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Bird And Intruder Detection System for Farmland's Using Image Processing

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Abstract: Birds play a dual role in agriculture: while they contribute to the ecosystem by controlling pests, they can also cause significant crop damage. Traditional deterrents like scarecrows and sound devices often prove ineffective. This project presents a smart bird repellent system using image processing (MATLAB), deep learning (CNN), and IoT (Arduino, GSM). It detects harmful bird activity in real time and triggers a buzzer to scare them off. PIR sensors identify intruders, and a GSM module alerts the farmer. The system is low-cost, eco-friendly, and enhances agricultural productivity by reducing crop loss.

Keywords: Bird Detection, MATLAB, IoT, CNN, Arduino, PIR Sensor, GSM Module

I. INTRODUCTION

Bird-induced crop damage is a persistent and growing challenge for farmers, particularly during the sowing and harvesting phases. Open agricultural fields are especially vulnerable to flocks of birds that feed on seeds and developing crops. Traditional deterrent methods such as scarecrows and noise-producing devices (e.g., crackers, reflective materials, or wind chimes) offer only temporary relief. Over time, birds learn to recognize these tools as non-threatening, leading to a sharp decline in their effectiveness. More aggressive measures like trapping or poisoning, though occasionally used, pose serious risks to the ecosystem, non-target species, and even human health. Additionally, such methods may violate environmental and wildlife protection regulations, making them unsuitable for sustainable agriculture.

In recent years, the integration of Artificial Intelligence (AI) and Internet of Things (IoT) technologies has opened new avenues in smart farming. These innovations enable farmers to monitor and manage agricultural operations with greater precision and responsiveness. One promising application is in automated wildlife deterrence, where intelligent systems can identify and respond to bird activity in real time.

This project introduces an AI-powered bird repellent system that combines computer vision, embedded systems, and IoT-based alerting to offer a robust and non-lethal crop protection solution. The core of the system is a Convolutional Neural Network (CNN) model implemented in MATLAB, trained specifically to detect 'farm disturbance birds' using a custom image dataset. High-resolution images captured by a camera module are processed and analyzed to determine the presence of birds. Upon detection, the system transmits a signal to an Arduino microcontroller, which activates a buzzer through a relay to emit a loud noise and repel the birds.

In addition to bird detection, the system features a Passive Infrared (PIR) sensor positioned at the field's boundary to identify unauthorized human movement. If intrusions are detected, the system promptly sends an SMS alert to the farmer using a GSM module, allowing immediate action

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This intelligent bird repellent system not only reduces manual effort and response time but also ensures environmental safety by eliminating the need for harmful chemicals or mechanical traps. The integration of IoT enables remote monitoring and real-time decision-making, thereby aligning with the broader goals of precision agriculture and sustainable farming. The proposed system represents a significant advancement toward safeguarding crops from avian threats using modern technological frameworks.

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II. RELATED WORK

[1] The research paper titled **"Small Mammals and Bird Detection Using IoT Devices"** by K. Shim et al., presented at the 2021 International Conference on Computer Design (ICCD), introduces a wildlife monitoring system based on IoT devices. This system uses sensors and smart devices to detect the presence and movement of birds and small animals. The study validates the effectiveness of using IoT technology for environmental and agricultural monitoring, providing a foundation for real-time detection systems in farmlands.

[2] The paper **"A Real-Time Image Processing Based System to Scare Birds from Agricultural Fields"** by S. Maheswaran et al., published in the Indian Journal of Science and Technology, describes a MATLAB-based image processing approach using background subtraction and the Kalman filter algorithm. While the background subtraction method also detects irrelevant moving objects, the Kalman filter improves tracking accuracy with minimal errors. This research supports the use of image processing for accurate bird detection in dynamic environments.

[3] the paper **"Deep Learning-Based Farm Disturbance Bird Detection"**, published in the Proceedings of the International Conference on Self Sustainable Artificial Intelligence Systems (ICSSAS 2023), introduces a bird detection system trained on the 'farm disturbance bird' dataset using the MobileNetV2 model. Object detection is implemented using the Caffe framework. The use of a modified MobileNetV2 model via transfer learning improves image classification accuracy, especially for real-time video feeds. This research highlights the potential of deep learning and mobile AI models in precise bird detection.

[4] the paper **"Automated Bird Detection and Repeller System Using IoT Devices: An Insight from Indian Agriculture Perspective"** by R. Riya and colleagues, published in 2020. It presents an automated system that combines IoT technology, artificial intelligence, and sensors to detect birds in rice fields and activate a repelling mechanism. The system is designed to minimize crop damage by automating the process of bird detection and deterrence, emphasizing the importance of non-harmful bird management strategies.

III. METHODOLOGY

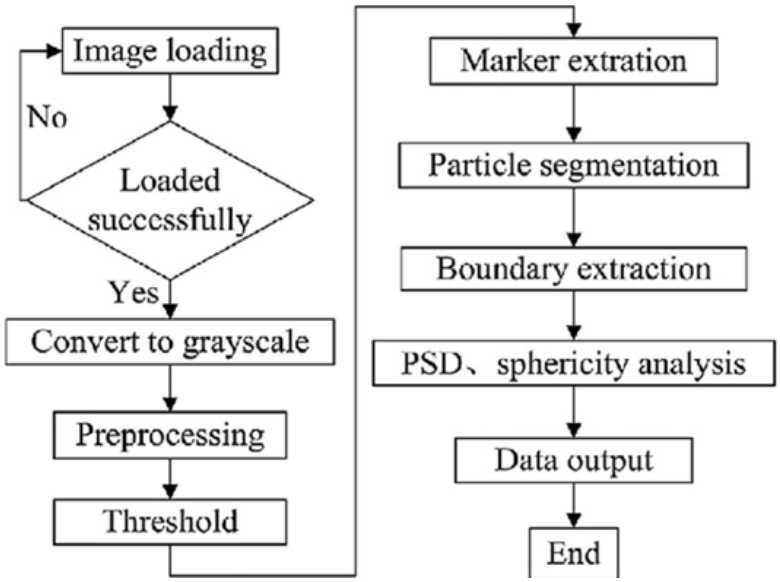

Fig. 1 process of bird detection

The Bird Detector System follows a structured methodology to ensure accurate bird detection, deterrence, and intrusion monitoring. The project is divided into two main components: software and hardware. The software part is responsible for image processing and data transmission, while the hardware part includes sensors, microcontrollers, and actuators that execute the system's functions.

The image processing system is developed using MATLAB, where it is trained with images of different bird species. The training process involves collecting images, applying preprocessing techniques such as noise removal and edge detection, and implementing machine learning algorithms to classify detected objects as birds.

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When an image is captured, the system processes it by converting it into grayscale, extracting important features, and comparing them with the trained dataset to identify the presence of birds.

Once a bird is detected, a unique identification number is generated and sent to the Arduino microcontroller, which acts as the central processing unit. The microcontroller then triggers the buzzer, producing a loud sound to scare the birds away from the monitored area. Additionally, the detection results are logged and transmitted to an IoT webpage for remote monitoring.

To enhance security, the system also incorporates a PIR (Passive Infrared) sensor at the entrance, which detects unauthorized human movement. When motion is detected, the sensor sends a signal to the Arduino, which can trigger an alarm or notify users through an IoT-based alert system. The GSM module plays a crucial role in sending real-time notifications about both bird and intruder detections.

The hardware integration includes components such as the Arduino MC, PIR sensor, GSM module, relay, buzzer, and power circuit, ensuring seamless functionality. Each component is connected and synchronized to maintain efficiency and responsiveness. Once testing is completed, the system is deployed in the target area, where cameras capture images continuously, PIR sensors monitor movement, and users can access real time updates via the IoT webpage. Regular maintenance and updates are carried out to improve bird detection accuracy, calibrate sensors, and upgrade the IoT interface for better user experience. This structured methodology ensures that the Bird Detector System functions effectively in detecting birds, deterring them using sound, and alerting users about unauthorized human entry, thereby achieving both wildlife management and security monitoring.

IV. ARCHITECTURE DESIGN

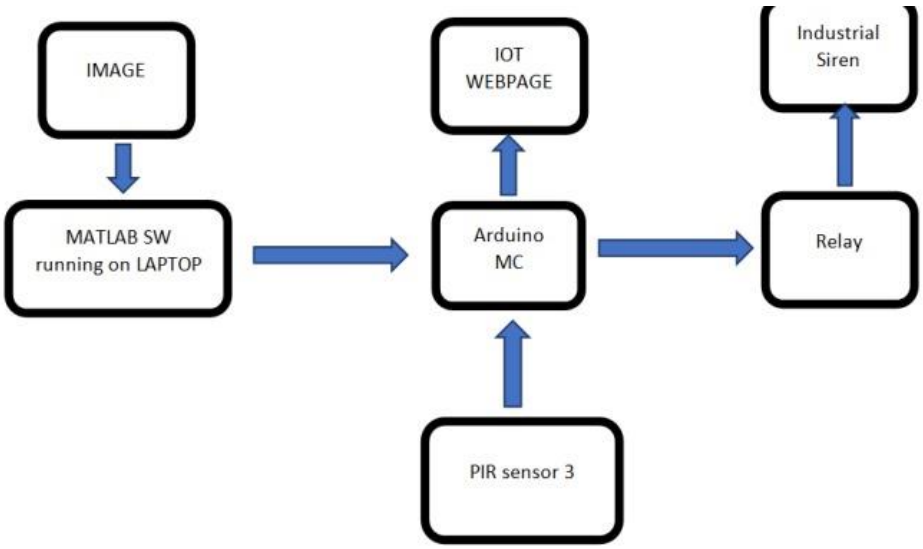

Fig.2 Flowchart of the System design

a) Image Processing for Bird Detection

- Train an image processing model in MATLAB using images of various birds.
- Capture live images using the Camera Module.
- Process these images using MATLAB image recognition algorithms.
- If a bird is detected, send a signal to Arduino via serial communication.

b) Activating the Buzzer to Scare Birds

- Once the Arduino receives the detection signal, it triggers the relay module.
- The relay activates a buzzer, producing a loud noise to scare birds away.

c) Intruder Detection Using PIR Sensor

- APIR sensor is placed at the entrance of the farm.
- It detects any unauthorized motion within its range.
- If movement is detected, the sensor sends a signal to the Arduino.

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d) Sending Alerts via IoT Webpage

• If an intruder is detected, Arduino sends a notification via the GSM module.
• The alert is displayed on an IoT Webpage, notifying the farmer.
• The webpage is developed using HTML and embedded C

V. RESULTS AND DISCUSSION

Test Case	Input	Expected Output	Result
Bird Detection	Image of a bird	"Bird Detected" alert	Passed
Non-Bird Object Detection	Image of non-bird objects	"No Bird"	Passed
PIR Sensor Motion Detection	Simulated human motion	Intruder Alert via IoT webpage	Passed
Hardware Integration	Full system test	Alerts and deterrence mechanism	Passed

Fig.3 testing of GoogleNet model

Snapshots:

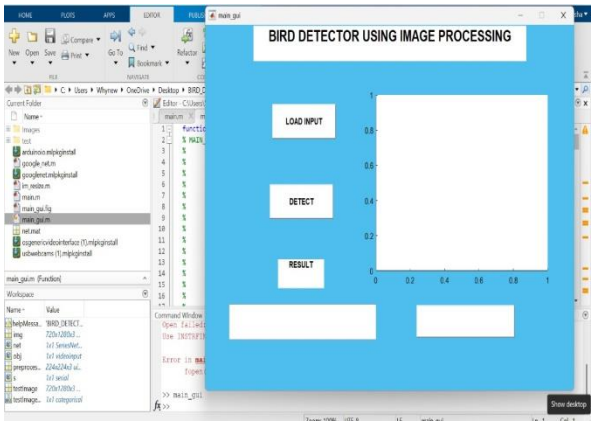

Fig.4 image uploading web page

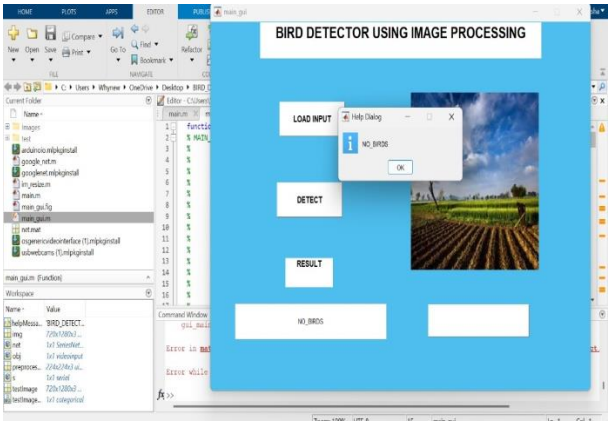

Fig. 5. Result if birds are not present

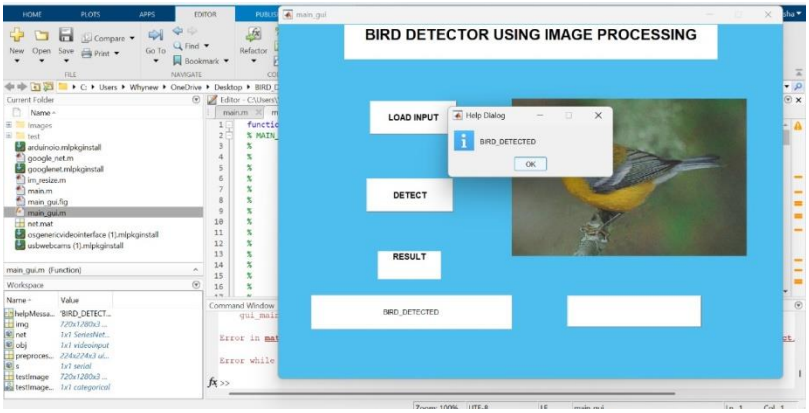

Fig.6. Result if bird is detected

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The Testing and Results section evaluates the performance, accuracy, and functionality of the bird detection and repellent system. For this project, the system was tested under real-time conditions to assess its ability to accurately detect birds and trigger appropriate actions, such as activating the buzzer and sending alerts. The testing involved capturing images using the camera module, processing these images in MATLAB with the fine tuned GoogleNet CNN model, and transmitting the classification results to the Arduino microcontroller.

VI. CONCLUSION

An innovative bird detection and repellent system that utilizes CNN algorithms to identify birds and emit specific frequency-based sounds to deter them. The system aims to provide an efficient, non-harmful, and automated solution to prevent birds from damaging crops, infrastructure, or other sensitive areas. The use of machine learning enhances detection accuracy, while frequency-based sound repellers offer an eco-friendly alternative to traditional bird control methods.

The results indicate that the proposed method is effective in recognizing birds and success fully repelling them without causing harm. Future improvements could include refining the detection model, optimizing frequency selection, and expanding the system's adapt ability to different environments. Overall, it contributes to the development of intelligent and humane bird control technologies

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