Animal Detection in Farmlands Using Artificial Intelligence and IoT: A Case Study of Thalavady Region, Erode District

Ms.B.Primila
Assistant Professor, Department of Artificial Intelligence and Data Science,
Dhaanish Ahmed Institute of Technology.

Abstract- Agriculture remains the backbone of the Indian economy, providing livelihood for a large portion of the population. However, farmers living near forest boundaries frequently experience severe crop losses due to wildlife intrusion. In regions such as Thalavady in the Erode district of Tamil Nadu, animals including elephants, wild boars, deer, monkeys, and cattle often enter agricultural lands and destroy crops. Traditional crop protection methods such as manual monitoring, fencing, and scare devices are inefficient and require continuous human effort. This research proposes an intelligent animal detection system based on Artificial Intelligence (AI), computer vision, and Internet of Things (IoT) technologies to monitor farmland and detect wildlife intrusion in real time. The system utilizes camera modules and edge computing devices to process images using deep learning algorithms such as Convolutional Neural Networks (CNN) and YOLO object detection models. When animals are detected, alerts are sent to farmers through mobile notifications, and deterrent mechanisms such as sound alarms and lights are activated. The proposed system aims to reduce crop damage, enhance farmland security, and support coexistence between agriculture and wildlife. Experimental results suggest that AI-based detection systems can achieve high accuracy and significantly reduce farmer workload.

Keywords – Smart Agriculture, Animal Detection, Computer Vision, IoT, Crop Protection, Wildlife Intrusion, Deep Learning.

I. INTRODUCTION

Agriculture plays a crucial role in sustaining rural livelihoods in India. Farmers depend heavily on crops such as sugarcane, banana, maize, and vegetables for income and food security. However, farmers located near forest areas face significant challenges due to wildlife intrusion into agricultural lands. Animals such as elephants, wild boars, monkeys, deer, and stray cattle frequently enter farmland in search of food and water, causing severe crop damage.

The Thalavady region in Erode district is located close to forest reserves and wildlife habitats. Due to its geographical proximity to forest zones, human–wildlife conflicts have increased over the years. Farmers often spend nights guarding their fields to prevent animals from entering. This manual monitoring process is time-consuming, risky, and inefficient.

Traditional crop protection techniques include:
- Wooden or electric fencing
- Scarecrows
- Fire torches and noise devices
- Human patrolling

Although these methods may provide temporary protection, they are not reliable for continuous monitoring. With advancements in Artificial Intelligence (AI), Internet of Things (IoT), and computer vision technologies, automated monitoring systems can be implemented to detect animals in real time.

Smart agriculture technologies are increasingly used to improve farming productivity, reduce labor requirements, and enhance crop protection. AI-based image recognition systems can detect objects in images or videos and classify them accurately. When integrated with IoT devices, these systems can send alerts to farmers and trigger automated responses.

This research proposes a cost-effective intelligent animal detection system specifically designed for farmland monitoring in rural agricultural areas such as Thalavady in Erode district.

The major objectives of this research include:
1. Designing an automated animal detection system for farmland protection.
2. Implementing computer vision algorithms to identify wildlife intrusion.
3. Integrating IoT communication modules for real-time alerts.
4. Reducing crop damage and improving farmer safety.

II. PROBLEM STATEMENT

Wildlife intrusion into farmland is a major issue in many agricultural regions of India, particularly those located near forest boundaries. Farmers in the Thalavady region face significant challenges due to animals entering their fields at night or during early morning hours.

Some of the common problems faced by farmers include:
- Crop destruction caused by elephants and wild boars
- Banana and sugarcane crop damage by monkeys
- Invasion by stray cattle and deer
- Difficulty in monitoring farmland continuously
- Risk to farmer safety during nighttime monitoring

Farmers typically rely on manual monitoring methods to guard their fields, which is both labor-intensive and dangerous. Additionally, installing large fencing systems is expensive and not always effective against wildlife.

Therefore, there is a need for a smart and automated system that can:
- Monitor farmland continuously
- Detect animals accurately
- Notify farmers immediately
- Activate deterrent mechanisms

Such a system can help minimize crop damage and improve agricultural sustainability.

III. LITERATURE REVIEW

Several researchers have proposed technological solutions to address the problem of wildlife intrusion in agricultural lands. IoT-based smart agriculture systems have been developed to monitor environmental conditions and detect motion using sensors. These systems use motion detectors, ultrasonic sensors, and cameras to identify animal movement and send alerts to farmers.

Computer vision techniques have also been widely used for object detection. Deep learning models such as Convolutional Neural Networks (CNN) and YOLO (You Only Look Once) have demonstrated high accuracy in identifying objects in images.

Studies have shown that AI-based animal detection systems can achieve detection accuracy between 85% and 95% depending on dataset quality and environmental conditions.

Some research systems combine sensors with camera modules to create hybrid detection systems. These systems detect motion using sensors and then activate cameras to capture images for classification.

Other studies have implemented automated deterrent systems such as:
- Sound alarms
- Flashing lights
- Ultrasonic repellents

These deterrent methods help scare animals away without harming them.

Although these solutions show promising results, many existing systems are expensive or require high technical expertise. Therefore, there is a need for affordable and easy-to-implement systems suitable for rural agricultural environments.

IV. PROPOSED SYSTEM

The proposed system integrates Artificial Intelligence, IoT technologies, and computer vision to detect animals entering farmland and alert farmers in real time.

The system consists of the following components:
1. Surveillance Camera
2. Edge Computing Device
3. Deep Learning Model
4. IoT Communication Module
5. Alarm and Deterrent System

Cameras installed around farmland boundaries continuously capture images or video frames. These images are processed using a trained deep learning model capable of identifying animals.

When the system detects an animal, it performs the following actions:
- Sends an alert notification to the farmer
- Activates sound alarms or lights
- Stores detection data for analysis

This automated approach enables farmers to monitor their fields remotely without requiring constant human presence.

V. SYSTEM ARCHITECTURE

The architecture of the proposed system consists of three major layers:

A. Data Acquisition Layer
This layer includes camera modules and motion sensors that collect real-time data from farmland environments.

B. Processing Layer
The processing layer consists of an edge computing device such as Raspberry Pi or NVIDIA Jetson Nano. The device runs the deep learning algorithm to detect animals from captured images.

C. Communication Layer
The communication layer transmits alerts and notifications to farmers using GSM, Wi-Fi, or mobile applications.

VI. METHODOLOGY

A. Data Collection
A dataset of animal images is required to train the deep learning model. Images can be collected from:
- Open-source wildlife datasets
- Field cameras
- Agricultural surveillance videos

Animals included in the dataset may include:
- Elephant
- Wild boar
- Monkey
- Cow
- Deer

B. Data Preprocessing
Collected images are processed before training the model. Preprocessing steps include:
- Image resizing
- Noise removal
- Data labeling
- Data augmentation

C. Model Training
A deep learning object detection algorithm such as YOLO or CNN is trained using labeled images.

The training process includes:
1. Feature extraction
2. Pattern recognition
3. Object classification
4. Model optimization

D. Real-Time Detection
The trained model is deployed on the edge device connected to farmland cameras. When the camera captures images, the model analyzes them and identifies animals entering the farmland.

VII. HARDWARE COMPONENTS

The proposed system requires the following hardware components:
1. Raspberry Pi or Edge AI Device
2. Camera Module
3. PIR Motion Sensor
4. GSM or Wi-Fi Module
5. Speaker or Buzzer
6. LED Lights
7. Solar Power Supply (optional)

These components work together to monitor farmland continuously and respond to animal intrusion.

VIII. EXPECTED RESULTS

The proposed system is expected to achieve the following outcomes:
- Accurate detection of animals entering farmland
- Real-time alerts sent to farmers
- Reduced crop damage
- Lower labor requirements
- Improved farm security

AI-based detection systems can achieve high accuracy depending on dataset size and environmental conditions such as lighting and weather.

IX. ADVANTAGES

The proposed system offers several advantages:
- Automated farmland monitoring
- Reduced economic losses for farmers
- Real-time alert notifications
- Non-harmful animal deterrent mechanisms
- Cost-effective implementation
- Suitable for rural environments

X. FUTURE WORK

Future improvements to the proposed system may include:
- Integration with drone surveillance systems
- Improved datasets for better detection accuracy
- Mobile application development for farmers
- Integration with solar energy systems
- Multi-camera monitoring systems

XI. CONCLUSION

Wildlife intrusion into agricultural land is a serious problem for farmers living near forest regions. In areas such as Thalavady in the Erode district, crop damage caused by animals significantly affects farmer income and agricultural productivity.

This paper proposed an intelligent animal detection system using Artificial Intelligence and IoT technologies to monitor farmland and detect wildlife intrusion in real time. By integrating camera modules, deep learning algorithms, and communication systems, the proposed solution provides automated crop protection and instant alerts to farmers.

The implementation of such systems can help reduce crop losses, improve farmer safety, and promote sustainable coexistence between agriculture and wildlife.

REFERENCES

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach. Pearson Education, 2021.
2. J. Redmon et al., "YOLO: Real-Time Object Detection," IEEE Conference on Computer Vision and Pattern Recognition, 2016.
3. N. Goyal and N. Sandhu, "Animal Intrusion Detection System for Crop Protection Using IoT," International Journal of Intelligent Systems, 2023.
4. A. Samuvel et al., "Smart Agriculture Using Deep Learning Based Animal Detection," International Journal of Computer Applications, 2024.
5. H. Narula and A. Pathak, "IoT Based Smart Agriculture and Animal Detection System," International Journal of Research in Engineering and Technology, 2022.