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Agroguard – Crop Protection Using AI to Detect and Deter Animals

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ABSTRACT

Wildlife monitoring and conservation require accurate and efficient detection of animals in real time. Traditional methods like manual tracking or using motion-triggered cameras often fall short due to low accuracy and lack of immediate response. In this project, we present an intelligent animal detection system that utilizes computer vision and deep learning with the YOLO (You Only Look Once) algorithm to identify various animal species in real time through a camera feed. The system is integrated with an Arduino via serial communication to enable physical alerts or actions based on the detected animal class. It recognizes multiple animal classes including bear, deer, elephant, lion, tiger, and more, and sends a corresponding character signal to the Arduino to trigger specific functions such as alarms or lights. This project demonstrates the potential of AI-powered object detection combined with embedded systems for real-time applications in wildlife security, forest surveillance, and human-wildlife conflict mitigation. The model also incorporates a delay timer and class comparison logic to prevent repetitive alerts for the same animal. It is designed to work reliably in outdoor conditions, including low-light and occluded environments. The alert system can be expanded using a GSM module to send SMS notifications directly to forest officials or farmers. This innovative approach enhances proactive response and contributes significantly to preserving biodiversity and protecting farmlands.

INTRODUCTION

Monitoring wildlife and ensuring safety in areas with frequent human-animal interactions has become a growing concern, especially in regions near forests or wildlife sanctuaries. Traditional surveillance techniques, such as manual patrolling or static motion-sensor cameras, often fail to provide timely information or identify specific animal species. This limitation can lead to delayed responses and increased conflict between humans and animals. To address these challenges, computer vision and deep learning techniques have emerged as powerful tools for automated detection and classification of animals in real-time. The integration of such intelligent systems with embedded devices like Arduino provides a robust framework for prompt response and alerts. This project leverages the YOLO (You Only Look Once) object detection model to identify various wild and domestic animals from a live video feed. The system then communicates the detection results to an Arduino module via serial communication to initiate corresponding actions. This fusion of AI and hardware serves as a scalable and efficient solution for animal monitoring, capable of reducing human-animal conflict, protecting farmlands, and enhancing forest surveillance efforts.

PROBLEM STATEMENT

Human-wildlife conflict has become a growing concern in regions bordering forests and wildlife sanctuaries. +Farmers frequently suffer crop damage due to wild animal intrusions, and there is an increasing risk to human life and property in such areas. Traditional methods of wildlife monitoring—such as manual patrolling, motion-triggered cameras, or fixed deterrents—are often reactive, inefficient, and incapable of providing real-time alerts

There is a critical need for an automated, intelligent system capable of detecting and identifying various wild animals in real time and triggering appropriate responses to mitigate potential damage or danger.This project aims to address these challenges by developing a real-time animal detection and alert system using the YOLO deep learning algorithm and

Arduino-based hardware integration. The goal is to enable timely, species-specific responses through alarms or SMS alerts, enhancing safety, reducing crop loss, and promoting coexistence between humans and wildlife.

LITERATURE REVIEW

Bharathan and Suganthi [1] (2022) presented a detailed overview of various animal detection systems leveraging IoT and machine learning technologies to mitigate crop damage caused by wild animals. Their literature review emphasizes the importance of real-time monitoring systems utilizing GPS and GSM modules to track animal movements and alert nearby communities. They reference earlier systems that integrate machine vision for road safety, thermal and PIR sensors for zoo surveillance, and acoustic deterrents to protect crops from birds. Moreover, YOLOv3-based CNN models are highlighted as effective tools for object detection in agricultural environments. The authors conclude that while many methods have been proposed, integrating deep learning with IoT offers a robust, scalable solution for minimizing human-animal conflicts in farmland areas.

Shanmugam et al. [2] (2020) explored prior efforts in utilizing IoT-based systems for wild animal intrusion detection in agricultural lands. Their review covers various technologies such as RFID, GSM, motion sensors, and machine learning for effective monitoring and response. They particularly note the "Where The Bear" (WTB) system which uses AI to classify animals via camera trap images and reduce manual processing. Previous systems also utilized sound sensors and buzzers to deter intruding birds, and PIR-temperature combinations for zoo applications. The authors underscore the efficacy of feature matching and image processing for object recognition

EXISTING SYSTEM:

Traditional animal monitoring systems rely heavily on human efforts or basic technologies such as motion sensors and infrared cameras. These systems, while useful to some extent, have several limitations. Motion sensors often fail to distinguish between animal types, triggering unnecessary alerts due to wind or non-animal movements. Similarly, infrared cameras can detect movement in the dark but do not classify the type of animal detected. Most existing systems lack the intelligence to differentiate between species and do not support real-time decision-making or response actions.

In some modern forest departments, camera trap systems are used, but they require manual retrieval and processing of data, which delays action. Moreover, these setups do not integrate with hardware systems to initiate real-time alarms or alerts. They are primarily used for research and tracking purposes rather than proactive conflict

The proposed project overcomes these limitations by combining real-time AI detection using YOLO with serial communication to an Arduino module. This allows for immediate response such as activating deterrents or notifying authorities, offering a smart, automated, and efficient alternative to conventional systems.The current systems essentially give the observation usefulness. Additionally these systems don't give security from wild animals, particularly in such an application region. They additionally need to make moves in light of the on the kind of animal that attempts to enter the region, as various techniques are taken on to keep various animals from entering such confined regions. Likewise the ranchers resort to different techniques by raising human manikins and likenesses in their homesteads, which is ineffectual in warding off the wild animals, however is valuable somewhat to avert birds .The other usually involved strategies by the ranchers to forestall the harvest vandalization by animals incorporate structure actual obstructions, utilization of electric wall and manual reconnaissance and different such thorough and risky techniques.

PROPOSED SYSTEM:

The proposed system integrates the Ultralytics YOLO deep learning model with an Arduino-based communication setup to deliver real-time animal detection and automatic alert response. Designed as an intelligent, low-cost solution, this architecture enables timely action in environments prone to human-animal interaction, such as forest borders, farms, and wildlife reserves.

SYSTEM ARCHITECTURE

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