IOT and AI-Based Smart Crop Protection System for Real-Time Animals and Birds Detection

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Abstract — Agriculture is an important source of income in India, but farmers often suffer crop losses due to attacks by animals, insects, and birds. Animals such as buffaloes, cows, goats, birds, insects, and wild elephants enter farm fields in search of food and water, causing serious financial loss. It is difficult for farmers to watch their fields all the time. To solve this problem, this paper presents a smart and automatic system to detect animals, insects, and birds in agricultural fields. The system uses Infrared (IR) and ultrasonic sensors to detect movement near the farmland. When an intruder is detected, a controller turns on a sound system to safely scare the animals away and also sends alert messages to farmers through a GSM module. In addition, an IoT- and AI-based method using the Mobile Net model is included to improve early and accurate detection. The system works continuously to provide real-time monitoring and early warnings, helping to reduce crop damage and improve agricultural productivity in an eco-friendly manner.

Keywords— Smart Agriculture, IoT, Birds and Animal Detectio,n, Mobile Net, Crop Protection, GSM

I. INTRODUCTION

Agriculture is very important for the Indian economy and provides jobs to many people. However, farmers often face problems in protecting their crops from animals, insects, and birds. These animals and birds enter farm fields in search of food and water and cause serious damage to crops, leading to financial losses. Traditional methods such as fencing, manual watching, and scare devices are commonly used, but they are not very effective. These methods also require a lot of time, effort, and money. In addition, farmers cannot stay in their fields all the time, especially at night.

With the development of Internet of Things (IoT) and Artificial Intelligence (AI), smart farming systems have become helpful in solving these problems. Sensor-based systems along with intelligent detection methods can monitor fields continuously and give early warnings. This paper proposes a smart system to detect animals, insects, and birds using sensors, GSM alerts, and AI-based techniques. The system helps protect crops without harming animals and improves safety and productivity in agriculture.

II. LITERATURE REVIEW

Many researchers have proposed different methods to protect agricultural fields from animals, birds, and insects. Traditional techniques such as electric fencing and manual field monitoring have been widely used; however, these methods are expensive to maintain and may pose risks to both animals and humans [2], [3]. Some studies have also implemented scarecrows and sound-based systems to repel animals and birds, but their effectiveness decreases over long-term usage [3].

In recent years, IoT-based crop protection systems using sensors such as PIR, IR, and ultrasonic sensors have gained significant attention for detecting movement in agricultural fields and sending real-time alerts to farmers [2]. However, these systems are generally limited to motion detection and cannot accurately identify the specific type of animal, bird, or insect entering the field. To overcome this limitation, camera-based systems integrated with image processing and machine learning techniques have been introduced to improve detection accuracy [1].

Recent studies on real-time insect detection for precision agriculture highlight the importance of early pest identification to reduce crop loss and support ecological monitoring [4]. Advanced IoT and AI-driven systems such as the Smart Pest Guardian further enhance pest detection by combining sensor networks with deep learning models for accurate insect classification and timely alerts [5]. Lightweight deep learning models like Mobile Net are well suited for such applications due to their low computational requirements and energy efficiency. Integrating Mobile Net-based vision systems with IoT architectures provides a cost-effective, scalable, and reliable solution for comprehensive crop protection against animals, birds, and insects [1], [2], [4], [5].

III. PROPOSED SYSTEM

This project is used to protect crops from birds, animals, and insects using AI and IoT technology. An Arduino board is used as the main controller of the system. Sensors and a camera are placed in the farm to monitor the crop area.

When movement is detected, the camera captures images of the field. These images are improved using image normalization so that objects can be seen clearly. The images are then processed using a Mobile Net model to identify birds, animals, or insects. Mobile Net is a lightweight AI model, so it works fast and uses less power.

For detection, a dataset of birds, animals, and insects is created. The images are labelled and trained using the Mobile Net model. After training, the system is tested to check the accuracy of detection.

If birds or animals are detected, the Arduino turns on a sound device to scare them away safely. At the same time, a GSM module sends an alert message if the quantity of animals or birds is huge, to the farmer's mobile phone.

The system works automatically and requires less human effort. It is simple, low cost, and helpful for farmers in protecting crops from damage.
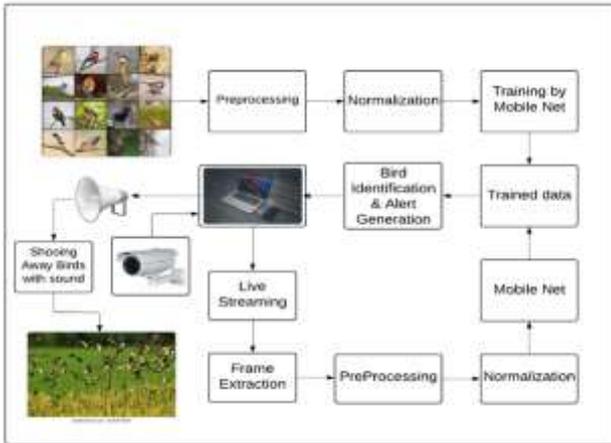

Fig. Architecture Diagram

IV. IMPLEMENTATION

1. Controller:
   The Arduino board is the main controller of the system. It receives signals from the camera and sensors and controls the sound device and GSM module.
2. Sensors and Camera:
   IR sensors and motion sensors detect the movement of birds, animals, or insects near the crops. A camera continuously captures live images of the farm. These images are sent for AI detection.
3. AI Detection (MobileNet):
   Captured images are processed and normalized for clarity. Mobile Net AI model is used to identify birds, animals, and insects. The model is trained with a dataset of images to recognize intruders accurately.
4. Image Preprocessing:
   Images are resized, normalized, and converted into the format suitable for the AI model. This ensures faster and more accurate detection.
5. Decision Making and Automatic Action:
   Arduino applies if-then rules after receiving processed data. When intruders are detected: The sound device produces loud noise to scare them   away safely. The GSM module sends a message or call to the farmer.
6. Power and Operation:
   The system works on a regulated DC power supply. Fully automatic, runs continuously, and safe for animals.
7. Outcome:
   Protects crops effectively from birds, animals, and insects. Reduces the farmer's effort and allows remote monitoring. Low-cost, simple, and increases farm productivity.

V. ALGORITHM

a. Start the system.
b. Initialize the Arduino controller, camera, sensors, AI model, sound device, and GSM module.
c. Camera captures live images of the crop field continuously.
d. Sensors (IR/motion) detect movement near the crops.
e. Captured images are preprocessed (resize and normalize).
f. The AI model (MobileNet) analyzes the images.
g. Check whether a bird, animal, or insect is detected.
h. If intruder is detected:
i. Turn ON the sound device to scare it away safely.
j. Send an alert message or call to the farmer using GSM.
k. If no intruder is detected:

l. Continue monitoring the field.
m. Repeat the process continuously for crop protection.
n. Stop the system (only when power is turned off).

VI. HARDWARE & SOFTWARE ARCHITECTURE

The project requires a Core i5/i7processor, 8 GB RAM, 500 GB hard disk, and a 48 MP camera for proper working of the system. These hardware components help in smooth processing and clear image capture.

For software, the project uses Java and Python programming languages. JDK 1.8 and Python 3.8 are used for development. The front end is created using Java Swing, and the project is developed using NetBeans 8.2 and Spyder 3.8.

VII. APPLICATION WITH REAL-LIFE EXAMPLE

a. Protection of Farm Crops
   This system helps farmers protect crops from birds, animals, and insects.
   Example: In a vegetable farm, when birds enter the field, the system detects them and scares them away using sound.
b. Use in Forest Border Areas
   The system is very useful for farms located near forests where wild animals enter fields.
   Example: If animals like deer or monkeys come near the crops, the farmer gets an alert on the mobile phone.
c. Automatic Night Monitoring
   The system works automatically during day and night.
   Example: At night, when animals come into the field, the system detects them and activates the sound device without human help.
d. Remote Farm Watching
   Farmers can know what is happening in their fields from any location.
   Example: A farmer staying at home receives a message when intruders are detected in the farm.

e. Safe and Eco-Friendly Farming
This system protects crops without harming animals or the environment.
Example: Instead of using harmful chemicals, sound alerts are used to protect crops safely.

VIII. FUTURE SCOPE

The IoT and AI-based smart crop protection system can be further enhanced for higher accuracy in detecting animals and birds under diverse environmental conditions. Advanced predictive analytics can enable proactive measures, while integration with drones and autonomous devices can provide wide-area, real-time protection with minimal human intervention. Cloud-based data sharing and AI-driven decision-making may transform this system into a fully automated smart farming solution, improving crop yield, reducing losses, and promoting sustainable agriculture.

IX. RESULTS AND DISCUSSION

The system was tested in the farm. The sensors and camera detected birds, animals, and insects correctly. When any intruder was found, the speaker made sound to scare them away, and the GSM module sent a message or call to the farmer. The AI model (Mobile Net) correctly found birds, animals, and insects from the images. The system worked on its own all the time and kept the crops safe. It helped the farmer save crops, do less work, and watch the field from anywhere.

X. CONCLUSION

Farmers face a lot of crop loss due to birds, animals, and insects. In this project, an AI and IoT based system is developed to protect crops in an easy and smart way. Sensors and a camera are used to watch the field and detect unwanted movement.

When birds, animals, or insects are detected, the controller turns on sound or alert devices to scare them away safely. At the same time, the farmer receives a message through the GSM module, so the field can be monitored from anywhere.

The system works automatically and does not harm living beings. It is low cost, easy to use, and useful for farmers. This project helps in reducing crop damage and improving farm productivity.

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