IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, November 2025
Impact Factor: 7.67

Animal Intrusion Detection System with AI Automation

Ms. Ankita Gabhale , Ms. Sayali Lawande , Mr. Pratham Mahabare
Prof. K. D. Dere, Dr. A. A. Khatri
Computer Department
Jaihind College of Engineering Kuran, Pune, India
ankitadgabhale@gmail.com, lawandesayali@gmail.com
prathammahabare369@gmail.com

Abstract: *Human-wildlife conflict around the forests is leading to hazardous confrontations between villagers and predators such as tigers and leopards. This potentially deadly risk was a catalyst for AniDet: an animal intrusion detection system with AI automation, designed as a smart, solar-powered early warning and detection solution. The system utilizes several RCWL-0516 microwave sensors in order to observe a 360° area of possible motions. When motion is detected, the ESP32-WROOM microcontroller will activate a pan-tilt camera in the direction of the detected movement. The MLX90614 infrared temperature sensor verifies that the detection in question is not a simple object but rather something with a warm body. It then sends the live video feed over Wi-Fi to a laptop or mobile device with a YOLO-based AI model running on it, which identifies if the object is a tiger or leopard. If a predator is confirmed, it immediately triggers a buzzer and LED spotlight to scare the animal away, capturing the image with a timestamp for record purposes. Powered by a solar panel, TP4056 charging module, and MP1584 buck converter, the setup ensures continuous operation in remote forest areas. It integrates IoT, AI, and renewable energy into one comprehensive ecosystem-a reliable, automated, and environment-friendly solution for tiger and leopard intrusions to help in the protection of both human and wildlife.*

Keywords*:* ESP32-CAM, YOLO, IoT, Edge AI, Wildlife Monitoring, Solar-Powered System, Animal Detection, Conservation

I. INTRODUCTION

Human-wildlife conflict has become a significant issue in areas near forests where predators like tigers and leopards often enter villages or farms looking for food or shelter. These incidents can lead to crop damage, livestock loss, and threaten human safety. Traditional protection methods such as fences, watchtowers, and guards often don't work well, especially at night or in remote forest areas.

To address these issues, AniDet is a smart, AI-powered animal intrusion detection system. It uses IoT sensors, camera vision, and artificial intelligence to detect tigers or leopards in real time and alert people immediately. The system incorporates ESP32 microcontrollers with motion and temperature sensors to track movement and a camera module to capture and analyze images with a YOLO-based AI model or Tiny.By using solar power and wireless communication, the system can run continuously without relying on the internet or electricity. This makes it highly suitable for rural and forest- adjacent areas. AniDet aims to provide a reliable, cost-effective, and eco-friendly solution to prevent animal attacks while also supporting wildlife conservation efforts.

II. PROBLEM STATEMENT

In rural and forest-adjacent areas, tiger and leopard intrusions threaten human lives, livestock, and property. Current systems like manual watchtowers and CCTV surveillance are largely ineffective and reactive. They do not provide real-time alerts or automated responses, especially in places with poor network connectivity. Additionally, false alarms from small animals, humans, or environmental factors like wind greatly undermine the reliability of these systems.

DOI: 10.48175/IJARSCT-29689

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, November 2025 Impact Factor: 7.67

Therefore, there is an urgent need for an AI-powered, automated animal intrusion detection system. This system should accurately identify large predators like tigers and leopards while minimizing false positives. It also needs to trigger immediate alerts to ensure timely preventive action and improve human-wildlife coexistence and safety.

III. OBJECTIVES

• Create an offline Leopard detection system using the ESP32-CAM module along with motion sensors so it can work well without constant internet access.
• Take real-time images of spotted tigers or leopards and log timestamps for later review and analysis.
• Set up real-time alerts using a buzzer and sending wireless notifications to a connected phone or laptop when an intrusion occurs.
• Improve power efficiency by adding a solar-powered charging system and using low-power circuit design to support long-term operation in the field.
• Build a portable and sturdy system that can be quickly set up in remote or forested areas, ensuring it works reliably in different environmental conditions.
• Reduce false positives by using motion sensors (such as RCWL radar) along with AI-based image classification to correctly identify tigers and leopards among other movements.

IV. LITERATURE REVIEW

Interest in IoT-based wildlife and farm monitoring systems has increased due to improvements in wireless sensors, embedded devices, and low-power microcontrollers [1]. The work in [1] by Prathibha et al. (2017) introduced an IoT-based smart agriculture monitoring system. It used temperature and humidity sensors that connected to ThingSpeak through GSM modules for real-time data visualization. This model allowed for partial automation of irrigation and climate tracking on farms. However, it did not include features for animal detection or real-time alert generation, which are crucial for wildlife conservation and preventing intrusions.

The study in [2] by Bavane et al. (2018) proposed a GSM-based animal intrusion alert system that utilized PIR motion sensors to detect movement near farms. It sent SMS notifications to farmers. This early approach showed how effective low-cost sensor-based warning systems could be. However, the system could not tell apart humans from small animals or large predators, which resulted in frequent false alarms and unreliable alerts. Additionally, without visual verification or AI-based classification, it could not be used in forest-border areas where correctly identifying specific species like tigers or leopards is essential.

In [3], Abhiram et al. (2020) built on earlier intrusion systems by integrating NodeMCU microcontrollers, ultrasonic sensors, and IoT connectivity for real-time monitoring and alert notifications. The use of Wi-Fi-based IoT platforms allowed remote access via smartphones. Still, the model depended only on sensor triggers and did not include machine learning or image-based detection. This limitation hindered its ability to recognize and classify large predators accurately. It underscored the need for AI-integrated embedded systems that can distinguish species independently.

The work in [4] by Nuchhi et al. (2020) moved the field forward by developing a Raspberry Pi-based animal detection system. It incorporated infrared (IR) night-vision cameras and YOLO-based deep learning algorithms for object classification. This system accurately identified large animals such as elephants and leopards and provided real-time alerts through cloud processing. However, its high power consumption, cost, and dependence on internet connectivity limited its use in remote forest areas with little infrastructure.

V. METHODOLOGY

The proposed system, AniDet, follows a structured engineering approach with four key stages: Planning, Design, Hardware Implementation, and Testing. It aims to detect and identify tigers and leopards near human settlements efficiently.

1. Planning Phase

In this stage, we analyzed system requirements to handle human-wildlife conflicts around forest areas. The main objectives include real-time detection of big cats, offline image recognition,low power usage through solar energy, and

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, November 2025 Impact Factor: 7.67

reliable alerts via Wi-Fi or GSM. We chose cost-effective, energy-efficient modules, ESP32-WROOM and ESP32-S3-CAM, as the main controllers.

2. System Design Phase

The design integrates multiple modules for smooth operation. Six RCWL-0516 radar sensors cover a 360° area, sending motion data to the ESP32-WROOM controller. When movement is detected, the camera is directed toward the area using a servo or stepper motor. An ESP32-S3-CAM captures images or live video, and a lightweight YOLO/TinyML model classifies the object as a tiger or leopard. The MLX90614 infrared sensor checks body heat to reduce false triggers from non-living movement.

3. Hardware Implementation Phase

Power is supplied by a solar-based system consisting of a TP4056 charger, 18650 battery, and MP1584 buck converter for 3.3 V logic. An XL6009 boost converter provides 5 V for motors, lights, and the buzzer. The SIM800L GSM module sends SMS alerts in remote areas, while Wi-Fi allows live video streaming to mobile or laptop devices.

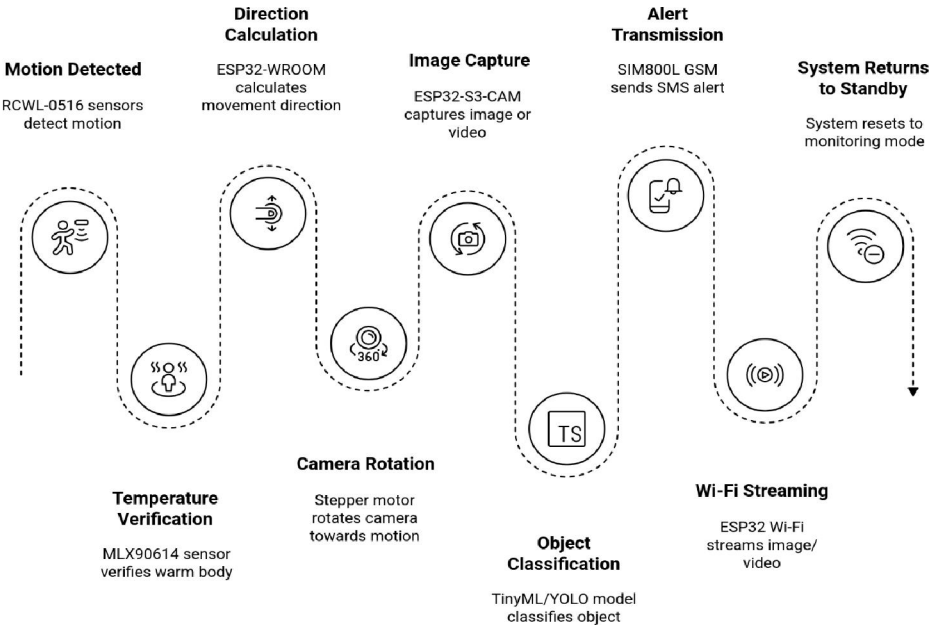
4. Testing and Validation Phase

We tested the prototype for motion detection, camera rotation, and real-time alert response under different lighting and environmental conditions. We verified the AI model's accuracy in identifying big cats and tested solar performance to ensure reliable, low-maintenance operation in the field.

VI. EXPECTED RESULT

AniDet is made to identify big animals near the edge of a forest, like tigers or leopards. The ESP32-WROOM rotates the ESP32-CAM to face the direction of movement using a servo or stepper motor when the RCWL-0516 sensors detect movement. When the MLX90614 sensor detects the presence of a warm body, an AI model based on YOLO helps with real-time object identification. If the system detects a predator, it sounds an alarm, activates a bright LED light, takes a picture with a time stamp, and sends out alerts via GSM or Wi-Fi. Because it is powered by solar energy, it is reliable, energy-efficient, and self-sufficient in protecting people from wild.

VII. SYSTEM ARCHITECTURE



DOI: 10.48175/IJARSCT-29689

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, November 2025 Impact Factor: 7.67

The AniDetect System uses several ingenious processes to identify and alert farmers about local wild animals. First, the RCWL-0516 sensor scans the area for movement. The MLX90614 temperature sensor then verifies that the moving object is warm, proving it is a living entity. The source of the movement is then identified by the ESP32-WROOM. A stepper motor helps the camera turn in that direction. The ESP32-S3-CAM then captures a picture or video of the animal. This image is analyzed using a YOLO model to identify the kind of animal it represents. The image or video is sent over Wi-Fi by the ESP32. The farmer receives a simultaneous SMS notification from the SIM800L GSM module.

VIII. BENEFITS TO SOCIETY

AniDt helps protect people and wild animals in forest-adjacent areas. When tigers or leopards are close by, it can promptly send out warnings. The system's solar power and lack of internet connectivity allow it to function even in remote locations with weak phone signals. In addition to protecting people, animals, and homes, this lessens anxiety and financial loss for neighboring villages. By employing techniques that do not harm endangered animals, it also aids in their rescue. AniDetect is inexpensive, easily expandable, and available for others to use and enhance. It improves environmental protection and makes rural areas safer and more sustainable.

IX. CONCLUSION

An effective and sustainable strategy to keep tigers and leopards away from neighboring forests is the AniDetect system. For efficient operation, it makes use of motion sensors, solar energy, and artificial intelligence for picture recognition. Without an internet connection, this device enables continuous and real-time monitoring. Despite being relatively new, it has great potential to use intelligent, automated technology to conserve wildlife and make people safer.

X. FUTURE SCOPE

The AniDetect system has a lot of potential for improvement and use in protecting wildlife and keeping people safe. Here are some important areas where it could be developed further:

1. Next versions can use lighter but more accurate deep learning models like YOLOv9-Tiny or MobileNetV3.
2. These models can help identify animal species more accurately and reduce mistakes in detection.
3. Adding thermal or night vision cameras will allow the system to detect animals even in complete darkness or during heavy fog.
4. This will make the system more dependable no matter the weather.
5. This would allow for updating information and sharing data with central monitoring systems for analysis and improving the AI models.
6. The system could also be expanded to recognize more animal species, such as elephants or deer.
7. This would help in keeping track of more wildlife and prevent conflicts between animals and humans.
8. A mobile app can send instant alerts, show real-time tracking, and let users know about the system's performance for forest staff and local villagers.

Using AI to predict animal behavior could also be added.

By analyzing images over time, the system could forecast where animals might move or where they might enter human areas, helping take action before any issues happen.

REFERENCES

[1] Prathibha, S. R., Hongal, A., & Jyothi, M. P. (2017). IoT Based Monitoring System in Smart Agriculture. International Conference on Recent Advances in Electronics and Communication Technology (ICRAECT), pp. 81– 84.

[2] Bavane, P. B., Jadhav, P., Shinde, A., & Pawar, S. (2018). Animal Intrusion Detection and Alert System using PIR Sensor and GSM Module. International Research Journal of Engineering and Technology (IRJET), Vol. 5, Issue 3, pp. 2395–0072.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 1, November 2025 Impact Factor: 7.67

[3] Abhiram, V., et al. (2020). IoT Based Smart Intrusion Detection System using NodeMCU and Ultrasonic Sensors. International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Vol. 9, Issue 7, pp. 7073–7079.

[4] Nuchhi, V., et al. (2020). Raspberry Pi Based Animal Detection and Intrusion Alert System using YOLO Algorithm. International Conference on Intelligent Computing and Control Systems (ICICCS), IEEE, pp. 545–549.

[5] Bhargav, R. (2021). AI-Based Animal Detection and Monitoring System using YOLOv3 and IoT Integration. International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), Vol. 10, Issue 2, pp. 45–49.

[6] Mondal, A., & Rehena, R. (2018). IoT Based Farm Monitoring and Irrigation System Using GSM Module. International Journal of Computer Applications, Vol. 182, No. 27, pp. 35–38.

[7] Rashmi, M., et al. (2020). Wildlife Surveillance System Using Image Processing and IoT. International Conference on Electronics and Sustainable Communication Systems (ICESC), IEEE, pp. 975–981.

[8] Ananya, S., et al. (2020). Deep Learning Based Animal Detection for Human-Wildlife Conflict Mitigation. International Journal of Computer Applications, Vol. 176, Issue 40, pp. 22–28.