Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection

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Abstract—*A smart eco-friendly peacock deterrent system for sustainable crop protection is developed to prevent crop damage in rural agricultural fields without harming birds or disturbing biodiversity. The system operates using a solar power supply with battery backup, ensuring continuous performance without dependence on grid electricity, making it suitable for remote farm locations. An audio deterrent module generates specific sound patterns to discourage peacock intrusion, while a visual deterrent mechanism employs a rotating light mounted on a free- rotating structure to create continuous visual disturbance. The combined use of sound and visual stimuli enhances deterrence effectiveness while maintaining environmental safety. By utilizing renewable energy, the proposed system reduces operational costs, minimizes maintenance efforts, decreases the need for manual field guarding and promotes long-term sustainable farming practices.*

Index Terms— Solar-Powered System, Crop Protection, Peacock Deterrent, Audio-Visual Repellent, Sustainable Agriculture, Renewable Energy

I. INTRODUCTION

The Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection is developed to prevent crop damage caused by peacock intrusion in rural agricultural fields. Traditional methods such as manual guarding and firecrackers are temporary and may disturb the environment. The proposed system uses a hybrid deterrent approach combining sound and visual stimuli to safely discourage birds without harming them.

The audio module consists of a Class-D amplifier connected to two speakers, generating specific sound patterns to repel peacocks efficiently with low power consumption. A high-intensity projector lamp is mounted on a ventilator drum that rotates freely using wind, creating continuous visual disturbance. The

system is controlled by a microcontroller with wireless transmitter and receiver communication to automatically trigger a relay for light activation.

Fig.1: Illustration of Peacock Intrusion in Agricultural Fields Showing Crop Damage and Feeding Activity Affecting Yield and Farmer Productivity.

Powered by a solar panel with battery backup, the system ensures reliable operation in remote areas, promoting sustainable, cost-effective and eco-friendly crop protection.

II. LITERATURE REVIEW

Kumar et al. discussed that bird intrusion in agricultural fields significantly reduces crop yield and farmer income. Their study explains various traditional bird control methods such as scarecrows, reflective tapes and manual guarding. However, they reported that these techniques are temporary and lose effectiveness over time as birds adapt to static deterrents. The study emphasizes the need for dynamic and automated deterrent systems.

Ramesh et al. presented research on audio-based bird repellent systems using distress calls and predator

sounds. Their findings indicate that sound frequency variation and irregular playback patterns improve repellent efficiency. However, continuous operation without power optimization was identified as a limitation in rural environments.

Singh et al. examined solar-powered agricultural protection systems and highlighted that renewable energy-based solutions are highly suitable for remote farm locations. Their work demonstrates that integrating battery backup ensures uninterrupted performance during low sunlight conditions, improving reliability.

Patel et al. reviewed visual deterrent techniques including flashing lights, rotating reflectors and moving mechanical structures. The study concluded that moving visual stimuli are more effective than stationary devices, as motion creates a stronger disturbance effect for birds.

Sharma et al. explored wireless sensor and microcontroller-based automation in agricultural monitoring systems. Their research explains that transmitter-receiver communication improves system responsiveness and reduces manual intervention in field operations.

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Mehta et al. investigated hybrid pest control systems combining multiple deterrent techniques. Their analysis shows that integrating sound and visual mechanisms increases overall effectiveness compared to single-method approaches, especially in open agricultural environments.

III. DESCRIPTION OF EXISTING SYSTEM

For generations, farmers have faced serious challenges in protecting crops from wildlife intrusion, particularly peacocks. Although peacocks are culturally valued and protected in many regions, they cause significant damage to grains, pulses, vegetables and young seedlings. To reduce crop loss, farmers traditionally rely on manual and physical deterrent methods, which are simple but have several practical limitations.

One of the most commonly used methods is manual sound generation. Farmers create loud noises using metal plates, tins, drums, or other objects to scare peacocks away when they enter the field. Some farmers shout, clap, or use whistles to produce sudden startling sounds. While this method is low-cost and easy to implement, it requires constant human presence. Over time, peacocks may become habituated to repeated noise, reducing its long-term effectiveness.

Firecrackers and explosive sound devices are also used during peak crop seasons. These produce loud, sudden noises that temporarily drive birds away. However, this approach is not environmentally friendly and may disturb nearby residents and wildlife. Additionally, firecrackers pose fire hazards, especially in dry agricultural regions.

Fig.2: Existing Traditional Methods for Peacock Deterrence Including Manual Noise Generation, Rope Fencing, Electric Fencing and Firecracker-Based Scare Techniques Used in Agricultural Fields

Some farmers install low-voltage electric fencing around their fields to prevent bird entry. Although the mild electric shock discourages animals from crossing boundaries, this method involves high installation and maintenance costs. It may also pose risks to farm workers and other animals. Moreover, since peacocks are strong fliers, they can easily bypass fences by flying over them.

Physical barriers such as rope fencing and net enclosures are also commonly used. These act as physical obstacles to restrict movement into cultivated areas. However, rope fences are largely ineffective because peacocks can fly over them. Net fencing requires frequent maintenance and damage or gaps in the nets allow easy entry.

IV. CHALLENGES IN EXISTING SYSTEM

Existing peacock deterrent methods used in agricultural fields face several operational and practical limitations. Manual noise-based methods such as beating metal plates, drums, or shouting require continuous human presence in the field. Their effectiveness depends entirely on timely intervention by farmers. Over time, peacocks may become habituated to repeated sounds, reducing the long-term reliability of such scare techniques.

Firecracker-based deterrence provides temporary relief but introduces safety and environmental concerns. The explosive sound may disturb nearby residents and wildlife and there is a potential risk of fire hazards, particularly in dry crop conditions. This method is not sustainable for regular agricultural use.

Physical barriers such as rope fencing and net enclosures offer limited protection. Since peacocks are strong fliers, they can easily bypass low-height fences by flying over them. Net fencing requires frequent maintenance and damage or gaps allow easy intrusion.

Fig.3: Challenges in Existing Peacock Deterrent Methods Including Manual Guarding, Fence Bypassing, Fire Hazard Risks and High Labor Dependency in Agricultural Fields

Low-voltage electric fencing involves higher installation and maintenance costs, making it less affordable for small-scale farmers. It may also pose risks to farm workers and non-target animals.
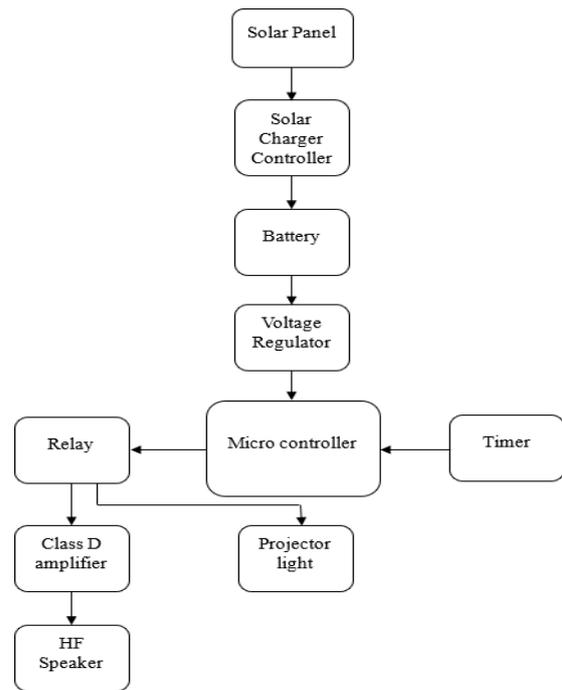
V. BLOCK DIAGRAM

Fig.4: Block Diagram of the Proposed System
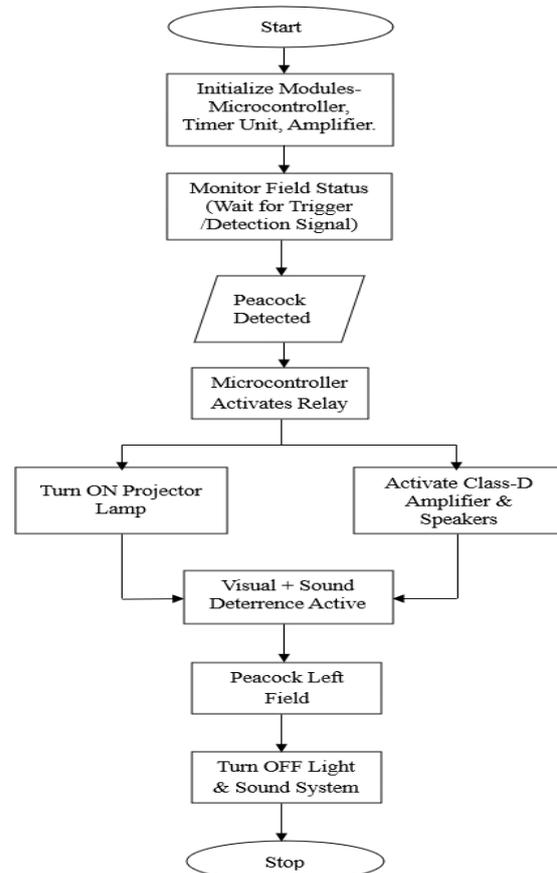
VI. FLOW CHART

Fig.5: Flow Chart of the Proposed System

VII. HARDWARE IMPLEMENTATION

a. Microcontroller Unit: Acts as the main control unit to process signals and control the relay, sound and lighting system.
b. Solar Panel: Generates renewable energy to power the system in agricultural fields without grid dependency.
c. Solar Charge Controller: Regulates charging of the battery and protects it from overcharging and deep discharge..
d. 12V Battery: Provides backup power to ensure continuous operation during night and low sunlight conditions..
e. Voltage Regulator (5V/12V): Supplies stable and regulated voltage to the microcontroller, RF modules, amplifier and relay.
f. Transmitter and Receiver Modules: Enable wireless communication for triggering the deterrent system automatically.
g. Relay Module (5V): Provides isolated switching to safely control the projector lamp.
h. Class-D Amplifier Module: Efficiently amplifies audio signals with low power loss for field operation.
i. Speakers (2 Units): Produce high-intensity sound patterns to repel peacocks effectively.
j. Projector Lamp: Generates bright light to create visual disturbance.
k. Ventilator Drum Mechanism: Allows wind-driven free rotation of the lamp for continuous dynamic light movement.

VIII. WORKING OF PROPOSED SYSTEM

The working of the proposed Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection is based on hybrid sound and visual deterrence with automated control and solar-powered operation. When the system is powered, the solar panel charges the 12V battery through the solar charge controller. The regulated DC supply energizes the microcontroller, RF communication modules, Class-D amplifier and relay circuit.

Once initialized, the microcontroller continuously monitors for the activation signal through the RF receiver module. When peacock intrusion is detected, the transmitter sends a signal to the receiver unit. Upon receiving this signal, the microcontroller processes the input and generates a control output to the 5V relay module.

The relay activates the high-intensity projector lamp, which is mounted on a ventilator drum mechanism. The ventilator rotates freely using wind energy, creating continuous dynamic light movement across the field. Simultaneously, the microcontroller enables the Class-D amplifier, which drives two speakers to generate specific sound patterns that disturb and repel peacocks.

The combined effect of moving light and deterrent sound enhances effectiveness without harming birds. When no intrusion signal is present, the controller deactivates the relay and amplifier, returning the system to monitoring mode. This ensures energy-efficient, automated and sustainable crop protection.

IX. OPERATION OF PROPOSED SYSTEM

The operation of the proposed Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection follows a controlled sequence from power generation to deterrent activation. Initially, the solar panel converts sunlight into electrical energy and charges the 12V battery through the solar charge controller. The regulated DC supply powers the microcontroller, RF communication modules, Class-D amplifier and relay interface. The system initializes and enters monitoring mode.

The microcontroller continuously monitors for an intrusion trigger signal through the RF receiver module. When peacock movement is detected, the transmitter sends a wireless signal to the receiver unit. The received signal is processed by the controller, which compares it with the programmed activation logic and generates an output to the relay driver circuit. Once triggered, the relay connects the power supply to the projector lamp.

The lamp, mounted on a wind-driven ventilator drum, begins producing dynamic rotating light disturbance across the field. Simultaneously, the controller activates the Class-D amplifier, which drives two speakers to emit specific deterrent sound patterns.

The combined audio and visual stimuli create an effective non-harmful repellent effect. When no intrusion signal is present, the controller deactivates the relay and amplifier, returning the system to standby mode. This controlled ON–OFF operation ensures energy-efficient, automated and sustainable

crop protection.

X. RESULTS AND DISCUSSIONS

The developed Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection demonstrated stable and reliable performance under field conditions. The integrated solar-powered architecture ensured uninterrupted operation during both daytime and low-light conditions using battery backup. The microcontroller-based control unit successfully coordinated the wireless communication, relay switching, sound generation and lighting activation stages.

Fig.6: Developed Hybrid Solar-Powered Audio-Visual Peacock Deterrent System for Sustainable Crop Protection

The RF transmitter and receiver modules provided consistent signal transmission and reception within the required operating range. The relay-controlled switching mechanism operated effectively, ensuring proper isolation between the low-power control circuit and the high-power projector lamp section. The voltage regulation stage maintained stable DC supply to all modules, preventing fluctuations during operation.

The Class-D amplifier delivered efficient audio output with minimal power loss and the dual-speaker arrangement generated sufficient sound intensity to repel peacocks from the protected area. The projector lamp mounted on the wind-driven ventilator drum produced continuous dynamic light disturbance without additional mechanical power consumption. The rotating light pattern increased deterrent effectiveness compared to static lighting methods.

Fig.7: Working Model of the Proposed Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection

The combined audio-visual deterrent approach showed better performance than traditional manual noise-making, rope fencing, or firecracker methods. The automated activation reduced the need for constant human supervision and minimized labor dependency.

Overall, the system validated coordinated operation of power generation, wireless communication, control logic and hybrid deterrent mechanisms. The results confirm that the proposed system offers an energy-efficient, environmentally safe and sustainable solution for long-term crop protection in rural agricultural environments.

XI. CONCLUSIONS

The proposed Smart Eco-Friendly Peacock Deterrent System for Sustainable Crop Protection has been successfully designed and implemented to address crop damage caused by peacock intrusion in agricultural fields. The system replaces traditional manual and hazardous deterrent methods with a hybrid, automated and environmentally safe approach. By integrating solar power with battery backup, the system ensures reliable operation in remote farm locations without dependence on grid electricity.

The microcontroller-based control unit, along with wireless transmitter and receiver modules, enables automated activation of the deterrent mechanism. The Class-D amplifier and dual-speaker arrangement generate effective sound patterns, while the wind-

driven rotating projector lamp provides dynamic visual disturbance. The combined audio- visual strategy enhances deterrence efficiency without harming birds or disturbing ecological balance.

The coordinated operation of power generation, control logic, wireless communication and hybrid deterrent modules confirms the system's functional reliability and energy efficiency. Overall, the developed system offers a sustainable, low maintenance and cost-effective solution for long term crop protection. Further large-scale field testing can support performance optimization under diverse agricultural conditions.

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