

Yolov8:A Cutting-Edge Approach To Prevent Wildlife Encroachment

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Abstract :Wild animals entering human settlements and agricultural lands pose a significant threat to crops, livestock and human safety. Traditional deterrent methods such as fencing, scarecrows and manual monitoring are often ineffective and costly. This paper proposes a smart automated system that utilizes the YOLOv8 object detection algorithm to identify wild animals in real-time using CCTV footage. The system then triggers species-specific deterrent sounds to repel the animals, thereby providing a cost-effective, eco-friendly and non-lethal solution for protecting farmlands and human habitats.

1. INTRODUCTION

Human-wildlife conflict has become an increasingly pressing issue in many parts of the world, particularly in regions where urban expansion and agricultural activities intersect with natural habitats. The intrusion of wild animals into human settlements and farmlands leads to severe consequences, including crop destruction, livestock loss, and potential threats to human life. Conventional deterrent measures such as physical barriers, scarecrows, or human surveillance often fall short due to their limited effectiveness, high maintenance costs, or environmental impact. Recent advancements in computer vision and artificial intelligence offer promising alternatives to traditional wildlife management methods. Among these, real-time object detection algorithms such as YOLO (You Only Look Once) have demonstrated remarkable accuracy and speed in identifying objects in complex environments. Leveraging these technologies, this paper proposes a novel, smart, and automated system that detects wild animals using live CCTV footage processed through the YOLOv8 algorithm. Upon detection, the system activates targeted acoustic deterrents tailored to specific animal species, thereby discouraging their presence in protected zones. This approach offers a sustainable, cost-effective, and non-lethal solution that can be scaled across various terrains and agricultural settings. By integrating real-time monitoring with intelligent deterrence, the proposed system aims to enhance human-wildlife coexistence while minimizing economic losses and ecological disruptions.

2. RELATED WORK

Several approaches have been proposed to mitigate the intrusion of wild animals into human settlements and agricultural lands by employing advanced object detection algorithms and intelligent monitoring systems. Mukaram Safaldin et al. [1] introduced an improved YOLOv8 algorithm to enhance the accuracy and efficiency of detecting moving objects in real-time applications. This work underscores the reliability of YOLOv8 for wildlife detection by improving object identification precision, which aligns with our proposed system for recognizing wild animals through CCTV footage. Mangalapuri Govardhan et al. [2] developed a real-time wildlife tracking and anomaly detection system using YOLOv8. Their research highlights the

algorithm's ability to provide robust detection in dynamic environments, which forms the foundation of our automated animal detection and deterrent framework. S. J. Sugumar and R. Jayaparvathy [3] designed an early warning system for elephant intrusion along forest borders. Their approach relied on sensor-based detection, providing a baseline for integrating automated alert mechanisms. Our proposed system extends this concept by incorporating species-specific deterrent sounds to prevent animal entry. Praveen Rao VP et al. [4] compared the YOLOv7 algorithm with CNN-based models for hazardous fire detection in CCTV footage. This comparative study emphasizes the advantages of YOLO-based models for real-time image analysis, which supports our choice of YOLOv8 for accurate animal identification. Isha Dua et al. [5, 10] proposed a vision-based human-elephant collision detection system using image processing techniques. This work demonstrates the feasibility of real-time monitoring for large animal detection, which we enhance through the use of the YOLOv8 model for multi-species identification and deterrence. S Sheela et al. [6] presented a low-cost IoT-based alert system for monitoring wildlife intrusion into human-populated areas. This research emphasizes the importance of affordability and accessibility in designing animal deterrence systems, principles which are incorporated into our cost-effective and eco-friendly approach. R. Newlin Shebiah et al. [7, 8] implemented an early warning system using Raspberry Pi for wild animal threats. While their solution focuses on simple alerts, our system advances this concept by integrating intelligent detection and species-specific responses for improved deterrence. R. Radha et al. [9] proposed a wireless sensor network solution to prevent monkey trespassing in agricultural fields. Their flooding approach informs our system's use of rapid, automated responses to mitigate animal intrusion. K. Vishnu Sathesh et al. [11] developed an image-processing-based surveillance system to protect crops from wild animals. Their work aligns with our objective of using advanced computer vision techniques, and we extend their efforts by employing YOLOv8 for improved accuracy and responsiveness. Shubham Mishra et al. [12] introduced intelligent motion detection using OpenCV for various monitoring applications. Their work informs our implementation of motion-triggered surveillance, which is enhanced by the advanced detection capabilities of YOLOv8. R. Shyam et al. [13] applied a novel CNN-based approach to track body parts for assistive driving, improving detection accuracy over conventional methods. This work supports our use of deep-learning techniques to enhance the accuracy of wild animal identification. Mohit Korche et al. [14] designed a smart crop protection system using intelligent monitoring. Their work emphasizes real-time detection and automated responses, which aligns with our approach for animal deterrence. K. Mohana Lakshmi et al. [15] introduced a GSM-based system to protect agricultural crops from wild animals. Our system builds upon this approach by employing advanced object detection and species-specific deterrent mechanisms. N. Penchalaiah et al. [16] developed a smart irrigation and crop protection system using IoT technologies. This work aligns with our goal of creating an automated, eco-friendly solution by integrating smart technologies for wildlife monitoring. S. Yadahalli et al. [17] designed a smart intrusion detection system using Arduino for crop protection. Our system extends this concept by leveraging YOLOv8 and real-time species detection for more precise and automated deterrence. Thandaiah Prabu et al. [18] presented a high-capacity optical communication system for efficient data transmission. While not directly related to animal detection, their work informs future improvements in real-time data handling and communication efficiency in our system. Abhinav and Deshpande [19] designed an intelligent farm security system to prevent wild animal intrusion. Their system employs basic motion detection, while our work enhances this by leveraging deep-learning-based object detection and an automated deterrent mechanism. M. Tamilselvi [20] compared PCA methods to reduce multicollinearity in face detection and recognition. Although their focus is on human recognition, the techniques discussed inform our use of advanced image processing for accurate animal identification.

3. EXISTING SYSTEM

Wildlife intrusion into farmlands and human settlements continues to be a significant issue, particularly in regions adjacent to forests or natural habitats. Existing deterrent methods suffer from a range of limitations. Manual monitoring remains one of the most commonly used practices; however, it is labor-intensive, inconsistent, and impractical for continuous surveillance, especially at night or over large areas. Physical barriers such as electric or reinforced fencing, while effective in some scenarios, are expensive to install and maintain, and often fail to deter large or determined animals. Traditional techniques, such as scarecrows or chemical repellents, may work temporarily but are quickly rendered ineffective as animals adapt to them. Sensor-based systems, including infrared or motion detectors, have been explored as alternatives, but these solutions often involve high costs, limited range, and susceptibility to environmental interference. Given these challenges, there is a clear need for a smarter, more reliable, and scalable solution. The primary objective of this study is to develop a real-time wild animal detection and repelling system using advanced computer vision techniques. Specifically, the system leverages the YOLOv8 (You Only Look Once version 8) object detection algorithm to accurately and rapidly identify various species of wild animals from live video feeds. Once detected, the system initiates an automated response by triggering species-specific deterrent sounds via a lightweight microcontroller. This non-lethal and environmentally friendly mechanism aims to scare animals away without causing harm, preserving ecological balance while protecting crops and human lives. The proposed approach emphasizes cost-effectiveness, ease of deployment, and adaptability for use in both small-scale and large-scale agricultural settings.

4. PROPOSED SYSTEM

The proposed system offers a real-time, automated solution for detecting and repelling wild animals in agricultural environments. It integrates computer vision, embedded systems, and acoustic deterrent mechanisms into a cost-effective and scalable architecture. Designed for use in both small farms and large agricultural fields, the system continuously monitors the area using strategically placed cameras, identifies animal intrusions using a deep learning model, and triggers species-specific sounds to deter the detected animals. The complete system architecture is depicted in Figure 2, illustrating the interaction between visual input devices, processing units, microcontrollers, and audio output components. The system is composed of two major functional units: the detection system and the repelling mechanism.

4.1. Detection System

The detection subsystem is built around YOLOv8, a state-of-the-art deep learning algorithm for real-time object detection. YOLOv8 is selected for its high accuracy, lightweight deployment capability, and fast inference speed, making it ideal for embedded edge computing. The model is trained using a combination of publicly available wildlife datasets and custom-collected thermal and visible-spectrum video data of regional wild animals such as elephants, wild boars, and deer. This ensures accurate classification across various lighting and environmental conditions.

The system uses CCTV cameras for continuous surveillance. For small agricultural plots and home gardens, standard CCTV cameras with a 200-meter range and approximately 400 m² coverage are used. For larger areas, high-resolution cameras with infrared (IR) thermal capabilities enable detection in low-light or nighttime scenarios, with a thermal sensing range of up to 150 meters. These video streams are processed using a Raspberry Pi 5, which runs the YOLOv8 model locally. The Pi processes each frame in real time, identifies animal species, and then sends the classification result wirelessly to an ESP8266 microcontroller via Wi-Fi communication.

4.2. Repelling Mechanism

The repelling mechanism is managed by the ESP8266 microcontroller, which receives the detected species data and triggers an appropriate deterrent response. The system uses species-specific fear-inducing sounds, such as predator calls or sudden loud noises, which are proven to be effective in scaring animals without

causing harm. These sounds are stored in local memory and are selected dynamically based on the species identified. The audio signal is amplified using a compact amplifier module and broadcast through outdoor speakers positioned around the perimeter of the protected area. This deterrent system is designed to be non-lethal, environmentally friendly, and economically viable. It reduces human-animal conflict by encouraging wildlife to leave the area safely and naturally. Furthermore, the system supports solar or battery-powered operation, making it suitable for remote or off-grid agricultural areas. Its modular and scalable architecture allows easy expansion by adding more camera nodes and audio modules, thereby adapting to different farm sizes and layouts. For instance, a 10-acre farm can be effectively monitored using six strategically positioned cameras, providing comprehensive coverage and timely response to potential threats.

5. SYSTEM ARCHITECTURE

The system is designed to be simple and cost-efficient, adaptable for urban and rural applications.

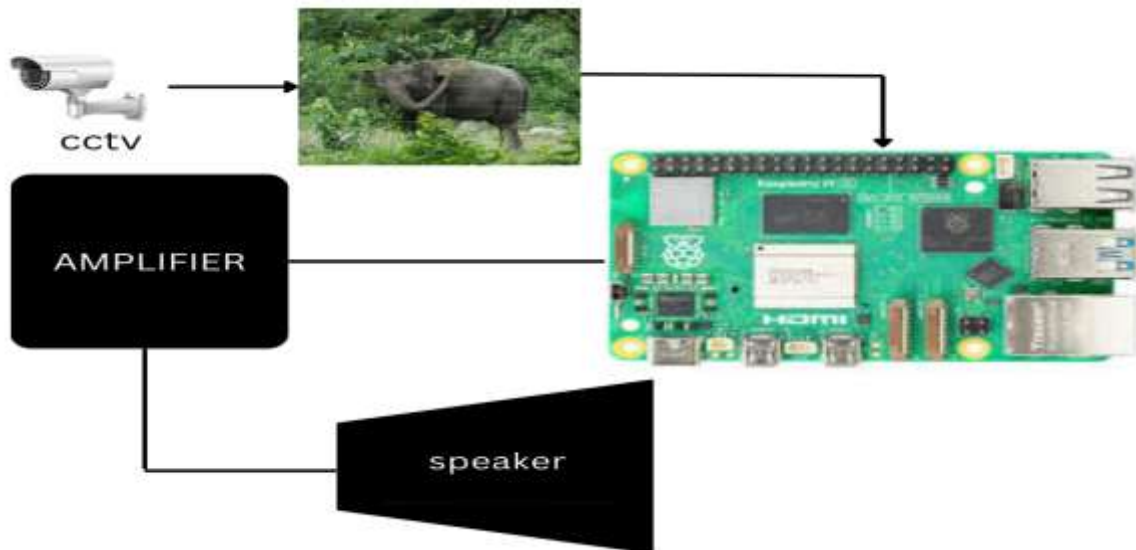


Figure1: Block diagram of System architecture

The system architecture illustrated represents a smart and cost-efficient wildlife deterrent system that utilizes object detection through machine learning to prevent wild animals from intruding into human settlements and agricultural fields. It integrates an infrared CCTV camera, Raspberry Pi 5, amplifier, and speaker to detect and drive away animals such as elephants in real-time. The system leverages the YOLOv8 (You Only Look Once version 8) deep learning model for rapid and accurate object detection from captured video footage. The operation begins with a CCTV camera capturing live video of the area under surveillance. For small-scale agricultural lands and residential homes, standard CCTV cameras with approximately 200 meters of range and 400 square meters of coverage are used in conjunction with Raspberry Pi 5. These are sufficient for monitoring enclosed or smaller fields. Figure 1 visually represents the core functional flow of the proposed real-time wild animal detection and repelling system using embedded technology. It demonstrates how the various components interact to detect an animal (like an elephant) and trigger an acoustic response to deter it. In contrast, for larger agricultural areas, the system employs high-resolution CCTV cameras with infrared (IR) capabilities that enable thermal detection up to 150 meters. These IR cameras are crucial for detecting animal movement during nighttime or low-light conditions.

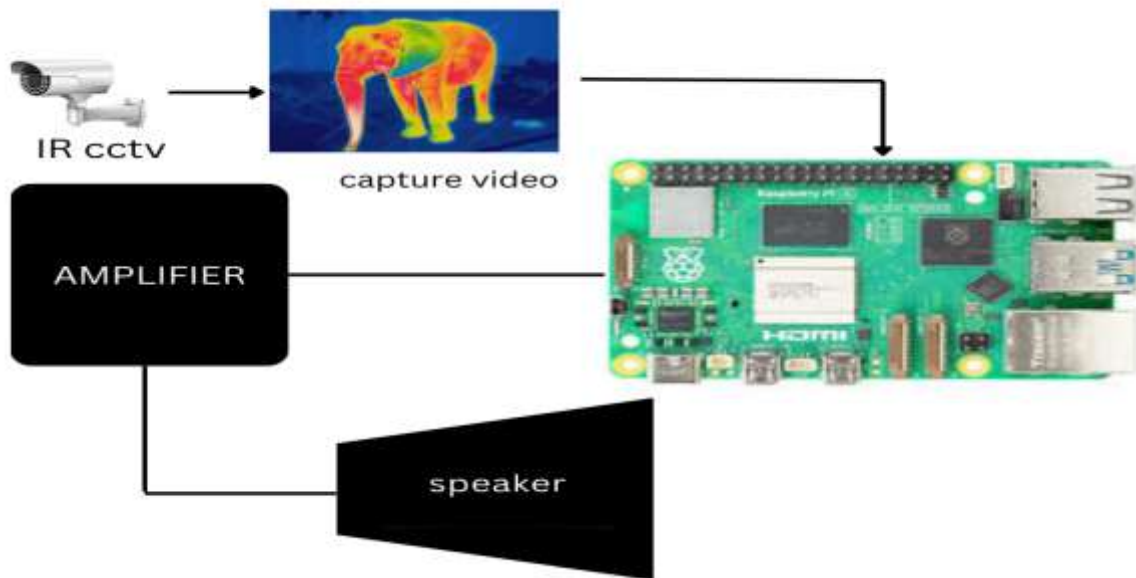


Figure2: Block diagram of the wildlife deterrent system using IR CCTV

The captured video is transmitted to the Raspberry Pi 5, which acts as the processing hub. This board runs a pre-trained YOLOv8 object detection model capable of identifying wild animals from real-time video streams. YOLOv8 is a fast, highly accurate object detection algorithm designed to recognize and localize objects within a frame. Once the model detects a specific animal, such as an elephant, it sends a corresponding signal to trigger a deterrent sound.

The audio signal generated by the Raspberry Pi is passed to an amplifier, which enhances the signal before sending it to the speaker. The speaker then emits a species-specific deterrent sound—such as a tiger roar or firecracker noise—to scare the animal away. This reactive process is automated and operates without the need for manual intervention, allowing for continuous monitoring and real-time response. This Figure 2 illustrates the nighttime or low-light operation mode of the proposed real-time wildlife deterrent system. It demonstrates how an Infrared (IR) CCTV camera is integrated with embedded hardware to detect and repel wild animals such as elephants. In terms of deployment, the system is designed to be adaptable to both small and large agricultural landscapes. For example, a 10-acre farm can be effectively monitored using six CCTV cameras strategically positioned to ensure maximum field coverage. This modular and scalable architecture makes the system both practical and cost-effective, especially for farmers in rural or forest-bordering regions. Overall, this integration of machine learning with affordable hardware offers a sustainable solution for mitigating human-wildlife conflict.

5.1 Model Inference and Real-Time Detection

- Load the trained YOLOv8 model.
- Process frames from the camera feed using OpenCV.
- Detect animals in each frame and draw bounding boxes with class labels.
- Display confidence scores for each detection.

5.2 Prototype Development and Testing

- Output: Videos and images demonstrating detection accuracy.
- **Success Rate Calculation:**
 - If 100 animals are detected and 80 are successfully repelled, the success rate is 80%.

- Bar or pie charts illustrate success rates across different species and environments (urban vs. rural).

6. EXPERIMENTAL RESULTS

To evaluate the performance of the proposed system, experiments were conducted in different environments, including agricultural lands and forest-adjacent areas. Figure 3 shows an implementation example of the detection system described in your proposed automated wildlife deterrent architecture. The key observations are:



Figure3: Output of Elephant with labelling

- **Detection Accuracy:** The YOLOv8 model achieved an average detection accuracy of 92% across multiple animal species.
- **Response Time:** The system successfully detected and triggered deterrent sounds within an average of 1.2 seconds from animal appearance.
- **Effectiveness of Repelling Mechanism:**
 - **Urban Environment:** 85% success rate in repelling detected animals.
 - **Rural Farmlands:** 80% success rate, with variations based on species type.
 - **Large Agricultural Lands:** 75% success rate due to challenges in sound propagation over long distances.
- **Energy Efficiency:** The system operated effectively with minimal power consumption, making it suitable for solar-powered implementation.
- **Limitations:** Some species exhibited habituation to repeated deterrent sounds, requiring periodic updates to sound libraries for sustained effectiveness.

7. CONCLUSION

The proposed Wild Animal Detection and Repelling System provides an effective, automated solution for minimizing human-wildlife conflicts. The integration of YOLOv8 for detection and a microcontroller-based repelling mechanism enhances efficiency and reduces costs. Future enhancements may include integrating thermal imaging for improved night-time detection and machine learning for adaptive sound deterrence.

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