DUAL MODE ROTATING LIGHT AND SPEAKER ANIMAL REPELLENT SYSTEM

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Abstract

Farmers worry about birds and animals eating their crops. Wildlife can eat crops which cuts down farm yields.Old ways to guard farms sometimes fail.A new approach: lights move while sound builds.One motor spins a beam; another plays loud noise. Something catches the eye when the light pivots round.A startling beep drives pests off. Hardly any remain nearby afterward.No creatures get hurt even though they stay out.People do not need to stand watch all day now.Simple equipment handles a big farm task.A low-cost way works well at keeping pests off fields.

Keywords :-Crop Protection,Animal Detection,Sound Waves,Modern Farming.

1. Introduction- Agriculture plays a significant role in economic development and food security. However, crop damage caused by wild animals and birds remains a major challenge for farmers, particularly in agricultural areas located near forests and natural habitats. The entry of animals into cultivated fields can result in substantial agricultural losses, reduced productivity, and increased financial difficulties for farmers. Therefore, developing affordable and effective crop-protection technologies is an important area of research.

Traditional animal-repellent methods often involve manual monitoring, physical barriers, and conventional deterrent devices. Although these approaches can provide some protection, they may require continuous human involvement, regular maintenance, and additional operational costs. These limitations create a need for alternative electronic solutions that combine simple hardware components with practical deterrent techniques.

This research proposes a **Dual-Mode Rotating Light and Speaker-Based Animal Repellent System** designed to discourage animals from entering agricultural fields through visual and acoustic stimuli. The proposed system integrates a rotating light mechanism and a speaker-based sound unit to provide two complementary deterrent modes. The rotating light generates intermittent visual stimuli, while the speaker produces selected sound signals intended to discourage animal presence.

The dual-mode approach aims to provide flexibility in agricultural crop protection by combining two different deterrent techniques within a single system. The proposed design focuses on simplicity, affordability, ease of operation, and potential suitability for small-scale agricultural applications.

The system is intended to offer an alternative approach to conventional crop-protection practices. Its practical effectiveness will depend on factors such as animal species, environmental conditions, sound characteristics, light intensity, installation location, and repeated exposure. Therefore, experimental evaluation is necessary to determine its effectiveness under real agricultural conditions.

Overall, this research explores the application of electronic systems in agriculture and presents a potential technology-based approach to reducing animal-related crop damage.

Several studies have explored **sound-based animal-repellent systems** that use speakers to produce different types of sounds to discourage animals from entering agricultural areas. These systems offer an electronic alternative to traditional methods. However, their performance may vary depending on animal species, sound frequency, environmental conditions, and repeated exposure.

Researchers have also investigated **light-based deterrent techniques** using flashing lights, LED indicators, and rotating light mechanisms. These visual signals are intended to create disturbances that may discourage animals from approaching crop fields, particularly during nighttime. The effectiveness of these techniques depends on light intensity, visibility, distance, and surrounding environmental conditions.

Recent developments in electronic and embedded systems have made it possible to integrate multiple functions into a single device. Microcontrollers, electronic circuits, speakers, and lighting components can be combined to develop automated agricultural protection systems. Such technologies can reduce manual monitoring and provide flexible operation.

The proposed **Dual-Mode Rotating Light and Speaker Animal Repellent System** combines visual and acoustic deterrent techniques in a single electronic system. Unlike systems that use only light or sound, the proposed design provides two operating modes. The rotating light produces visual signals, while the speaker generates selected sound signals to discourage animal presence.

The proposed system focuses on developing a simple, affordable, and user-friendly solution for agricultural crop protection. Further experimental studies are required to evaluate its performance, reliability, power consumption, and effectiveness for different animal species and environmental conditions.

2. Literature review

Agricultural crop damage caused by wild animals and birds is a major challenge for farmers. Various researchers have studied different techniques to protect agricultural fields from unwanted animal interference. Traditional methods such as scarecrows, fencing, firecrackers, and manual monitoring are commonly used. However, these methods have limitations, including continuous human involvement, maintenance requirements, and reduced effectiveness over time.

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3. Methodology -The proposed **Dual-Mode Rotating Light and Speaker-Based Animal Repellent System** is designed to reduce crop damage caused by unwanted animal interference in agricultural fields. The system uses two different deterrent techniques: visual signals through a rotating light and acoustic signals through a speaker. The methodology involves hardware integration, system design, mode selection, and operational testing.

3.1 System Design

The system consists of electronic components such as a power supply, control circuit, rotating light, speaker, and switching mechanism. These components are integrated to provide two operating modes. The overall design focuses on simplicity, low cost, and ease of installation in agricultural areas.

3.2 Hardware Implementation

The hardware components are connected according to the proposed circuit design. The power supply provides the required electrical energy to the system. The control circuit manages the operation of the rotating light and speaker. The switching mechanism allows the user to select the required operating mode.

3.3 Working Principle

The system operates in two modes:

Mode 1: Rotating Light Mode

In this mode, the rotating light is activated to generate visible light signals around the protected area. These visual signals are intended to create disturbances that may discourage animals from approaching the agricultural field, especially during nighttime.

Mode 2: Speaker Mode

In this mode, the speaker is activated to produce selected sound signals. These acoustic signals are intended to discourage animals from entering the protected agricultural area.

3.4 System Operation

The user can select either rotating light mode or speaker mode using the switching mechanism. Based on the selected mode, the corresponding output device is activated. The system is designed to provide simple and convenient operation without requiring continuous manual monitoring.

3.5 Testing and Evaluation

The developed prototype is tested under controlled conditions to verify the operation of both modes. The rotating light is checked for proper rotation and illumination, while the speaker is tested for sound output. The system's power consumption, operating

stability, and reliability are also considered during testing.

3.6 Performance Analysis

The performance of the proposed system can be evaluated based on the following parameters:

1. Proper functioning of rotating light.
2. Speaker sound output and clarity.
3. Power consumption.
4. Operating time and reliability.
5. Ease of installation and operation.
6. Observed animal response during field testing.

3.7 Overall Methodology Flowchart

Start : **Power Supply ON**

Mode Selection

Mode 1

Rotating Light

Light Activation

Mode 2

Speaker

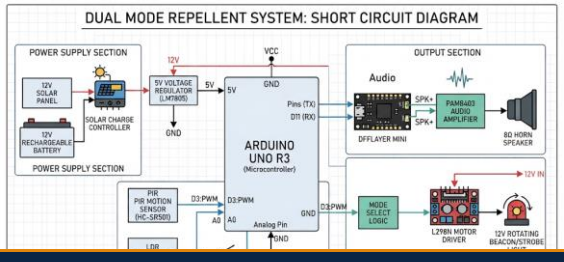
Sound Activation

System Testing and Evaluation

END

Methodology Outcome: The methodology provides a structured approach for developing and testing a dual-mode electronic animal-repellent prototype using rotating light and speaker-based sound signals.

4. Circuit Diagram



5. Component Details

1. Main Processing Unit

- **Arduino Uno R3 (Microcontroller)**
  - **Role:** Serves as the central brain. It reads inputs from the PIR, LDR, and toggle switch, handles mode logic, triggers the audio playback, and outputs control signals to the motor driver.
  - **Key Specifications:**
    - Operating Voltage: 5V (Input Voltage: 7–12V via Vin)
    - Microcontroller: ATmega328P
    - Digital I/O Pins: 14 (6 PWM outputs)
    - Analog Input Pins: 6

2. Power Supply Section

- **12V Rechargeable Battery (Lead-Acid or Li-ion)**
  - **Role:** Main energy reservoir powering the 12V high-intensity lights, audio amplifier, and stepping down to 5V for logic electronics.
  - **Capacity:** 12V 7Ah – 12Ah recommended for continuous overnight operation.
- **12V Solar Panel (10W – 20W)**
  - **Role:** Charges the battery during daylight hours to ensure off-grid, self-sustained performance in farmlands.
- **12V Solar Charge Controller (10A PWM / MPPT)**
  - **Role:** Regulates voltage and current from the solar panel to prevent overcharging or deep discharging of the battery.
- **5V Voltage Regulator (LM7805 or DC-DC Buck Converter)**
  - **Role:** Steps down 12V from the battery to a steady 5V DC supply for the Arduino Uno, sensors, and low-power ICs.

3. Sensing & Input Section

- **PIR Motion Sensor (HC-SR501)**
  - **Role:** Detects warm-body infrared motion from intruding animals (e.g., wild boars, deer, stray dogs).

- **Detection Range:** Up to 7 meters across a 110° cone.
- **Operating Voltage:** 4.5V – 20V (Outputs 3.3V High logic when motion is detected).

- **LDR (Light Dependent Resistor / Photoresistor)**
  - **Role:** Monitors ambient light intensity to differentiate between day and night, allowing auto-activation of strobe lights only during darkness.
  - **Setup:** Configured in a voltage divider circuit using a 10kΩ resistor, connected to Analog Pin A0.
- **Mode Selection Switch (SPST Toggle Switch)**
  - **Role:** Allows manual toggling between **Mode 1** (Sensor Triggered / Motion Activated) and **Mode 2** (Continuous Sweep / Periodic Interval Deterrence).

4. Visual Output & Rotational Unit

- **L298N Dual H-Bridge Motor Driver / Relay Module**
  - **Role:** Interfacing module that uses low-power Arduino signals (5V PWM) to drive the high-current 12V DC motor and 12V high-intensity strobe light safely.
  - **Max Current:** 2A per channel.
- **12V DC Gear Motor / Servo Motor (MG996R / High-Torque)**
  - **Role:** Provides 360-degree rotational sweeping for the light beacon, covering the full surrounding perimeter.
- **High-Intensity 12V LED Strobe Beacon Light**
  - **Role:** Produces rapid, multi-colored (red/blue/white) flashes to disorient pests and simulate human presence or danger.

5. Acoustic Output Unit

- **DFPlayer Mini MP3 Audio Module**
  - **Role:** Reads pre-recorded audio files stored on a microSD card (e.g., ultrasonic frequencies, predator roars, barking, sirens, gunshots) and streams them upon microcontroller command.
  - **Communication:** UART Serial interface connected via SoftwareSerial (Pins 10 & 11) with a 1kΩ resistor on the RX line.
- **Audio Power Amplifier Module (PAM8403 / TDA2030)**
  - **Role:** Boosts the line-level audio signal output from the DFPlayer to drive high-wattage speakers loud enough to cover large crop fields.
  - **Power Rating:** 3W (PAM8403, 5V) to 15W–30W (TDA2030 / TDA7297, 12V).
- **8Ω Outdoor Horn Speaker / Ultrasonic Piezo Tweeter**
  - **Role:** Broadcasts high-decibel audible deterrence sounds and ultrasonic frequency sweeps (15 kHz–40 kHz) across long distances

Here is the comprehensive breakdown of all the electronic and hardware components required to build the **Dual-Mode Rotating Light and Speaker Animal Repellent System**, including their specifications, functions, and key features:

6. Result



7. Feature Scope

Core Functional Features

- **360-Degree Visual Deterrence:** Integrated rotating beacon with high-intensity LEDs (red/blue) to disorient intruding wildlife across a complete perimeter.
- **Multi-Sound Acoustic Repellent:** Plays randomized predator calls, sirens, gunshots, and high-frequency/ultrasonic sweeps (15 kHz–40 kHz) to prevent animals from getting habituated to a single sound pattern.
- **Dual Operational Modes:**
    - **PIR Sensor Mode (Intelligent Activation):** Triggers light and sound only when warm-body motion is detected within range, saving battery.
    - **Continuous Sweep Mode:** Runs scheduled lighting and periodic sound bursts at set intervals during peak risk hours (midnight to early morning).
- **Automatic Day/Night Switching:** LDR (Light Dependent Resistor) module automatically disables high-intensity lights during daylight and activates night-only visual modes.
- **Off-Grid Solar Power System:** Integrated solar panel with a 12V rechargeable battery and charge controller for continuous, self-sustained field deployment.

In-Scope vs. Out-of-Scope

In-Scope (Implemented Features)

- PIR motion detection up to 7 meters.
- Manual mode selection toggle (Sensor vs. Continuous Sweep).
- Custom sound loading via microSD card on the audio module.
- Weatherproof enclosure for outdoor deployment.
- Non-lethal and eco-friendly wildlife disruption.

Out-of-Scope (Future Enhancements)

- **AI Camera Vision / Object Classification:** Species-specific recognition (e.g., distinguishing between a farm animal and a wild boar).
- **IoT / Cellular Alerts:** SMS or app notifications sent to the farmer's mobile phone upon intrusion.
- **Thermal Imaging:** Long-range night thermal detection.
- **Centralized Mesh Network:** Multi-device synchronization across large multi-acre farmlands.

8.Conclusion : Key Takeaways

- **Energy Efficiency:** The dual-mode operational design (PIR sensor-triggered vs. continuous sweep) paired with an LDR day/night sensor optimizes power consumption, running high-draw visual components only when necessary.
- **Off-Grid Reliability:** Solar charging paired with a 12V battery system allows continuous, self-sustained operation in remote agricultural fields without needing grid power.
- **Cost-Effective Build:** Built using standard, widely available electronic components (Arduino, PIR sensor, DFPlayer, L298N driver), the system is simple to assemble, maintain, and adapt for various field sizes.

By bridging simple automation with multi-frequency sensory disruption, this system offers small to large-scale farmers an accessible and reliable line of defense against crop damage.

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