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Automatic Animal Repellent Scarecrow Using Raspberry pi

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A B S T R A C T

This paper presents an innovative approach to safeguard crops against wildlife interference-a solar-powered automatic animal repellent scarecrow driven by Raspberry Pi technology. Integrating infrared motion detectors and advanced image recognition algorithms, the system accurately identifies the presence of animals and triggers a response mechanism, such as flashing lights or audible deterrents. The Raspberry Pi single-board computer serves as the system's brain, ensuring real-time decision-making and adaptability. Emphasizing sustainability, the scarecrow is equipped with photovoltaic panels, enabling it to operate off-grid with energy stored in a rechargeable battery. This eco-friendly solution aims to minimize crop damage, promote efficient agricultural practices, and foster coexistence between humans and wildlife. The proposed system offers a scalable and intelligent tool for farmers, combining cutting-edge technology with renewable energy to address the challenges of wildlife intrusion in agricultural settings.

Keywords: Animal detection, Raspberry Pi, machine learning, crop protection, sustainable agriculture

Introduction

Agricultural fields are frequently at risk of damage caused by wild animals, leading to significant crop losses. Traditional methods such as scarecrows have long been used to deter animals, but their effectiveness diminishes over time. With the rise of modern technology, more sophisticated systems have been introduced to address this issue. A camera vision-based animal repellent system using machine learning, as proposed by Aarthi et al. [1], uses image processing techniques to detect animals in real-time, offering a more reliable approach for protecting crops. Similarly, Singh et al. [6] developed an automatic scarecrow system that aims to safeguard crops from animal interference through automation.

The protection of crops from animals like deer, birds, and small mammals is crucial to ensuring food security, particularly in regions where agriculture plays a central role in the economy. There is a need to offer an intelligent, eco-friendly solution for preventing wildlife from damaging crops that integrates real-time image recognition and motion detection to accurately identify the presence of animals in the field. Once detected, the system should activate deterrents such as ultrasonic sounds and flashing lights to scare the animals away, ensuring crop protection without harming wildlife. The use of machine learning allows for high precision in animal detection, reducing false alarms, and the incorporation of solar power ensures the system is energy-efficient and sustainable. This project aims to provide farmers with a cost-effective, autonomous system that protects crops, minimizes environmental damage, and promotes coexistence between agriculture and wildlife.

Literature Review

Recent advancements in artificial intelligence (AI) and the Internet of Things (IoT) have further propelled the development of smart farming solutions. Systems utilizing AI and deep learning, such as those discussed by Mathanraj et al. [2] and Abirani et al. [4], have shown great potential in accurately identifying and deterring animals from agricultural lands. These systems continuously learn and adapt to different animal behaviors, making them more efficient over time. Dange et al. [5] proposed the integration of IoT in scarecrow systems, allowing remote monitoring and control, which enhances the system's functionality in diverse agricultural settings. Similarly, Mapari et al. [8] discussed smart scarecrow systems that offer real-time detection and response mechanisms to protect crops.

Sustainability plays a critical role in the effectiveness of these systems. Kulkarni and Parashuram [3] emphasized the use of solar-powered mechanisms, which ensure the uninterrupted operation of scarecrows, even in areas lacking a stable power supply. Pandit et al. [7] and Zhang et al. [10] highlighted the integration of solar power and sound-sensing mechanisms, making the system more eco-friendly and autonomous. The proposed system leverages Raspberry Pi technology, as demonstrated by Karnik [9], to enhance processing power and provide a platform for integrating various functionalities such as real-time animal detection, solar energy utilization, and automated response systems.

Material and Method

The proposed system consists of several hardware components, including the Raspberry Pi 4, infrared (IR) sensors, a web camera, a buzzer, and solar panels. The Raspberry Pi serves as the central processing unit, managing the detection and response system using machine learning algorithms. The IR sensors detect motion in the field and trigger the camera to capture images when movement is identified. The camera captures real-time images, which are processed using the YOLO (You Only Look Once) object detection algorithm.

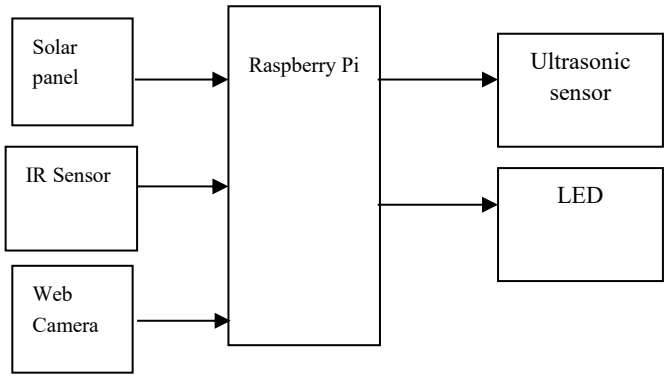

Fig. 1 - System Block diagram

This algorithm is specifically trained to identify animals in the images, allowing the system to distinguish between animals and other moving objects like humans or vehicles. The system then activates deterrents such as ultrasonic sounds or flashing lights to scare away the animals without causing them harm. Solar panels are employed to provide power to the system, ensuring that it operates continuously in off-grid, remote agricultural fields.

The software for the system is developed using Python, leveraging libraries like OpenCV for image processing and TensorFlow for running the machine learning models. The YOLO algorithm is pre-trained on a large dataset of animal images, which enables it to recognize various animal species such as deer, birds, and rodents with high accuracy. The Raspberry Pi processes the data and makes real-time decisions to activate the appropriate deterrents based on the detected animals. The system is designed to be energy-efficient by relying on solar power and using low-power components to reduce the system's overall energy consumption. The scarecrow can be deployed in various agricultural environments and easily modified to integrate additional sensors or updated software. This modular approach makes the system adaptable to different farming needs, providing a versatile and eco-friendly solution for protecting crops from wildlife intrusion.Utilizing a combination of infrared (IR) sensors, web cameras, and Raspberry Pi microcomputers, an innovative system has been devised for the purpose of animal detection and deterrence. Initially, the IR sensor serves as the primary trigger, detecting any motion within its designated range.

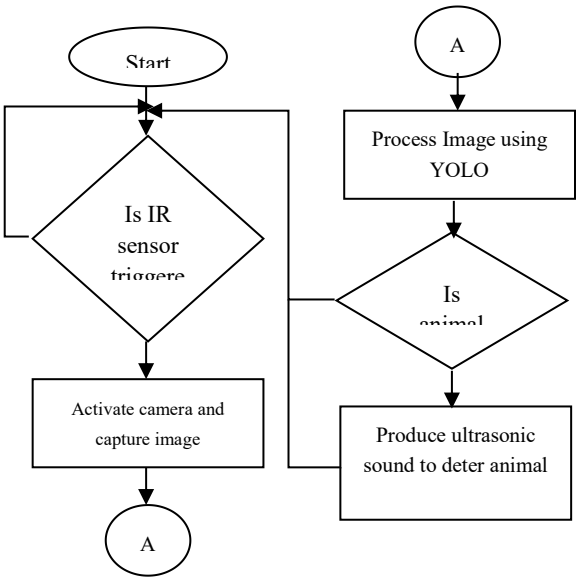

Fig. 2 - System flow chart

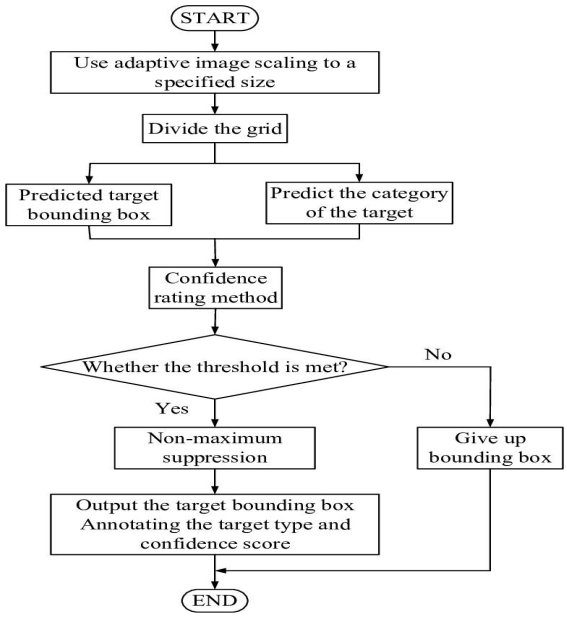

Fig. 3 Target detection and bounding box annotation

Upon activation, the Raspberry Pi orchestrates the subsequent steps of the process. The web camera, under the Pi's control, captures images of the detected motion. These images are then fed into a sophisticated object detection algorithm, such as YOLO (You Only Look Once), capable of discerning whether the motion corresponds to an animal. Upon confirmation of an animal's presence, the Raspberry Pi initiates two simultaneous actions: the activation of an ultrasonic sound generator and the illumination of an LED indicator.

The YOLO (You Only Look Once) algorithm divides an input image into a grid and predicts bounding boxes and class probabilities for each grid cell. It processes the entire image in a single pass, detecting objects and their locations simultaneously. By using a single convolutional neural network, YOLO is fast and efficient, making it suitable for real-time object detection tasks. The ultrasonic sound, inaudible to humans but perceptible to animals, serves as a deterrent, encouraging the detected creature to vacate the area. Simultaneously, the LED indicator provides a visual cue, alerting observers to the system's operation. The integration of these components creates a comprehensive solution for detecting and deterring animals in various environments. By combining cutting-edge technology with practical application, this system exemplifies the potential of modern engineering to address real-world challenges, from wildlife management to property protection, in an effective manner. A bounding box creates an outline that highlights an object in an image.

Results and Conclusion

The image is divided into grid cells. Each grid cell forecasts B bounding boxes and provides their confidence scores. The cells predict the class probabilities to establish the class of each object. Intersection over union ensures that the predicted bounding boxes are equal to the real boxes of the objects. This phenomenon eliminates unnecessary bounding boxes that do not meet the characteristics of the objects (like height and width). The final detection will consist of unique bounding boxes that fit the objects perfectly.

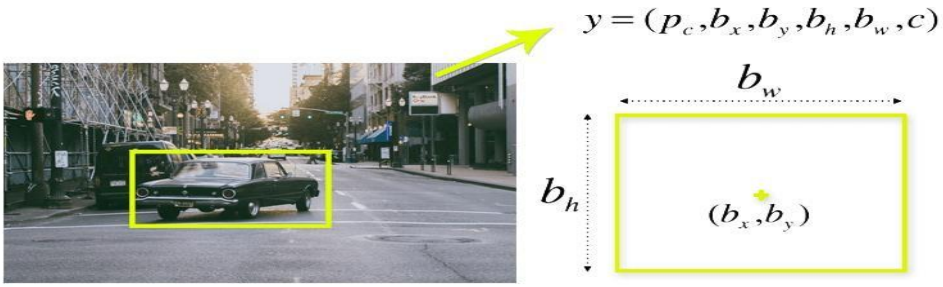

Fig. 4 - Bounding box

In Fig. 5, the car is surrounded by the pink bounding box while the bicycle is surrounded by the yellow bounding box. The dog has been highlighted using the blue bounding box. The final detection will consist of unique bounding boxes that fit the objects perfectly. All the predictions are made simultaneously using a single convolutional neural network.

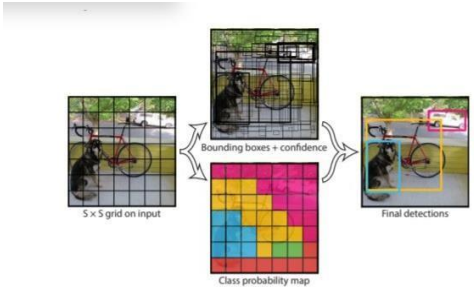

Fig. 5 - Process of animal detection

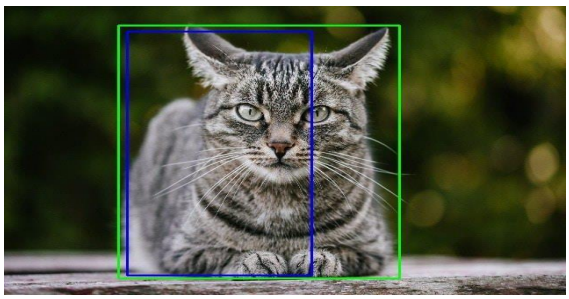

Fig. 6 - Animal detection

The Automatic Animal Repellent Scarecrow using Raspberry Pi presents a practical, sustainable solution for mitigating wildlife intrusion in agricultural fields. By leveraging machine learning algorithms like YOLO and utilizing renewable solar energy, the system provides real-time detection and response to protect crops efficiently. The eco-friendly design not only reduces the need for harmful

References

A. B. G. Aarthi, M. Harita, and K. Abhinayashri, “Camera vision-based animal repellent system for agriculture fields using machine learning,” *International Journal of Research in Electronics and Computer Engineering*, vol. 11, no. 2, pp. 251-258, Apr. 2023.

S. Mathanraj, K. Akshay, and R. Muthukrishnan, “Animal repellent system for smart farming using AI and deep learning,” in *Proceedings of the 2022 International Conference on Smart Agriculture and Technology (ICSAT)*, Erode, India, May 2022, pp. 120-125.

N. Kulkarni and A. Parashuram, “Fabrication of solar-powered bird scarer,” in *Proceedings of the 2021 International Conference on Renewable Energy and Agricultural Engineering (ICREAE)*, Bengaluru, India, Jul. 2021, pp. 340-345.

R. S. Abirani, S. Mohanaselvi, and S. Anitha, “Animal repellent system for smart farming using artificial intelligence and deep learning,” *Journal of Artificial Intelligence and Applications in Agriculture*, vol. 8, no. 2, pp. 180-185, Jun. 2022.

K. Dange, P. Bhoye, and Y. Muthe, “Designing smart scarecrow using IoT,” Proceedings of the 2023 International Conference on IoT and Smart Agriculture (ICISA), Nashik, India, Jun. 2023, pp. 450-456.

S. Singh, S. Kumar, R. Sharma, and R. P. Yadav, “Automatic scarecrow for crop protection,” *Journal of Agricultural Technology*, vol. 14, no. 3, pp. 275-280, Sep. 2022.

P. Pandit, P. Kulkarni, and P. Rathod, “Scarecrow with solar-powered & sound sensing mechanism,” *PES Journal of Engineering Research*, vol. 6, no. 4, pp. 400-405, Oct. 2023.

R. Mapari, K. Bhangale, L. Deshmukh, and P. Gode, “Agriculture protection from animals using smart scarecrow system,” *Journal of Advances in Engineering Technology*, vol. 18, no. 1, pp. 55-62, Feb. 2022.

A. Karnik, “Performance of TCP congestion control with rate feedback: TCP/ABR and rate-adaptive TCP/IP,” M.E. *thesis, Indian Institute of Science,* Bangalore, India, 1999.

S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, “A novel ultrathin elevated channel low-temperature poly-Si TFT,” IEEE Electron Device Letters, vol. 20, no. 4, pp. 569–571, 1999.