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IOT based automatic wildlife detection and alert systems for farms

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Abstract- Using real-time detection, identification, and deterrent, the automated agricultural land security system is a smart AI-supported solution that aims to halt animal encroachment and safeguard crops. Because of their great sensitivity, distance-based sensors can keep a constant eye on the crops and their agent as they approach. An alarm buzzer notifies the farmer the moment it detects the animal. The AI system will then activate the YOLO object detection algorithm to determine the animal's species and trigger the transmission of a deterrent frequency tailored to that species in order to ward off any unwanted visitors. In the event that the animal persists or if there is evidence of manipulation, the farmer is alerted using GSM communication signals. Along the perimeter, we will also install an electric shock pulse system to beef up security against unwanted access. In order to analyze judgments based on sensor data instantaneously and provide timeless feedback for alarms, the microcontroller incorporates sense modes, deterrents, and communication modules. Thus, the system offers efficient, automated, and least disruptive animal deterrent, which should lessen crop damage and eliminate the need for human monitoring during certain times of the day. It offers a more long-term solution to the problem of wildlife management than the traditional approaches by using AI and an intelligent deterrence strategy to increase agricultural security and production.

Keywords— Agriculture, Crop protection, Farmer, GSM, Wildlife deterrence, YOLO.

I. INTRODUCTION

Because they reduce harvest productivity and cause farmers to lose a lot of money, wildlife incursions onto farmland have long been a big worry. This is why many farms still use antiquated forms of animal control, such physical barriers or fear tactics. Sadly, these approaches aren't always successful, and they may be costly and time-consuming to boot. On top of that, these treatments lose part of their effectiveness over time since many animals develop immunity to them. Because of this, a scalable, automated, and enhanced approach is required, one that can guarantee adaption according to the many ontologies of wildlife [1-2]. Integrating distance-based sensors with artificial intelligence (AI) using the YOLO object identification framework and an active electric deterrent mechanism, this article presents an enhanced animal repulsion system. Depending on the species observed, the system may identify and categorize wildlife as it approaches farms in real time, and then respond with a targeted deterrent. Automated pasture wildlife reactions and accurate species identification are both made possible by AI. By updating the battle against wildlife encroachment, this technology offers a humane and effective way to secure crops that can be scaled with less human intervention and improves the overall security of agricultural fields.

II. LITERATURE REVIEW

A method for preventing animals from getting into crops is presented by Balakrishna et al., and it uses machine learning and the Internet of Things. Raspberry Pi, linked to various sensors and components including the Pi Camera and the

ESP8266 module, serves as the system's brain in this approach. Two kinds of picture detection models, SSD and Region-Based Convolutional Neural Networks, power the detecting part, which lets animals approach farms. When comparing the two types, SSD is considered a real-time animal detection system due to its great accuracy and speed. A scalable and affordable way to protect crops against animal infiltration is provided by the system, which can also link with the Twilio API to deliver SMS notifications to help farmers [3].

If Sabina and Haseena want to see less interaction between humans and animals in farming, they propose an animal repellant system that uses deep learning. When animals are detected and classified using MobileNet SSD, an alert is triggered to scare away nearby wildlife while also notifying the appropriate authorities. Its goal is to provide a way to deter animals without hurting them too much, in a compassionate way. Particularly useful for crop protection in rural regions, this approach enables real-time work while striking a compromise between speed and precision [4].

A machine learning–based camera vision system for agricultural animal identification and repellent is presented by Sudhakar et al. Ultrasound uses high-frequency sound waves to ward off animals, while faster R-CNN is used for real-time animal identification. An animal confusion matrix shows how well the detection model identifies and categorizes different types of animals. Since the techniques used to repel animals are non-destructive, the system raises timely notifications to farmers about the safety of crops and wildlife [5].

Additionally, the methods used to repel animals are humane. Therein, say Sivasubramanian et al., is an AI and deep learning-based intelligent system for animal identification that can keep animals out of areas that are used for farming. The system uses ultrasonic signals to compassionately repel animals whenever they are detected. This helps to prevent crop damage and the need for physical police intervention. This study demonstrates that artificial intelligence (AI) technology has the potential to improve crop security in the future [6]. In their study, Adami et al. detail an AI-powered edge system that can deter ungulates from crops in real time. The YOLO (you only look once) object identification algorithms and embedded hardware, such as Raspberry Pi and NVIDIA Jetson Nano, enable this system to identify crop-damaging animals and activate ultrasonic repellent devices to keep them at bay. Price, energy efficiency, and the feasibility of such AI-powered crop protection systems were all factors in the performance assessment of the suggested system, which shed light on its real-world agricultural applications [7].

A crop security system that can identify and repel animals from agricultural fields has reportedly been developed using machine learning analysis and algorithms (Marichamy et al., 2018). The Wildlife Detector can identify potentially harmful creatures in real-time using MobileNet SSD. This device aims for quick detection and a gentle method to discourage animals from damaging crops by using IoT and AI technology. How these machine learning methods contribute to conflict avoidance and food supply safety is outlined in this paper's implications [8].

It has been suggested to use deep learning technologies to create an AI-driven monitoring system that guards crops from animal invasion. Featuring a built-in camera, image processing, and a deep learning model, the approach can recognize animals in real-time. The moment an animal is seen, an algorithm for analyzing images will be activated to both identify and scare away the unwanted visitor. With the use of AI and image processing, the model then presents itself, which aids in crop protection and decreases the unit application of labor. For small-scale farmers, this is a practical and economical solution [9]. A discussion on crop damage using deep learning

and AI sheds light on the problem of animal raids in India. The authors propose an AI and CNN-based animal detection system that uses PIR sensors and sound alarms to alert farmers when there has been an intrusion, which is a more humane solution than the traditional methods of crop protection, which involve electric fencing and human guards [10]. Kolmennik et al.

To prevent wildlife damage to agricultural crops, propose a new model that makes use of computer vision and machine learning....The technology will sound an alert to keep animals off crops by using image processing to identify and detect animals on farmlands. The goal of this scalable, inexpensive, and AI-based animal identification and warning system solution is to decrease agricultural damage without harming the animals [11]. Jyothi et al.

presented an AI-based crop security system that uses YOLOv3 for object identification and real-time field monitoring to detect animal invasions. Cameras placed around the property will record footage that may be used to frighten animals away. As an economical substitute for conventional fence and human monitoring, the suggested method ensures the protection of crops while reducing labor expenses [12]. It also sends out immediate warnings to farmers via email and cellphone notifications.

III. METHODOLOGY

To keep pests out of crops, the system makes use of cutting-edge sensors, artificial intelligence, and auto-deterrent technologies. It employs distance-based sensors that encircle the farmland's perimeter walls, continually scanning for the arrival of wild animals. A farmer is alerted with a buzzer whenever an animal is discovered. As the animal gets closer, the YOLO AI system will identify its species and set the deterrent's frequency accordingly. In the event that an animal refuses to leave or if the system is being tampered with, it will quickly notify the farmer by GSM communication, allowing them to take fast action. Aside from the boundary, an electric shock pulse device is also put in place to prevent unauthorized individuals from entering the field. When it comes to real-time detection, categorization, and activation of additional features, a microcontroller unifies all components into one. Figure 1 depicts the system's operational flow, including detection, categorization, the deterrent mechanism, and alarms. This project presents a novel alternative to animal deterrence tactics that is easy to implement, eco-friendly, and clever.

Manual, labor-intensive monitoring, ineffective scare tactics, and environmentally harmful chemical repellents are the current techniques of wildlife deterrence. Thus, the system improves agricultural output while decreasing crop losses and ultimately leads to sustainable farm management, despite the system's reliance on artificial intelligence and automation.

The design provides a greater potential to address difficulties in modern farming since it can be scaled up or down to match various agricultural situations. Rapid monitoring, intelligent decision-making, and automatic deterrent make up the system, which gives farmers a weapon they can use in the here and now to protect their crops and fields from animals. To prevent animals from getting into crops, it would be best to use a combination of distance-based sensors, AI-powered item identification, and automated deterrent actions.

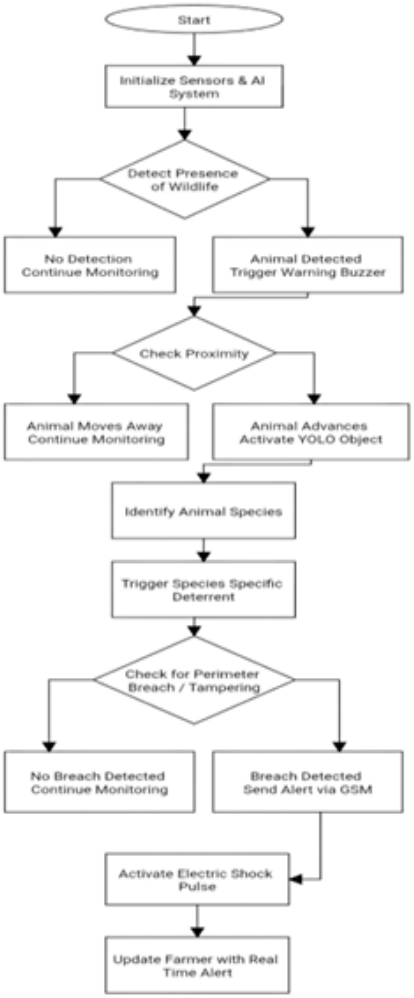

Fig. 1. Flowchart of the proposed system

In order to detect approaching animals that move within a certain range, distance sensors constantly survey the dispersed perimeter. The warning buzzer will sound to notify the farmer if any first detection is made. An AI-enabled YOLO object detection system immediately determines the species as animals approach and turns on a species-specific deterrent frequency to prevent further approach. Using GSM connectivity, the system immediately notifies the farmer of any tampering or persistent intrusion. Also, to prevent animals from getting beyond the border, a nonlethal deterrent called an electric shock pulse device is activated all over the property. In order to read sensors, create alarms, and initiate deterrents at the appropriate times, the complete system is controlled by a microcontroller. This system offers a smart and automated way to protect agricultural land from wild animals. It uses real-time monitoring, AI-based identification, and targeted deterrent mechanisms to keep crops safe and reduce the need for constant human vigilance. Figure 2 shows the system's block diagram, which shows how the different parts, including sensors, AI processing, and the microcontroller-controlled deterrent mechanisms, are integrated. The technique offers several benefits to the person using it. First, it minimizes the need for human intervention by automatically detecting, identifying, and discouraging animals without continual human oversight. The farmers are able to save time, labor, and operational expenses because of this. Furthermore, it improves precision and productivity by reducing the number of false alarms caused by the detection of species-specific deterrents to ward off unwanted animals. In contrast to chemical repellents or damaging barriers, the system preserves ecological balance and conservation of wildlife while providing non-lethal deterrents and smart alarm signals to keep crops in excellent condition. This third benefit is that it offers formal eco-friendly and sustainable protection.

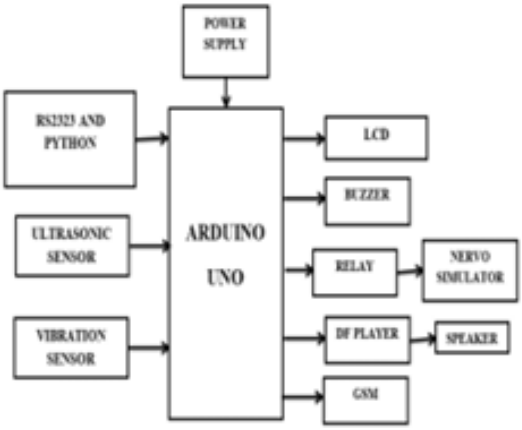

Fig. 2. Block diagram of the proposed system

The end user benefits greatly from the system. First, it minimizes the need for human intervention by automatically detecting, identifying, and discouraging animals without continual human oversight. The farmers are able to save time, labor, and operational expenses because of this. Furthermore, it improves precision and productivity by reducing the number of false alarms caused by the detection of species-specific deterrents to ward off unwanted animals.

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The detection and identification procedure is followed by the Alert and Deterrence Module. It initially scares the invader before signaling the farmer with a buzzer to convey warning signals. Consistently moving closer to it will cause it to release frequencies that are known to be deterrents to some species. If the intruder or meddlesome behavior continues, the farmer is immediately notified over the GSM network to implement a protective system that involves an electric shock pulse.

There is little need for human intervention since it is both active and automatic in its response to animal hazards. This central module acts as a central processing unit (CPU), connecting all other parts of the system via the microcontroller. It regulates the data collected by sensors, processes AI identifications, and manages deterrents. In the event of an incursion, the farmer will get immediate notifications since it handles GSM communications as well. It does its job so well, with little effort required for detection, categorization, and deterrent application. When it comes to automated decision-making, ongoing farm protection, and system stability, this module is crucial. In conclusion, the proposed solution is an all-inclusive automated service for agricultural land security that combines cutting-edge AI technology with real-time monitoring and non-lethal deterrence tactics. With the help of the sensors and the YOLO-powered AI detection model, the system helps to agricultural security in terms of preserving ecological balance. This solution is relevant to current farmers since it offers a sustainable and effective means to protect their crops. Its scalable design makes it suitable for different agricultural environments.

IV. RESULTS AND DISCUSSION

After the animal detection and deterrent systems have been deployed, implemented, and tested, this section details the results they obtained for the monitoring. In order to monitor and identify animals in real-time, the detection and deterrent detection system integrates YOLO-based object identification with an Arduino-based sensor network. Detection accuracy, system performance, reaction time, and overall effectiveness are the following outcomes that will be discussed there after.

Performance and Accuracy of Detection Utilizing both the animal dataset and live video stream, the object identification model that relies on YOLO was trained and evaluated.

The system can detect, categorize, and identify a wide variety of animals in a variety of settings, including zebras, buffalo, elephants, and rhinos. In both bright and dim light, the model worked well, as shown in Fig 3. So, you could count on its reliable performance all day long.

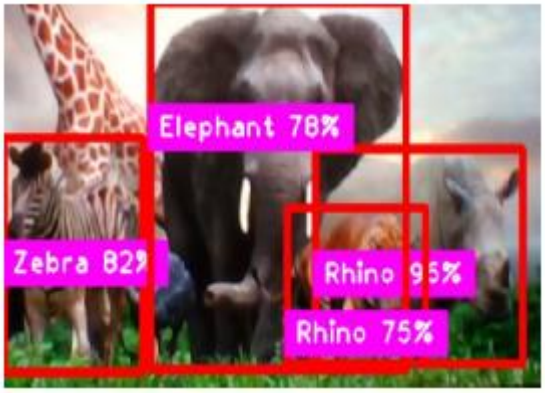

Fig 3 Object detection on wildlife with bounding boxes

In order to train and test the model that could recognize data from live video feeds and animals, the YOLO framework was used. The identification and categorization of buffalo, elephant, rhino, and zebra, among other animals, worked well in a variety of settings. Figure 3 shows that it works admirably in both bright and low light, making it resistant to variations in the passage of time.

For each species in question, YOLO determined detection effectiveness relative to confidence (see Table I). Rhinos and zebras, for example, had detection confidence ratings between 75% and 95% in this instance. Confidence ratings for buffalo and elephants were somewhat lower than 50, suggesting they may still be fairly well-categorized, but to a lesser extent.

Table I: Detection Accuracy For Different Animal Classes

Animal Class	*Detection Accuracy (%)*	*Confidence Range (%)*
Buffalo	89.9	50-95
Elephant	78.0	50-90
Rhino	95.0	75-99
Zebra	82.0	75-88

Figure 4 shows that the average inference time, which is crucial for real-time detection, falls somewhere between ninety and 105 milliseconds.

This discovery shows that the system strikes a good balance between accuracy and speed, enabling efficient animal detection without sacrificing performance, since it is proven that this inference time is sufficient to support real-time monitoring, with immediate detection and action being taken when animals approach.

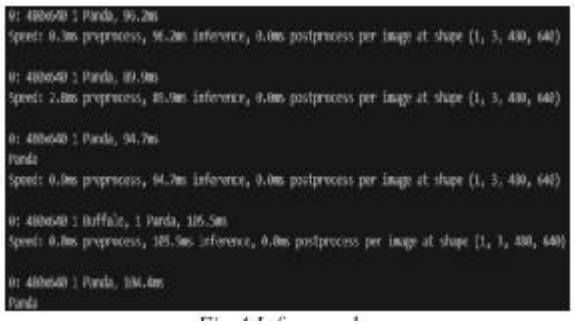

Fig 4 Inference log

Responding to System Integrations A robust and reactive deterrence system was achieved by integrating the detector model with a hard device. Thanks to a GSM module, vibration sensors, an Arduino microcontroller, and ultrasonic sensors, we were able to recognize when the animal was within the predetermined distance and take appropriate action in real-time.

The ultrasonic sensors in the detection system showed the distance in kilometers on an LCD interface once animals crossed the perceived 100-meter radius; a DF Player module then activated the sound deterrent.

Figure 6 shows that the vibration sensor may be used to make noise and frighten away animals at a maximum distance. When an animal attempts to harm the kit, the sensor displays the value 1, otherwise it displays the value 0.

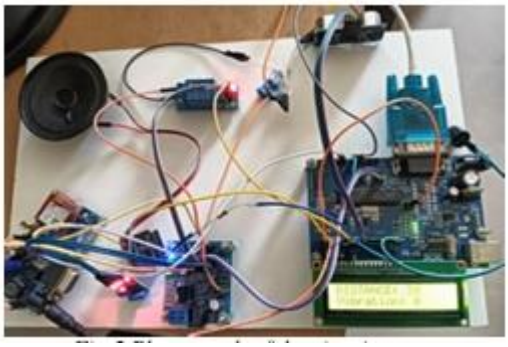

Fig 5 Photograph of the circuit setup

Still, a nerve stimulator was used as a third line of defense in the event that the animal would not halt after 50 meters. In this manner, the animal may be restrained from approaching the boundaries of the monitored region, such as a farm. As soon as the animals were within range of the user's property, the GSM module notified them in real-time. Because of this, users were able to take preventative actions, such as contacting the police or using additional manual deterrents.

Fig 6 Illustration of distance and vibration detection

V. CONCLUSION

Combining cutting-edge sensor technology, AI, and automated deterrent mechanisms, the planned farm defense system against animals is now under development. In this regard, the YOLO object identification system, which is supported by artificial intelligence, distance-based sensors, and species-specific deterrent reactions, provides an excellent, open-scale, long-term answer to the problem of animals destroying crops.

In response, a warning message will be sent out to farmers using the GSM standard architecture, and a non-lethal electric shock pulse system will be put in place to prevent intrusions along the perimeters. Overall, this approach significantly reduces the need for human interaction, increases accuracy, and replaces traditional deterrent tactics with more environmentally friendly ones.

It offers a solution to the current, difficult problems in farming with its modular and adaptable architecture, which should make it easier to integrate in any agricultural environment. Potential future enhancements include incorporating a fine-grained AI model filtering into the body to enhance detection accuracy, incorporating additional deterrent mechanisms to enhance specification-oriented repulsion, and integrating solar panels to make it an efficient energy-consuming system. In addition to providing farmers with more efficient crop protection tools, addressing the long-standing problem of wildlife accessing farmlands helps the system generate more food and agriculture.

REFERENCES

1. C. V. Vivekanand, I. T M, A. R, E. K E and J. S, "Efficient Harvest to Storage: Advancing with Automated Grain Systems," 2024 7th International Conference on Circuit Power and Computing Technologies (ICCPCT), Kollam, India, 2024, pp. 207-213, doi: 10.1109/ICCPCT61902.2024.10672665.
2. R. V, A. T, H. R S and I. T M, "Intelligent Water Management System in Agricuture," 2024 10th International Conference on Electrical Energy Systems (ICEES), Chennai, India, 2024, pp. 1-6, doi: 10.1109/ICEES61253.2024.10776864.

3. K Balakrishna, Fazil Mohammed, C.R. Ullas, C.M. Hema, S.K. Sonakshi,"Application of IOT and machine learning in crop protection against animal intrusion",Global Transitions Proceedings,Volume 2, Issue 2,2021, ISSN 2666285X, https://doi.org/10.1016/j.gltp.2021.08.061
4. Sabina, Nadia & P.V, Haseena. (2022). An Intelligent Animal Repellent System for Crop Protection: A Deep Learning Approach. International Journal of Engineering Research in Computer Science and Engineering. 9. 54-60. 10.36647/IJERCSE/09.09.Art014.
5. Sudhakar, & Janakiraman, Sreerambabu & Rajkumar, & Santhosh,. (2023). Camera Vision Based Animal Repellent System for Agriculture using Machine Learning. International Journal for Research in Applied Science and Engineering Technology. 11. 602 604. 10.22214/ijraset.2023.55032.
6. Sivasubramanian, Thylashri & N R, Rajalakshmi & Karthikeyan, P. & Lourdusami, Sahaya. (2023). Animal detection in farms using machine learning. Applied and Computational Engineering. 6. 318-323. 10.54254/2755-2721/6/20230799.
7. D. Adami, M. O. Ojo and S. Giordano, "Design, Development and Evaluation of an Intelligent Animal Repelling System for Crop Protection Based on Embedded Edge-AI", in IEEE Access, vol. 9, pp. 132125-132139, 2021, doi: 10.1109/ACCESS.2021.3114503
8. M. Marichamy, S. Ponnusamy, and R. Sivakumar, "Crop Protection from Animals Based on Machine Learning," Journal of Modern Agriculture and Biotechnology, vol. 12, no. 2, pp. 45-52, 2022.
9. Lakshminatha Reddy Chinapureddy, Moulika Kalimisetti, Bhavana Chigurela, Anusha Utti, Chandana Tupakula, 'Safeguarding agriculture: Using deep learning to prevent animal invasions', AIP Conf. Proc. 3237, 020017 (2025), https://doi.org/10.1063/5.0249032
10. Delwar TS, Mukhopadhyay S, Kumar A, Singh M, Lee Y-w, Ryu J-Y, Hosen ASMS. Real-Time Farm Surveillance Using IoT and YOLOv8 for Animal Intrusion Detection. Future Internet. 2025; 17(2):70. https://doi.org/10.3390/fi17020070
11. Manasa Kommineni , M. Lavanya , V. Harsha Vardhan , Mr. Jagadeesh Kumar G , Shamsheer Shaik V , T. Gouri Sankar,"Agricultural Farms Utilizing Computer Vision (AI) And Machine Learning Techniques For Animal Detection And Alarm Systems",Journal of pharmaceutical negative results.vol.13 Special issue 09 (2022) . https://doi.org/10.47750/pnr.2022.13.S09.411
12. G G. Jyothi, M.Anilkumar, G.Apoorva, B.Manikanta, M.Dhanraj, "Smart Crop Protection System using Deep Learning", Journal of Science and Technology, Vol. 09, Issue 11,-Nov 2024, pp01-20.