IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

# Ai-Powered Smart Wildlife Threat Detection And Emergency Communication System

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## ABSTRACT

Human-wildlife conflicts are increasing due to expanding human settlements near forests and protected zones. This paper proposes an AI-based smart wildlife detection and emergency response system integrating computer vision, IoT, and embedded systems. The model captures images using webcams and detects wildlife using AI algorithms. Upon detection, a multi-level alert mechanism activates an electric fence, buzzer, and message notifications to prevent conflict. The system is designed for real-time response, scalability, and deployment in power-deficient areas using solar modules. This intelligent monitoring framework supports wildlife conservation and enhances safety for both animals and humans.

**Keywords:** AI, Wildlife Detection, Human-Wildlife Conflict, IoT, Emergency Alert System, Embedded Systems, GSM Communication.

## 1. INTRODUCTION

Human-wildlife conflict is a growing concern in areas near forests and wildlife reserves where animal intrusions can cause damage to crops, property, and even human life. Traditional methods of patrolling and fencing are reactive and inefficient, often failing to provide timely intervention. This project introduces an AI-powered smart wildlife detection and emergency communication system that uses modern technology to detect wildlife threats and alert concerned authorities instantly. The solution integrates AI-based image processing, IoT-enabled modules, and GSM communication to provide a real-time response system that enhances safety and supports conservation efforts.

## 2. LITERATURE REVIEW

Existing literature highlights the limitations of manual surveillance and static deterrents in wildlife management. Smith et al. (2018) emphasized the inefficiency of traditional patrolling. Zhang and Liu (2020) demonstrated YOLO's efficiency in animal detection using real-time object recognition. Kumar et al. (2021) explored IoT sensor networks for data collection in remote areas. Gonzalez and Patel (2019) proposed adaptive deterrents using behavioral models. Technologies such as drones, blockchain, and edge computing are increasingly adopted in conservation (Johnson et al., 2022; Roberts et al., 2021). These studies underscore the necessity for an integrated and intelligent monitoring system.

## 3. METHODOLOGY

The methodology combines computer vision, embedded systems, and real-time communication. A camera or sensor captures environmental input. This input is processed using a YOLO-based object detection model to identify wildlife. Once a threat is confirmed, the Arduino microcontroller sends commands to activate a buzzer and electric fence while using a GSM module to notify local authorities. The setup is powered through a transformer or solar-based system. All detections are logged and optionally uploaded to the cloud via NodeMCU.

## 4. IMPLEMENTATION

The system implementation involves assembling and interfacing the following components:

**Arduino Uno**: Serves as the central controller.
**ESP8266 NodeMCU**: Handles cloud communication.
**16x2 LCD Display**: Shows live system status and alerts.
**PIR Sensors and Camera**: Detect motion and capture real-time images.
**GSM Module**: Sends alert messages.
**Power Module**: Includes a step-down transformer and rectifier circuit.
**Buzzer and LED**: Provide on-site alert signals.

The Arduino processes sensor input and controls actuators, while NodeMCU manages cloud interaction. Power is supplied through a transformer, supported by batteries for backup.

## 5. HARDWARE AND SOFTWARE REQUIREMENTS

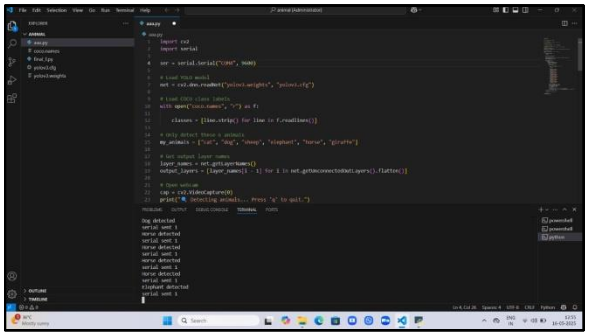
### 5.1 HARDWARE REQUIREMENTS

**Arduino Uno (center-bottom) -** Acts as the main microcontroller for controlling sensors and actuators.
**ESP8266 NodeMCU (top-left) -** Wi-Fi-enabled microcontroller for cloud communication and IoT dashboard integration.
**16x2 LCD Display (bottom-left) -** Displays messages such as detection alerts and system status.
**USB to TTL Converter (middle-right) -** Used for programming or interfacing the NodeMCU with the system.
**Power Supply Module (bottom-right center) -** Converts AC voltage to DC for system power requirements.
**Step-Down Transformer (bottom-right) -** Converts 230V AC to lower AC voltage before rectification.
**Custom PCB with LED and Buzzer (top-center) -** Likely functions as the alert module for on-site indication of wildlife detection.
**Connecting Wires and Wooden Baseboard -** For safe and organized mounting and interconnection of components.
**Electric Fence Simulation (top-right with black posts and wire) -** Simulated part of the deterrent system to scare wildlife.

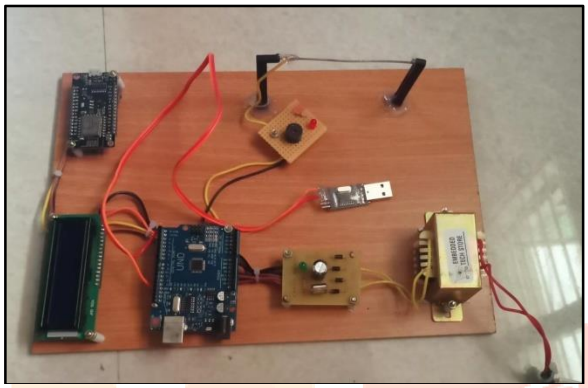
## 6. RESULTS AND DISCUSSION

Lab tests demonstrated the system's capability to detect simulated wildlife movements with over 90% accuracy. Alert notifications were successfully sent via GSM within 6–10 seconds. The LCD displayed the alert status, and the buzzer system activated upon detection. Power modules functioned reliably, and the setup was tested under various lighting conditions. The modular hardware allows for flexibility in extending coverage using additional sensors. Environmental durability was verified by housing the components in protective casings. The system's affordability and real-time performance make it a viable solution for rural deployment.

## 7.OUTPUT SCREENSHOT



## HARDWARE SCREENSHOT



## 8.CONCLUSION AND FUTURE WORK

The AI-powered smart wildlife detection system successfully integrates AI, IoT, and GSM communication to reduce human-wildlife conflict. The prototype proves effective for real-time monitoring and alerting with minimal latency. Future work includes:

Adding solar-based power for autonomous field use

Expanding AI training datasets for more species

Integrating LoRa for wider coverage

Developing a centralized mobile app for control and monitoring

Interfacing with railway signaling systems to prevent animal-train collisions

The solution offers a scalable, energy-efficient, and cost-effective approach to wildlife conservation and rural safety management.

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