

Sentinel Eye: Wild Animal Intrusion Detection Using IOT

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Abstract: *This project focuses on solving the common problem of wild animals entering farms and causing damage to crops and property. Farmers living near forest areas often face losses because of animals like wild boars, monkeys, or deer. Traditional methods such as fencing, guarding, or normal CCTV systems are not always effective and can be costly. Therefore, a smart and automated solution is needed to protect farms and improve farmer safety.*

The proposed system uses modern technologies like Artificial Intelligence, Machine Learning, and IoT to detect animal intrusion. A camera connected to a Raspberry Pi captures images from the farm area, and deep learning models such as YOLO or CNN are used to identify animals from the captured images. This image-based detection helps the system recognize animals accurately without requiring continuous video processing.

Once an animal is detected, the system immediately sends an alert message to the farmer or concerned authority with the detection details. At the same time, a sound alarm is activated to scare the animal away from the farm area. The system also stores captured images and detection data, which can be useful for monitoring and future analysis.

The main goal of this project is to create a low-cost, easy-to-use, and efficient solution for farmers, especially in rural areas near forests. By combining AI, computer vision, and IoT technology, the system helps reduce crop damage, improves safety, and supports smart farming practices while maintaining a balance between human activities and wildlife.

Keywords: Farm Animal Intrusion Detection, Image-Based Detection, Deep Learning, YOLO, CNN, Raspberry Pi, Internet of Things (IoT), Smart Farming, Computer Vision, Wildlife Monitoring, Crop Protection, Public Safety

I. INTRODUCTION

Wild animals entering farms has become a serious problem in many rural and forest-border areas. Farmers often face crop loss and property damage due to animals like wild boars, monkeys, and deer. Traditional protection methods such as fencing, guarding, or manual monitoring are not always effective and require a lot of effort and cost. With the growth of modern technologies, smart solutions can be developed to solve this problem more efficiently. In this project, a smart Farm Animal Intrusion Detection System is proposed using technologies like Artificial Intelligence, Machine Learning, and IoT. The system uses a Raspberry Pi and camera to capture images and detect animals using deep learning models such as YOLO or CNN. When an animal is detected, the system sends an alert message and activates a sound alarm to scare the animal away. This project aims to provide a low-cost and reliable solution for farmers to protect their crops and improve safety while supporting smart farming practices.

The system captures images through a camera, processes them locally on a Raspberry Pi, and, upon detecting an intrusion, triggers sound deterrents to drive animals away while simultaneously sending SMS notifications with time and location details to farmers or authorities. Its adaptable and scalable design makes it suitable for deployment not



only in farms but also at forest borders, highways, schools, and residential zones, thereby enhancing agricultural security, minimizing human–animal conflicts, and ensuring public safety.

II. LITERATURE SURVEY

Many researchers have studied the problem of wild animals entering farms and causing damage to crops and property. Traditional methods such as fencing, human guarding, and CCTV surveillance have been used to protect agricultural land. However, these methods are not always effective because they require continuous monitoring, are expensive to maintain, and sometimes fail to detect animals in time.

Some earlier systems used sensor-based technologies such as infrared sensors, motion detectors, and ultrasonic sensors to detect movement in farm areas. When movement is detected, the system activates an alarm to scare animals away. Although these systems are simple and low cost, they cannot identify the exact animal and often produce false alarms due to human movement or small animals.

With the advancement of computer vision and machine learning, researchers started using image processing techniques for animal detection. Deep learning models such as YOLO (You Only Look Once) and Convolutional Neural Networks (CNN) have shown high accuracy in object detection tasks. These models can analyze images captured by cameras and classify different animals automatically.

Recent studies also integrate IoT devices like Raspberry Pi with camera modules to create smart monitoring systems. These systems detect animals using machine learning models and send alerts to farmers through SMS or mobile notifications. Such smart solutions improve farm security, reduce crop damage, and help farmers take quick action. The proposed project builds on these ideas to develop a low-cost, efficient, and image-based animal intrusion detection system for smart farming applications.

To improve farm security, some researchers have developed sensor-based monitoring systems using infrared sensors, motion detectors, and ultrasonic sensors. These systems can detect movement in farm areas and trigger alarms to scare animals away. However, such systems cannot accurately identify the type of animal and may generate false alarms due to human movement or environmental factors like wind and rain.

Recent advancements in computer vision and deep learning have introduced more intelligent solutions for intrusion detection. Technologies such as YOLO and Convolutional Neural Networks (CNN) can analyze images captured by cameras and identify animals with high accuracy. When integrated with IoT devices like Raspberry Pi, these systems can send real-time alerts to farmers and activate deterrent mechanisms. This approach provides a smarter, more reliable, and cost-effective method for protecting farms and reducing conflicts between humans and wildlife.

III. ANALYSIS & FLEXIBILITY

3.1 Analysis

The proposed Farm Animal Intrusion Detection System is analyzed as a smart and efficient method for preventing wild animals from entering farm areas. The system uses a Raspberry Pi and camera module to capture images of the surrounding environment. These images are processed using deep learning algorithms such as YOLO or CNN to detect and classify animals. When an intrusion is detected, the system immediately triggers a sound alarm and sends a notification to the farmer through an IoT-based alert system. This approach reduces the need for continuous human monitoring and improves the response time to animal intrusion. The system also stores captured images and detection data for further monitoring and analysis.

3.2 How to animal detection:

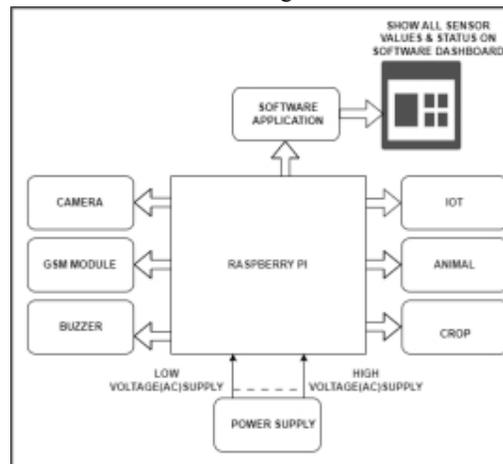
The animal detection process in this system is done using a camera, Raspberry Pi, and a deep learning model. First, the camera installed near the farm captures images of the surrounding area at regular time intervals. These images are then sent to the Raspberry Pi, which processes them using a trained machine learning model such as YOLO or Convolutional Neural Network (CNN).



The deep learning model analyzes the captured image and compares the objects in the image with the trained dataset of animals. If the system finds a match with known animal patterns such as wild boar, deer, or monkey, it identifies the animal and confirms an intrusion.

3.3 Flexibility

The proposed system is designed to be flexible and adaptable for different environments. It can be installed in farms, forest-border areas, highways, and residential locations where animal intrusion is common. The system can be improved by training the model with additional datasets to recognize more types of animals. It also allows integration with cloud storage, mobile applications, or additional sensors for better monitoring. Because the system uses affordable hardware like Raspberry Pi and simple camera modules, it is cost-effective and easy to deploy in rural areas. This flexibility makes the system suitable for various smart farming and wildlife monitoring applications.



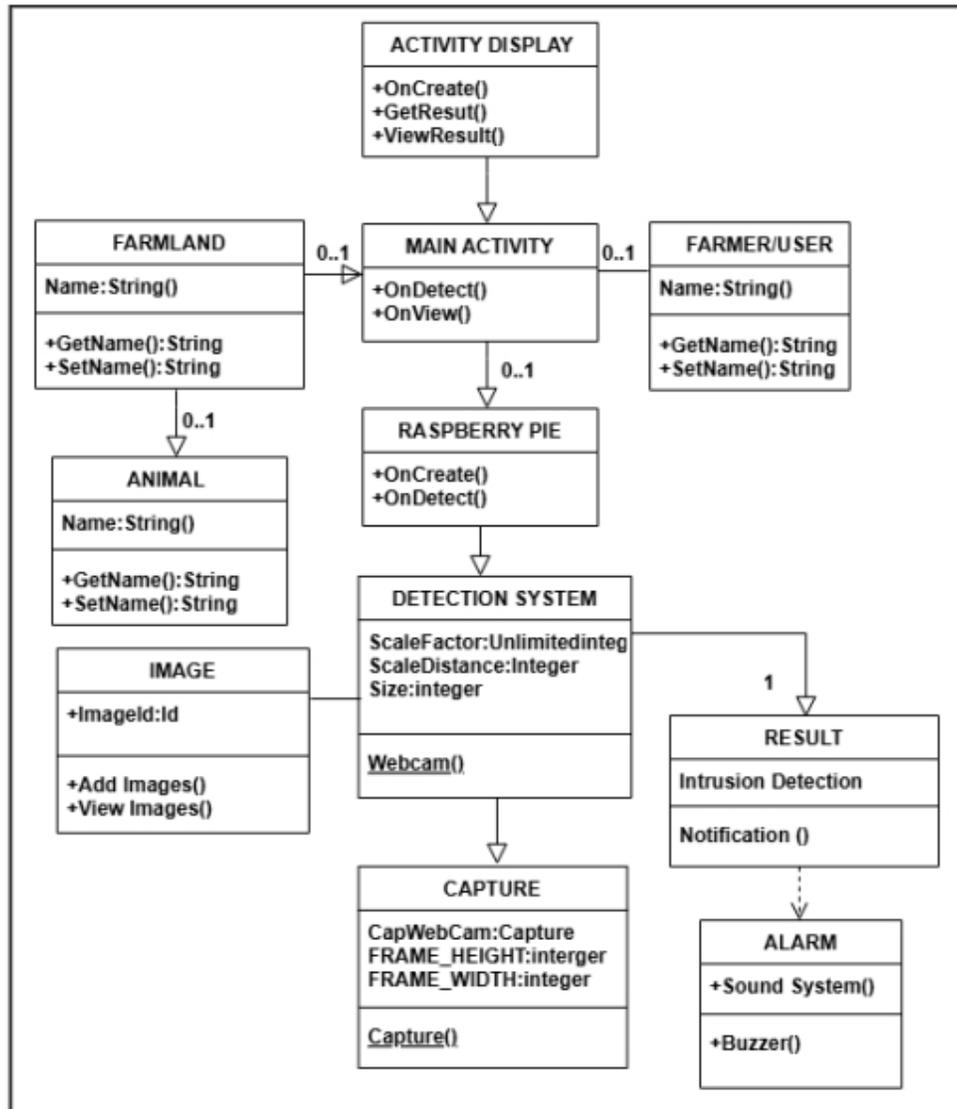
IV. PROPOSED WORKING

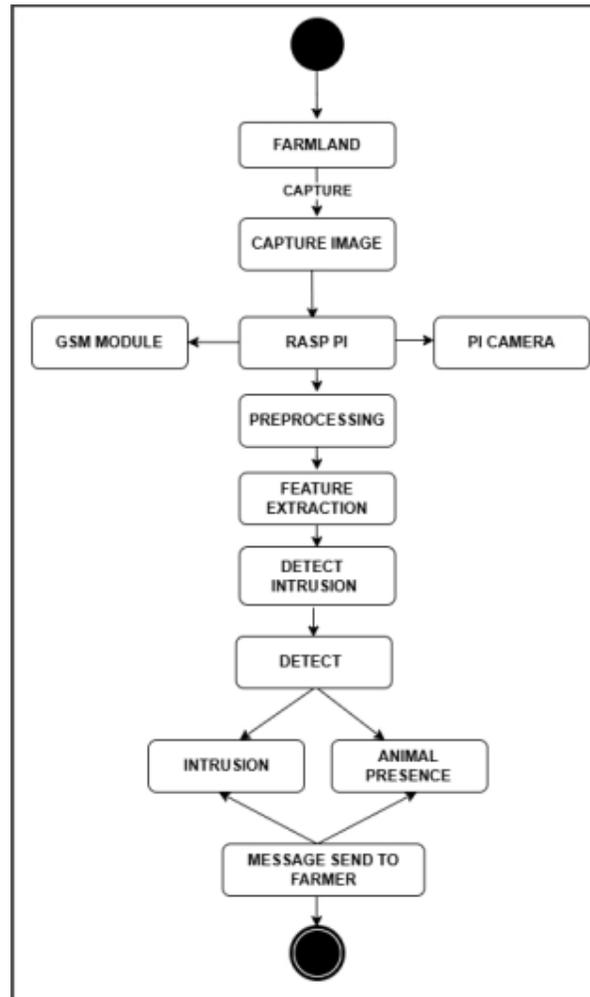
The proposed system is a Smart Farm Animal Intrusion Detection System that uses modern technologies such as Raspberry Pi, camera module, deep learning, and IoT to detect wild animals entering farm areas. The system captures images using a camera and processes them with machine learning models such as YOLO or CNN to identify animals. When an animal is detected, the system automatically sends an alert message to the farmer and activates a sound alarm to scare the animal away. This system is designed to be low-cost, reliable, and easy to use, making it suitable for rural areas where farmers need a simple solution to protect their crops.

The working of the system starts with the camera capturing images of the farm area at regular intervals. These images are sent to the Raspberry Pi, which processes them using a trained deep learning model to detect animals. The model analyzes the image and identifies whether an animal is present. If an animal is detected, the system triggers an alarm sound to drive the animal away and sends an SMS or notification alert to the farmer with the detection details. The system also stores the captured images and detection information for future analysis and monitoring. This automated process helps farmers respond quickly and reduce crop damage caused by wild animals.

1. The monitoring system is installed at the farm boundary using a camera and Raspberry Pi device.
2. The camera continuously observes the field and captures images of the surrounding area.
3. The captured image is transferred to the processing unit (Raspberry Pi) for analysis.
4. A trained deep learning model analyzes the image to detect the presence of animals.
5. If an animal is recognized, the system confirms it as an intrusion.







The flowchart shows the working process of the Farm Animal Intrusion Detection System. The system starts by monitoring the farmland area using a Pi camera connected to a Raspberry Pi. The camera captures images of the field, which are then sent to the Raspberry Pi for processing. The captured images go through preprocessing to improve image quality and remove unnecessary noise. After preprocessing, the system performs feature extraction to identify important patterns and objects present in the image.

Once the features are extracted, the system analyzes the image to detect whether an intrusion or animal presence is found. If the system identifies an animal in the farmland area, it confirms the intrusion and takes action. The Raspberry Pi then uses the GSM module to send a message alert to the farmer, informing them about the detected animal. This process helps farmers quickly respond and protect their crops from potential damage caused by wild animals.

V. MAIN BODY

The Farm Animal Intrusion Detection System is designed to protect agricultural fields from wild animals by using modern technologies such as Raspberry Pi, camera modules, machine learning, and IoT. The system continuously monitors the farmland area using a Pi camera installed at suitable locations. The camera captures images of the surrounding environment and sends them to the Raspberry Pi for further processing. This allows the system to observe farm boundaries and detect any unusual activity automatically.



After capturing the image, the system performs preprocessing to improve the quality of the image and remove unnecessary noise. Then the system extracts important features from the image using computer vision techniques. These features help the machine learning model analyze the image and identify objects present in the field. Deep learning models such as YOLO or CNN can be used to recognize animals from the captured images with better accuracy.

Once the system detects the presence of an animal in the farmland, it classifies the object and confirms the intrusion. When an intrusion is detected, the system immediately activates a warning mechanism such as a sound alarm to scare the animal away from the field. At the same time, the Raspberry Pi uses the GSM module to send a notification message to the farmer with the details of the detection.

The captured images and detection information can also be stored for monitoring and future analysis. This helps farmers understand the pattern of animal movement around their fields. The proposed system is designed to be low-cost, reliable, and easy to install, making it suitable for farmers in rural areas. By combining artificial intelligence, computer vision, and IoT technology, the system provides an effective solution for reducing crop damage and improving farm security.

Advantages of the System

1. Real-Time Monitoring: Provides continuous observation of farmland using cameras and sensors, ensuring instant detection of animal intrusions.
2. Instant Alerts: Automatically sends notifications to the farmer's mobile via GSM, enabling quick response and prevention of crop damage.
3. Automation and Efficiency: Reduces human effort and manual patrolling through automated detection and deterrent mechanisms.
4. Cost-Effective: Uses affordable IoT components like Raspberry Pi, sensors, and GSM modules for smart farm protection.
5. Enhanced Crop Protection: Minimizes crop losses by promptly deterring animals and maintaining field security

VI. OBJECTIVE & HYPOTHESIS

OBJECTIVE

- 1) The proposed project aims to design and implement a smart animal intrusion detection and alert system that leverages machine learning, IoT, and Raspberry Pi for real-time monitoring. The specific objectives are:
- 2) To develop an automated system capable of detecting and identifying wild animals in farmlands, residential areas near forests, and other vulnerable zones.
- 3) To implement deep learning-based models (YOLO or CNN variants) for accurate recognition of animal species while minimizing false detections.
- 4) To integrate Raspberry Pi and camera modules for low-cost, continuous, and scalable image-based monitoring.
- 5) To generate customized sound alerts tailored to specific animal types in order to deter them effectively.
- 6) To provide real-time notifications through SMS or similar communication methods to farmers, forest officers, or nearby residents.
- 7) To maintain a local or cloud-based log of detection events, including captured images, for analysis and record-keeping. To design the system in a way that it can be deployed across multiple environments—such as farms, highways, schools, and urban outskirts—ensuring versatility.
- 8) To contribute to smart farming practices by reducing crop losses, preventing human-animal conflicts, and supporting sustainable coexistence.



HYPOTHESIS

- Primary Hypothesis:

If IoT-based technologies such as Raspberry Pi, sensors, and GSM modules are integrated into farmland monitoring systems, then animal intrusions and crop damages can be detected and prevented in real-time, thereby enhancing overall agricultural productivity and security.

- Supporting Hypotheses:

- The use of a camera with image detection capabilities can accurately identify animal movement and trigger preventive actions like buzzers or alerts.

- Instant notifications sent via GSM modules can enable farmers to respond swiftly to potential threats, minimizing crop and livestock loss.

- Automated real-time monitoring systems will reduce the dependency on manual supervision and improve the efficiency of farm management.

- Integrating smart IoT-based solutions in agriculture will lead to higher crop yield, better resource utilization, and more sustainable farming practices.

- Null Hypothesis (H_0):

The implementation of IoT-based systems in farmland management does not significantly improve crop protection or reduce animal intrusions compared to traditional methods.

- Alternative Hypothesis (H_1):

The implementation of IoT-based systems in farmland management significantly improves crop protection and reduces animal intrusions compared to traditional methods.

VII. CONCLUSION

The Smart Farmland for Crop Prevention and Animal Intrusion Detection using IoT offers an innovative and efficient solution for modern agriculture. By integrating IoT sensors for real-time monitoring, the system helps in detecting environmental conditions, potential crop threats, and animal intrusions. With automated alerts and remote control capabilities, it enables farmers to take proactive measures to protect their crops and livestock, thereby enhancing productivity and reducing losses. This smart system ensures optimal resource utilization, minimizes manual intervention, and supports sustainable farming practices, ultimately contributing to a more resilient and technologically advanced agricultural landscape.

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