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ANIMAL DETECTION IN FARMS USING OPENCV

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Abstract

Agriculture plays a fundamental role in sustaining the Indian economy, providing employment and livelihood to a large portion of the population. Despite advancements in farming techniques, one of the persistent challenges faced by farmers is the intrusion of wild animals into agricultural fields. Such intrusions often lead to large-scale crop damage, financial loss, and emotional distress for farmers. Traditional animal deterrent methods, such as manual patrolling, fences, or scarecrows, have shown limited effectiveness and are not scalable for large areas. These techniques either require continuous human intervention or fail to adapt to the changing behavior of animals over time. To address this issue, this paper proposes an intelligent and automated solution using computer vision and OpenCV for real-time animal detection in farmlands. The system leverages a pre-trained deep learning model—MobileNet SSD (Single Shot Detector)—for identifying and classifying animals captured through surveillance cameras installed in the field. Once an animal is detected, the system activates an alert mechanism such as a loud siren or flashing light to scare away the intruder and notify the farmer instantly, either through a local alarm or via a remote communication system. This approach not only reduces the dependency on manual supervision but also offers a scalable, cost-effective, and energy-efficient solution for small and large farms alike. The use of MobileNet SSD ensures that the model runs efficiently on edge devices like Raspberry Pi or low-cost processors, making it accessible to farmers in rural areas without the need for expensive hardware. The system can be further enhanced by integrating night vision cameras, thermal sensors, or connecting with IoT devices for better monitoring and data logging. Through this study, we aim to demonstrate that a wellstructured computer vision system can help mitigate crop losses caused by animal intrusion, enhance farm productivity, and empower farmers with modern technological tools.

Keywords: Computer Vision, OpenCV, MobileNet SSD, Animal Intrusion, Smart Farming, Agriculture Monitoring, Deep Learning.

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INTRODUCTION

Agriculture is one of the most vital sectors for sustaining human life and economic development, providing food and raw materials for numerous industries. However, crop damage caused by wild animals has emerged as a significant social and economic concern, particularly in regions like India where small-scale farming predominates. Animals such as wild boars, macaques, porcupines, deer, and elephants often invade agricultural lands, causing extensive damage and sometimes even human casualties. Stringent wildlife protection laws further complicate matters, limiting farmers' ability to address this issue effectively. With advancements in technology, computer vision has found diverse applications in agriculture, ranging from disease detection in crops to ensuring the quality of agricultural products. Leveraging these innovations, this project proposes an artificial intelligence- based system using cameras to detect animal intrusions. Utilizing OpenCV and pre-trained MobileNet SSD models, this system identifies animals in real-time, triggering alerts to farmers or taking automated countermeasures. This system not only minimizes crop damage but also offers a costeffective and environmentally sustainable solution to safeguard farms from wild animal intrusions.

LITERATURE SURVEY

A study applied computer vision techniques in agriculture for food grading, plant disease detection, and farm security. Traditional methods like scarecrows, although widely used, proved ineffective against wild animal invasions. The paper introduced W-CoHOG, a feature extraction algorithm based on Histograms of Oriented Gradients (HOG), which improved detection accuracy. The LIBLINEAR classifier was used to handle high-dimensional data efficiently. Tests conducted on Wild-Anim and CamaraTrap datasets confirmed its superior performance over existing methods [1].

Another research emphasized the critical role of agriculture in the Indian economy and addressed the growing issue of wild animal intrusions. Traditional security systems, such as humanoid scarecrows, lack efficiency. This research proposed a system that detects intrusions, monitors activities, and alerts farmers. It aimed to provide an adaptable and effective security system for agricultural lands to mitigate crop losses [2].

MobileNets, lightweight models for mobile and embedded vision applications, were also explored. These models employ depthwise separable convolutions, reducing computational costs while maintaining accuracy. MobileNets can be customized with hyperparameters to balance latency and precision. Their application extends to object detection, fine-grained classification, and large-scale

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localization. MobileNets demonstrated robust performance across various use cases, making them suitable for detecting animals in agricultural fields. These studies collectively highlight the potential of integrating computer vision and AI in agriculture to mitigate crop damage caused by wild animals. By building on these insights, the proposed system aims to provide an efficient, cost effective, and practical solution [3].

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PROBLEM STATEMENT

Agriculture plays a significant role in India. Crop losses due to animal intrusions severely impact farmers, especially those with small-scale operations. Computer vision techniques offer promising solutions for enhancing agricultural productivity through automation. This research proposes an AI-based system to monitor fields using cameras, detect animal intrusions, and alert farmers promptly [5].

PROPOSED SYSTEM

This paper presents an AI-powered surveillance system to monitor farms for animal intrusions. The proposed solution uses a camera to capture video footage, which is processed using OpenCV [6]. The Mobile Net SSD model, pre-trained on the MS COCO dataset, is employed to detect specific animals such as birds, cows, and dogs. When an animal is detected, the system triggers a siren to scare the animal away and simultaneously alerts the farmer [7]. This approach ensures prompt action to minimize crop damage.

Advantages of Proposed System:

- i. Confidentiality and Integrity
- ii. Secure data sharing
- iii. Accessibility restricted to authorized users
- iv. Encrypted data transmission

SYSTEM ARCHITECTURE

The system architecture is designed to monitor farms using a combination of real-time video feeds, computer vision, and deep learning. It consists of three main components: image input via camera, object detection using MobileNet SSD, and an alert system. The camera captures continuous footage, which is analyzed frame-by-frame using the SSD model. Upon detecting animals, the system highlights them with bounding boxes and triggers an alert through a speaker or messaging system. This modular architecture ensures efficient processing, quick detection, and immediate response to animal intrusions figure 1.

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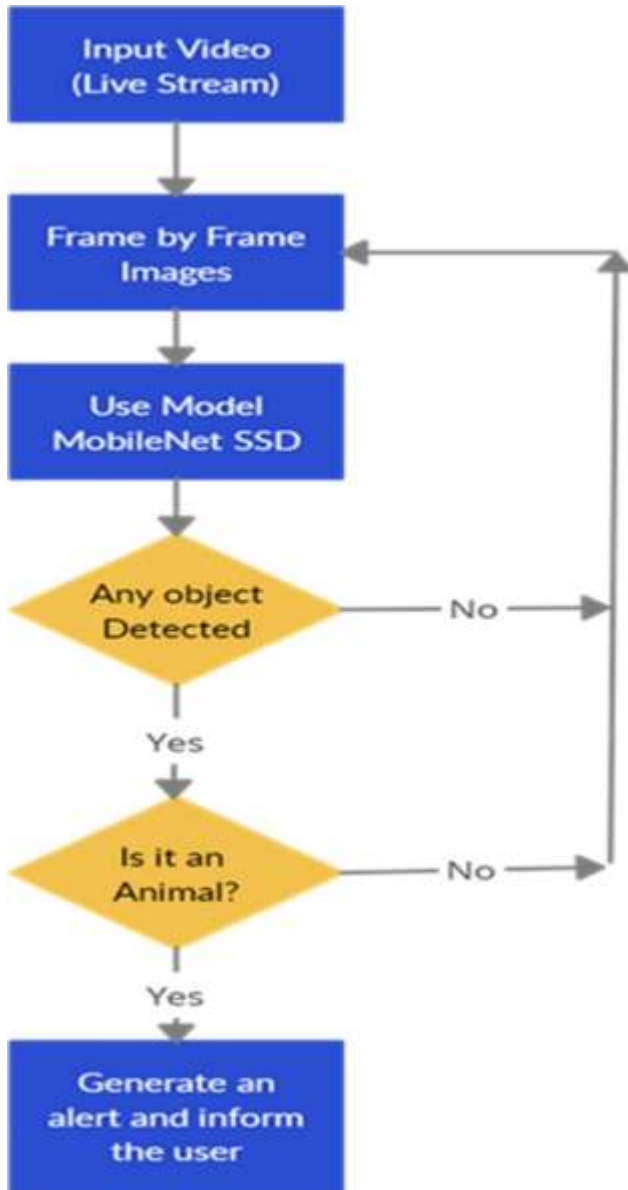


Fig 1. System Architecture

Algorithm Used

- **SSD (Single Shot Detector)** is an efficient and widely used algorithm for object detection.
- **Backbone Model Selection:**

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o The MobileNet SSD model is utilized for its lightweight architecture and ability to perform well in embedded systems.

o VGG Net acts as the feature extractor, producing feature maps from input images.

- **Speed Advantage:** It is significantly faster than traditional object detection algorithms like RCNN.

- **Feature Detection Process:**

o Softmax Layer :

- Converts the raw output (logits) into probabilities for each detected class.

- Ensures these probabilities sum up to one by normalizing them, which helps in generating accurate classification results.

o Probability Conversion : Each output is exponentiated and normalized to provide classspecific probabilities.

- **Components:** SSD consists of two main parts:

o **Backbone Model:** A pre-trained image classification network used as a feature extractor.

o **SSD Head:** Responsible for detecting and classifying objects based on extracted features.

SYSTEM DESIGN:

I Implementation Details:

- Framework: OpenCV for computer vision and image processing.

- Model: MobileNet SSD trained on MS COCO dataset.

- Hardware: A standard camera for capturing video feed and a speaker for audio alerts.

II Workflow:

- The video feed is captured in real-time using a camera.

- Frames are resized and converted into blobs for input into the MobileNet SSD model.

- The model identifies animals based on predefined classes (e.g., cows, dogs, birds).

- If an animal is detected, the system:

- o Draws a bounding box around the detected object.

- o Activates an audio siren to deter the animal.

- o Records the detection event for future reference.

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III Key Features:

- Adjustable confidence threshold for detection (default: 20%).
- Real-time alerting mechanism using a siren.
- Efficient processing with minimal hardware requirements.

PROJECT DESCRIPTION:

I. Feasibility Study:

In this stage, the viability of detecting wild animals in farms using OpenCV and SSD is assessed. A business proposal is formulated with a basic project plan and initial cost estimates. The practicality of the proposed system is evaluated to ensure it aligns with the intended goals without overwhelming resources. The feasibility analysis identifies whether the proposed solution is achievable and sustainable [8].

Three key considerations involved in the feasibility analysis are:

- Economical Feasibility
- Technical Feasibility
- Social Feasibility

II. Economical Feasibility:

This study evaluates the financial viability of implementing the animal detection system. The goal is to determine if the system can be developed within a reasonable budget. Most of the tools and technologies used, such as OpenCV and TensorFlow, are open-source and freely available, which significantly reduces the costs [9]. The only expenses are related to hardware setup, including cameras capturing live footage and minimal customization for deployment. The balance between cost and functionality makes this system an economically feasible solution for farms.

III. Technical Feasibility:

This study examines whether the technical requirements for the project are achievable. The proposed system leverages pre-trained MobileNet SSD models and OpenCV for efficient object detection and processing, requiring moderate computational resources. Modern systems and devices can run the model without significant overhead or the need for specialized hardware [10]. The system ensures scalability while keeping technical resource demands minimal, making it suitable for implementation in real-world farm scenarios.

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IV. Social Feasibility:

The social feasibility study assesses how well the system will be received by its users, primarily farmers and agricultural workers. The system is designed to be user-friendly, with minimal training required for effective operation. Users are provided with clear instructions on system usage, building their confidence in its functionality.

The solution is developed with a focus on practicality and ease of use, ensuring acceptance by the community and facilitating its integration into existing farm practices.

RESULT :

The proposed animal detection system successfully identifies animals in farm areas and alerts users to potential intrusions. Results from live testing show the system's ability to detect multiple animals in real-time with high accuracy, even in varying environmental conditions.

Key outcomes include:

- Timely detection and notification of animal presence.
- Prevention of crop damage and livestock harm.
- Seamless integration into existing farm monitoring setups.

Results are visually represented in figures showcasing the system architecture, detection accuracy, and real-world implementation scenarios. These figures illustrate the effectiveness of the system in achieving its intended goals.

IMAGES WILD ANIMALS

The system is capable of identifying various wild animals that commonly invade agricultural lands. Images of animals such as lions, elephants, tigers, and foxes are used during training and testing to validate the detection model. These species, known for causing significant crop damage, are recognized with high accuracy, helping farmers respond proactively figure 2-5.



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Fig 2 Lion



Fig 3 Elephant

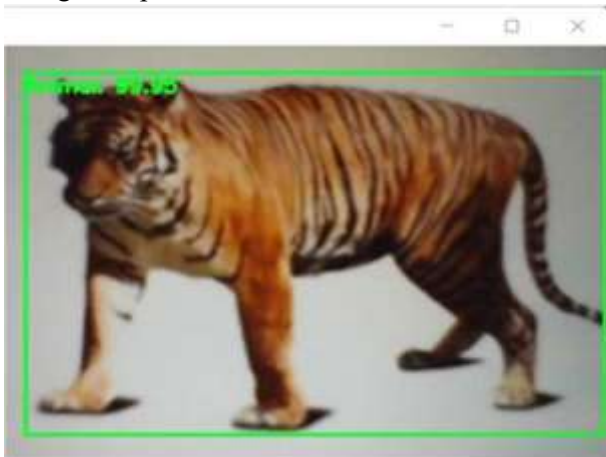


Fig 4 Tiger

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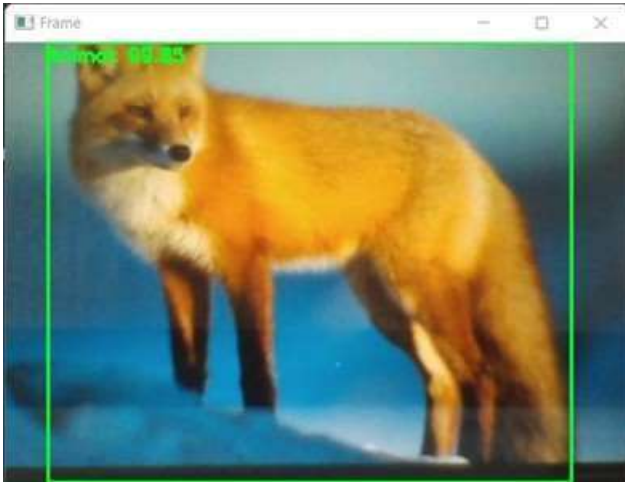


Fig 5 Fox

DOMESTIC ANIMALS:

The solution also detects domestic animals like cows, goats, and buffaloes, which may unintentionally wander into restricted crop zones. Including these animals ensures the system can differentiate between intentional and unintentional intrusions, improving its practical use in mixed-agriculture environments where livestock and crops are closely managed figure 6-8.



Fig 6 Buffalo

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Fig 7 Goat

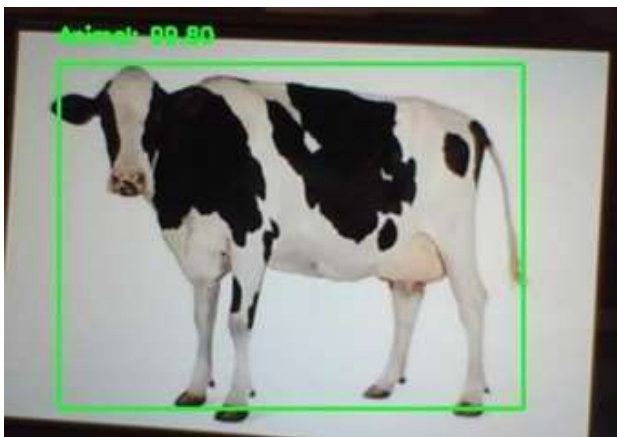


Fig 8 Cow

BIRDS:

In addition to land animals, the system identifies birds such as parrots, sparrows, and eagles. Birds are often overlooked in surveillance systems, but they can cause considerable damage to crops and stored grains. By incorporating bird detection, the system provides broader farm protection and supports early preventive actions figure 9-11.

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Fig 9 Eagle

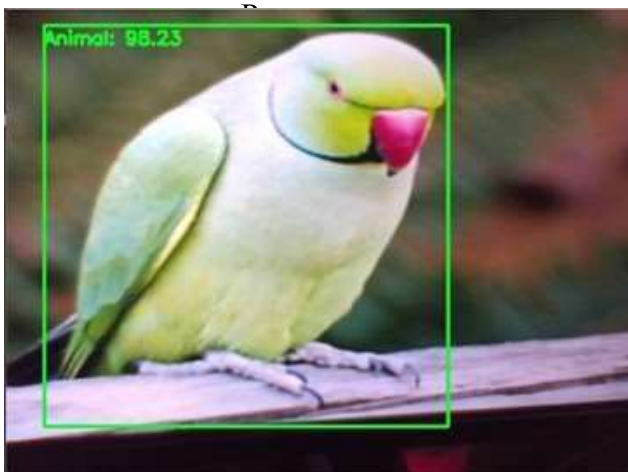


Fig 10 Parrot



Fig. 11 Sparrow

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This component of the project utilizes OpenCV for video analysis and image processing to detect animals in real time. OpenCV processes frames captured from live camera feeds, formats them as input blobs, and passes them to a pre-trained MobileNet SSD model. This lightweight model quickly identifies animals based on shape, size, and motion. Once an animal is recognized, the system marks it visually and triggers alarms or notifications. The use of OpenCV ensures the solution remains lightweight and efficient, suitable for rural areas with limited computational infrastructure.

CONCLUSION:

In the present, crop damage by wild creatures has grown to be a significant social issue. It needs immediate attention and a workable result. The suggested system enables us to cover footage from any camera device installed in granges to descry any beast presence or intrusion. At 18 frames per second, the object discovery model continuously. operated basically It's a dependable and affordable system. Both to scarify off interferers and to gesture the planter to take action, the temptress sounds. As a result, the ranch's crops can be defended with this operation. In place of the current traditional ways, it might be veritably helpful for agrarian objects.

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