment of highway. This makes it possible to monitor the roadway continuously throughout the whole year, no matter the weather. The technology can follow huge animals thanks to cutting-edge analysis and classification methods (e.g. deer). LAWDS is appealing for operational usage because of its low false alarm rate and minimal environmental impact.

In a study article titled [9] the issue of crop damage brought on by pests and animals is discussed. This poses a serious issue for farmers, especially in developing nations where small-scale farmers sometimes lack the finances necessary to put in place efficient crop protection measures. In the research, an unique crop protection strategy is suggested that makes use of an intelligent intrusion detection system based on Arduino microcontroller boards. The system is made up of infrared sensors that are installed around the crop field's perimeter and a central control unit that wirelessly connects to the sensors. The sensors are made to distinguish between animals and people and to identify intruders in agriculture fields. According to the authors, this is crucial since people and animals exhibit diverse behavioral patterns, necessitating the adoption of various defense mechanisms to limit the harm that each sort of intruder might bring. The authors provide diagrams and code samples to help readers understand how the system is implemented while thoroughly describing the system's hardware and software components. They clarify that the system is made of readily accessible, off-the-shelf components and is intended to be inexpensive and simple to implement. The authors also go into detail on the system's testing and evaluation using a real-world example in an agricultural field. They demonstrate that the system was highly accurate in identifying burglars and alerting farmers in real time. Additionally, they talk about the system's drawbacks and difficulties and offer prospective directions for further study and development.

In their essay [10], Rakesh Sharma and Vijay Anant Athavale discuss the developments in wireless communication and electronics that have led to the creation of large-scale wireless sensor networks (WSNs). Nevertheless, there are a number of restrictions on WSNs, including limited compute power, little memory, energy resource constraints, susceptibility to physical capture, and the requirement for infrastructure. These restrictions provide specific security difficulties, especially for situations where secrecy is essential. Security is a major issue for many of the uses of wireless sensor networks, which are numerous. To run WSNs safely, any attacker must first compromise the WSN system (i.e., sensor nodes and/or information destination) (i.e., data sink or base station)

III. Proposed System and Objectives

The Wild Animal Detection System is a computer vision-based system designed to detect and track wild animals in agricultural fields. The system is composed of a network of cameras installed in areas where wild animals are known to inhabit or roam. The cameras are connected to a computer processor that is constantly monitoring the area in search of any potential wild animal activity. When a potential wild animal is detected, the system will alert the user with an audible alarm as well as a visual alert. Simultaneously a wireless communication is established with the owner’s device. The user will then be able to view the animal on their device in real time, allowing them to track the animal’s movements. Additionally, the system will be able to log the animal’s movements over time, allowing analysis of the animal's behavior and habitat.The Wild Animal Detection System is designed to be quick, reliable and accurate. The cameras used in the system are equipped with advanced image processing algorithms that can detect and track wild animals in various lighting conditions and environments. The cameras are also able to detect any potential threats to the animal, such as potential poachers or hunters, and alert the user accordingly. The Wild Animal Detection System is designed to be easy to set up and use. It is designed to be installed in areas where crops are cultivated, where wild animals are prone to inhabit or roam, and is capable of being set up and operated remotely. Additionally, the system is designed to be highly secure, ensuring that only authorized users are able to access the system. An animal-vehicle collision (AVC) is a type of traffic accident that involves a vehicle striking an animal, such as a deer, a horse, or a cow. These types of accidents can be dangerous for both the occupants of the vehicle and the animal, and can cause serious damage to the vehicle. In some cases, AVCs can be fatal for the animal and/or the people involved. To reduce the risk of AVCs, it is important to be alert while driving, especially in areas where animals are known to be present. If you do encounter an animal on the road, try to slow down and move over to a different lane if possible. Animal-vehicle collisions (AVCs) can be a huge problem, particularly in regions with a lot of traffic and a lot of wildlife. AVCs can be particularly hazardous in a forest due to poor vision and the possibility that animals will suddenly dart into the road. When driving through places where there may be animals present, it is crucial for drivers to be aware and to slow down in order to limit the danger of AVCs. To assist keep animals off the road, it could be essential in some circumstances to erect fencing or other barriers. Drivers should also be ready to swerve if an animal does happen to cross in front of their car.

A multitude of suggested technologies are designed to lessen the likelihood of animal-vehicle collisions (AVCs) and lessen the effects of those collisions when they do happen. Several of these systems consist :

ANIMAL DETECTION SYSTEMS: These systems use sensors, such as radar or cameras, to detect the presence of animals on or near the road. When an animal is detected, a warning is issued to the driver to help them avoid a collision.

VEHICLE-MOUNTED ANIMAL REPELLENT SYSTEMS: These systems use noise, light, or other stimuli to deter animals from approaching the road.

ANIMAL CROSSING SIGNS: These signs are used to alert drivers to the presence of animals in the area and encourage them to slow down and be on the lookout for animals on the road. It is possible to use an animal-vehicle collision (AVC) detection system with flashlights in forested areas, although the effectiveness of the system may be limited by the presence of trees and other vegetation. Flashlights can be used as a visual warning signal to alert drivers to the presence of animals on or near the road. However, the light may not be visible from a distance, and it may be difficult for drivers to see the animal if it is hidden by trees or other vegetation.

The main objectives include:

- To detect the presence of wild animals in an area and alert local authorities of their presence.
- To provide real-time data on the location and movement of wild animals for conservation efforts.
- To help reduce human-wildlife conflict in areas where wild animals are present.
- To help identify potential threats to wild animals and their habitats.
- To reduce crop damage caused by wild animals through early detection.
- To provide farmers with an early warning system for wild animal activity on their land.
- To allow farmers to take the necessary steps to protect their crops and prevent further damage.
- To provide farmers with data to help them better understand the behavior of wild animals in their area.
- To help farmers form plans to manage the wild animal populations on their land.
- To provide farmers with the means to evaluate the success of their strategies to protect their crops.
- To help farmers identify specific species of wild animals in their area and prevent them from becoming a nuisance.
- To reduce the likelihood of vehicle-wildlife collisions through early detection of wildlife on or near the road.
- To monitor the population size, movement and habitat of wildlife in the areas adjacent to the roads.
- To raise public awareness of wildlife conservation and the potential for wildlife-vehicle collisions.
- To provide wildlife management staff with data to inform decisions about road closures, speed limits and other measures to reduce the risk of wildlife-vehicle collisions.
- To provide a warning system to alert drivers to the presence of wildlife on or near the road.
- To provide a reliable and cost-effective system to detect and identify wild animals from a distance.
- To enable the detection of wild animals in a variety of environments, including forests, wetlands, agricultural areas and urban landscapes.
- To accurately distinguish between wild animals and humans, so that appropriate action can be taken depending on the situation.
- To provide timely alerts to the appropriate authorities or conservationists, in order to minimize human-wild animal conflicts.
- To provide a comprehensive database of animal sightings, allowing for accurate monitoring and conservation efforts.
- To create a system which is easy to use and maintain, and which can be adapted to different user requirements.

A. Figures and Tables

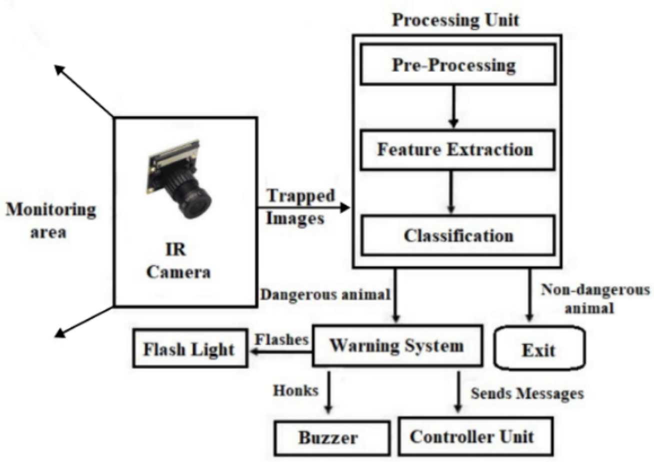

Fig. 1. Model Block Diagram of the Proposed system

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