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Wild Animal Intrusion Detection System usingYOLO

1st Aibin Abraham
Computer Science and Engineering
St. Joseph's College of Engineering and Technology
Palai, Kerala

2rd Bibin Mathew
Computer Science and Engineering
St. Joseph's College of Engineering and Technology
Palai, Kerala

3th Devika Panikkar
Computer Science and Engineering
St. Joseph's College of Engineering and Technology
Palai, Kerala

4th Jaya John
Computer Science and Engineering
St. Joseph's College of Engineering and Technology
Palai, Kerala

Abstract:- Agriculture plays a crucial role in the economy, and farmers strive to increase their crop yields annually. Hence effective reconnaissance is vital for farmlands and rural terrains to prevent unauthorized access and protect crops from animal damage. The expansion of agricultural lands into wildlife territories has escalated human-wildlife conflicts, with crop destruction by animals becoming a major concern. To address this, our project proposes an alerting system using YOLOv3, a real- time object detection algorithm based on deep convolutional neural networks, to classify and monitor animals that intrude into agricultural areas. This algorithm enables efficient iden- tification and tracking of animals, aiding in mitigating crop damage and ensuring the preservation of wildlife in their natural habitats. Whenever an animal is detected, the system will sendan SMS to the landowner and forest officials, providing them with early warning notifications to take appropriate actions based on the intruder's type. This proposed system offers significant benefits to farmers, helping them increase yields and protect both humans and livestock from wild animal attacks.

Keywords:- *Image Processing, YOLO Algorithm, Raspberry Pi, Convolutional Neural Network, GSM Module.*

I. INTRODUCTION

In ancient times, agriculture was the primary occupationfor livelihood, but it involved manual labor such as plowing, which was time-consuming and resulted in low crop yields. Animal intrusion, especially by animals like boars and tigers seeking refuge from human threats, became a major cause of low crop yields. These animals would enter farmlands and run through them, causing significant crop destruction. This led to financial problems for farmers, as they would lose their invested amounts on crops. Larger landowners faced even more challenges in protecting their vast lands from animal intrusions, making farming tedious. The expansion of residential areas due to deforestation further exacerbated the issue, with elephants and deer frequently entering cultivated lands and destroying crops. Some people resorted to electric fencing, but this posed a threat to wildlife and was not an ideal solution. To address this problem without harming animals, a system has been developed that produces alarm sounds to deter animals through image capture and message alerts to landowners. Wild animal intrusion remains a significant challenge for farmers worldwide, with animals like wild pigs, elephants, and monkeys causing extensive damage to crops. To mitigate these challenges, this project incorporates a surveillance camera and GSM module, allowing farmers to detect and respond to animal intrusions, thus safeguarding their crops and reducing potential harm to humans. Indian farmers, in particular, face serious threats from pests, natural calamities, and wildlife intrusion

II. RELATED WORKS

A.Sathesh et al 2022 [1] The proposed system utilizes the YOLO algorithm to detect predefined objects in the field. When a match is found, the hardware's camera cap- tures the object and uploads the image to a server. The Intelligent Surveillance System sends the captured image to the farmer via email. Additionally, the system automatically activates a buzzer, which can be controlled by the farmer. The AIOPENCV framework plays a crucial role in this system, and it also triggers the buzzer. The captured image undergoes pre-processing and compression before being used to train the model. The training involves feature extraction, obtaining the necessary patterns from the image, and subsequent feature fusion and dimension reduction to ensure reliable and real-time performance.

Shubham Mishra et al 2022[2] The system was implemented using Python, OpenCV, and pandas. It involves installing the necessary libraries and accessing the camera. The system de- tects motion by comparing frames and applying thresholding. Contours are used to identify objects, and their coordinates are used to draw rectangles on the frames. The system records timestamps of object entry and exit events. The collected data is stored in a pandas data

frame and can be exported to a CSV file for further analysis. The system provides real-time monitoring and detection of objects in front of the camera.

D. Ranparia et al 2021 [3] The proposed system incorporates an Arduino board as the core component, along with various sensors and a camera. When the PIR sensors detect motion within a 10-meter range, the camera activates, capturing an image and recording a video for several minutes. Both the image and video are stored onboard and in the cloud. Additionally, an automatic message is sent to a registered number using a SIM900A module, providing intrusion details along with temperature and humidity data obtained from a DHT11 sensor. Authorized personnel with valid RFID tags have their attendance recorded automatically, while unauthorized individuals without RFID tags undergo further processing. The system utilizes Haar feature-based Cascade Classifiers to detect objects and differentiate between animal and human intruders. If a human is detected, an alarm is raised to notify people about the intrusion. For animal intruders, the system determines the appropriate action based on the number of PIR sensors triggered. These sensors are installed vertically on poles, fencing, access points, or watchtowers in the area.

Mohit Korche et al 2021 [4] In the proposed system, the presence of animals in the farm area is detected using LDRs placed vertically to determine the size of the animal, while PIR sensors detect their position. Upon detection, the APR board activates, emitting a sound to divert the animal. During nighttime, a flash light is turned on, and a message is sent to the farmer. An LCD display shows the presence of the animal and LDR readings. A GSM module is utilized to send a warning message to the farmer regarding the intrusion.

K. Mohana et al 2020 [5] The proposed system involves powering the Arduino board using a power supply (RPS), checking for signals in the GSM module, supplying power to the IR sensor through Arduino, detecting obstacles near the IR sensor, raising an alarm upon animal detection, sending a message or making a call to the crop owner using the GSM module, turning on an LED light to indicate current flow through the fencing, and giving a slight shock to animals upon contact with the fencing.

N.Penchalaiah et al 2020 [6] The proposed system utilizes an Arduino board as the core component, with various sensors and a camera connected to it. When motion is detected by the PIR sensors within a 10-meter range, the system activates the camera to capture an image and record a video for aduration of five to six minutes. The captured media is stored both onboard and in the cloud. Additionally, an automatic message is generated via a SIM900A module to notify the registered number about the intrusion, including temperature and humidity data obtained from a DHT11 sensor. If the motion detection is from an authorized person with a valid RFID, their attendance is recorded automatically. In the case of an unauthorized person without a valid RFID tag, the system processes the image and video using Haar feature- based Cascade Classifiers for object detection, determining if the intruder is a human or an animal. If identified as a human intruder, an alarm is raised to alert people about the intrusion.

For animal intruders, the system decides the appropriate actionbased on the number of PIR sensors triggered, which are mounted vertically at fencing, access points, or watchtowers in the area.

Yadahalli et al. 2020 [7] The proposed system involves using an Arduino Uno board connected to various sensors and cameras. When motion is detected within a 10-meter range by the PIR sensors, the system activates the camera, captures an image of the intruder, and displays it on a TFT display. An automatic message is generated and sent to the owner's registered number using a GSM module, providing details of the intrusion and sensor readings. The system can be activated or deactivated by the farmer for access control. The PIR sensors detect human motion and trigger the camera and owner notification. The TFT display provides visual information to the farmer, while the GSM module sends a text message. An alarm or buzzer is included for audio alerts. The number of triggered PIR sensors determines the size of the intruding animal, helping decide the appropriate response to protect the crops. The system combines image transmission, text message notifications, and audio alerts to alert the owner and nearby individuals about the intrusion.

Roxanna et al. 2020 [8] The system aims to detect wild animal intrusion in a farm using ultrasonic sensors placed in multiple locations. When an intruder is detected, a buzzer alerts the residents. The project also involves monitoring soil moisture and weather conditions. An automatic irrigation system is implemented to control the water motor based on soil moisture and rainfall using IoT technology. The main objectives are to reduce manual effort, enhance security, and improve crop yield. The system integrates various sensors to monitor weather, moisture levels, and animal intrusion. When the moisture level is low, the motor pump is activated, and its operations are recorded in a database. If an animal enters the farm, the ultrasonic sensor detects the motion and triggers the buzzer to notify people on the farm.

Ashwini V. et al. 2021 [9] The system design involves integrating object detection, tracking, and notifications. Raspberry Pi 2, an embedded system with powerful capabilities, is used for interfacing with peripheral devices. The system utilizes two Raspberry Pi devices for illustration purposes, with inter-device communication limited to the hand-off procedure. Object detection is performed using a lightweight model to achieve faster processing, while tracking is done on the device itself. When an animal moves out of the camera's range, a notification is sent to other Raspberry Pi devices. The notification includes information about the detected object's class and the sender's identity. A monitoring program locates

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the camera based on the sender's information and sends an alert notification containing details about the type and last known location of the spotted animal. Unique identities are generated for each detected object, and tracking is performed until the object is visible in the camera's field of vision. If the object is no longer detectable, a notification is sent to initiate an object tracking hand-off. Multiple wild animals are assigned a single identity if they are detected as a group, as distinguishing individual animals of the same species can be challenging.

III. OBJECTIVE

The system aims to provide protection against wild animal attacks by alerting the landowner and forest officials when animals enter their land. This helps minimize financial losses, human casualties, and harm to livestock. It serves as an early warning system, enabling appropriate action based on the type of wild animals present. By sharing intrusion details with local forest officials, neighboring landowners can be alerted to take necessary precautions. The information collected allows for the study of repeated intrusions and provides insights to develop preventive measures against further encroachment by wild animals.

IV. EXISTING SYSTEM

The current system for animal recognition involves segmentation and object detection using Fourier transform. Deforestation has led to elephants venturing out of their natural habitats in search of food and resources, resulting in conflicts with humans and damage to cultivated lands. Various methods have been proposed to protect crops from animals, including acoustic signal-based crop protection, junction boxes, and alarm systems. However, these existing systems can be complex, expensive, and cause sound pollution. Despite these efforts, an effective and efficient solution for crop protection is still lacking. There is a need for the development of an intelligent system that can safeguard both animals and farmlands.

V. PROPOSED SYSTEM

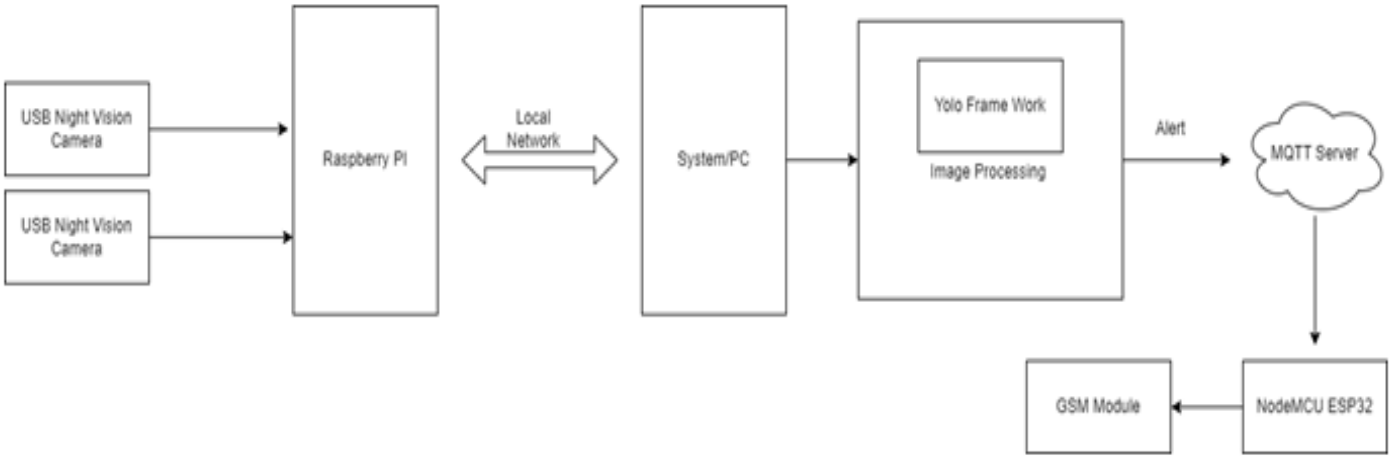

Fig. 1: Block Diagram Proposed model

The YOLO algorithm is utilized in our system to match the predefined objects with the objects detected in the field by our hardware camera. Once an object is detected, it is captured by the camera and uploaded to the server. Both the farmer and forest officials receive an alert message, and the captured image is sent to their respective email addresses. All the details about previous intrusions will be stored in a webpage that can be accessed by forest officials. All the details about previous intrusions are stored in a webpage that can be accessed by forest officials. This provides a centralized database for monitoring and analyzing animal activity in the area. Prior to further processing, the acquired image undergoes pre- processing and compression. These images are then used for training the model. The training process involves performing feature extraction on the images to identify the necessary patterns. Feature fusion and dimension reduction techniques are applied to compress the image, ensuring reliable and real- time performance. Fig. 1 shows the block diagram of proposed system. The major parts of proposed system are

- Pre-Processing
- Feature Extraction
- Classifier
- Raspberry Pi and GSM

Preprocessing: It is the technique employed to store similar images within an image processor. It involves comparing the features of a new image with those of existing images. By analyzing and matching these features, the system can efficiently organize and categorize images for further processing and retrieval.

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Feature Extraction: Feature Extraction is an useful technique used to extract relevant features from a new image. These extracted features are then compared with the features of existing images. This process helps in identifying and categorizing the type of animal entering the farm. A classifier, using the YOLO algorithm, is employed to perform this classification task. By analyzing the newly extracted features and comparing them with the features of existing images, the classifier determines the specific type of animal entering the land.

Raspberry Pi and GSM: Raspberry Pi is a type of microcontroller used in proposed system to run the camera module as the data source that continuously scan for motion and recording video at the same time. GSM is interfaced with raspberry pi to send message like represented in fig to the owner of the land/forest official.

YOLO Algorithm: It is a regression-based approach that simultaneously predicts the edges and classes of the image. It operates with high speed and provides accurate classification results. The algorithm incorporates three techniques: residual blocks, bounding box regression, and intersection over union. In the residual block technique, the image is divided into grid cells, where each cell is responsible for detecting objects within it. The bounding box represents the edges of the image and provides information about the height, width, and class of each grid cell. The intersection over union is utilized to determine the precise boundary of an object. Fig. 2 depicts the flow diagram of wild animal intrusion detection system

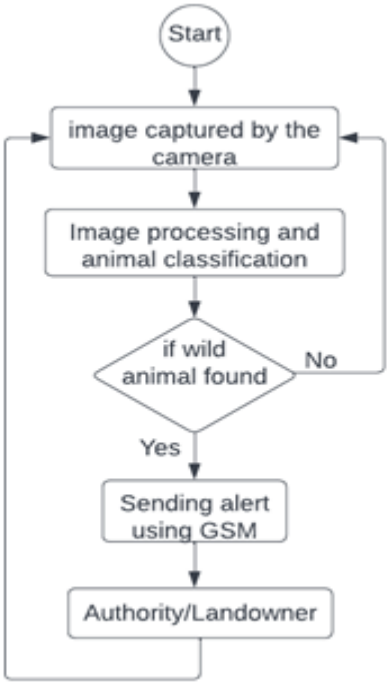

Fig. 2: Flow Diagram of Wild Animal Intrusion Detection System

VI. RESULTS

When an animal is detected in the field through a camera, it is captured by the camera and uploaded to the server. The model then classifies the animal based on its photo so that monitoring can be improved. Both the farmer and forest officials receive an alert message, and the captured image is sent to their respective email addresses. The system can detect animals with an accuracy of 94%.

➢ *Detecting Image of Tiger & Elephant*

The Fig. 3 & Fig. 4 represents the animal's Tiger & Elephant entering into the land and it was captured by cameras fixed at various locations around the land.

Fig. 3: Detected Tiger Image

Fig. 4: Detected Elephant Image

The Loss function used in the used in the model is the mean squared error (MSE) loss. When the IOU loss and total loss decrease during training, it means that the model is getting better at accurately detect-ing objects. Lower losses indicate higher accuracy in object detection.

The following Fig. 5 & Fig. 6 shows the IOU loss andtotal loss arrived for Animal classification.

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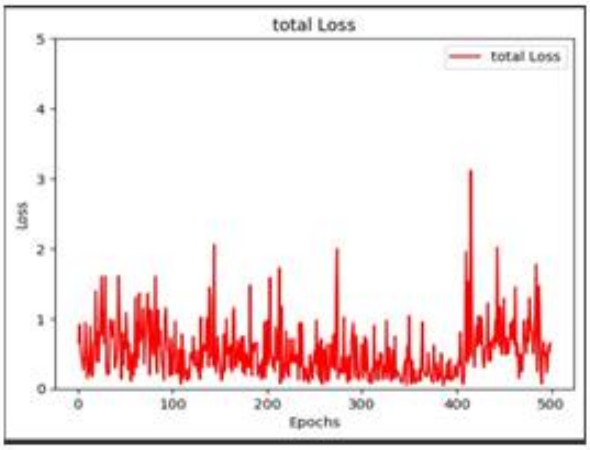

Fig. 5: Total loss

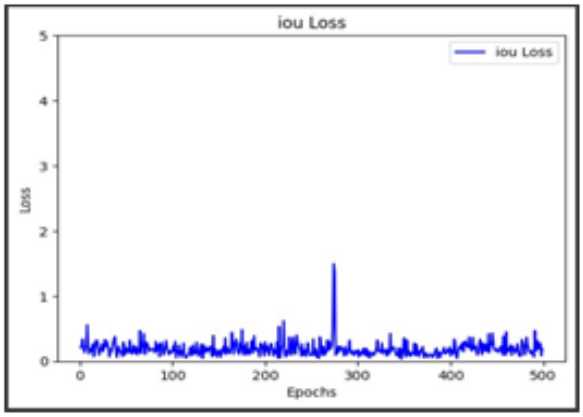

Fig. 6: IOU loss

VII. CONCLUSION

The project has been successfully designed, implemented, and tested. By deploying cameras at strategic locations aroundthe farm, the system effectively captures clear images of ani- mals. These images are then processed using pre-processing, feature extraction, and classification techniques to compare them with pre-defined images. The classification results ob- tained from the YOLO algorithm demonstrate high accu- racy.Each module of the system has been carefully reasoned out and placed, contributing to its optimal performance. The issue of crop destruction by wild animals is a pressing social problem that requires urgent attention and a viable solution. This project holds great social relevance as it addresses this problem by providing a low-cost and energy-efficient smart embedded farmland security and supervision system.The primary goal of this system is to prevent crop losses and protect farmland from intruders and wild animals, which pose significant threats to agricultural areas. By employingthis system, farmers can safeguard their orchards and fields, avoiding substantial financial losses. It eliminates the need forunproductive efforts spent on field protection, allowing farmers to focus on productive agricultural activities.

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