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Design and Fabrication of Avian Ultrasonic Deterrent System

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ABSTRACT

This project introduces an Avian Ultrasonic Deterrent System designed for farms to effectively monitor and mitigate bird and pest activities. While birds and pests play a crucial role in fertilization, their presence can lead to significant crop damage and subsequent economic losses. Conventional deterrent systems have proven inadequate in addressing this issue. To overcome these limitations, we propose a novel solar-powered mobile system equipped with motion detection, ultrasonic technology for pest control, human-like motion simulation, and alarming sounds. Additionally, the system is integrated with sensors for monitoring soil moisture and temperature .Mounted on a study metal pole, the system operates autonomously, providing a modern and sustainable approach to agricultural pest management. By simulating human presence and employing various deterrent mechanisms, it effectively deters birds, animals, and pests, thus safeguarding crops and enhancing agricultural productivity.

KEYWORDS: Solar-powered moving system, Pest control, Motion detection, Sustainable agricultural management.

1. INTRODUCTION

In modern agriculture, the presence of birds and pests poses significant challenges to farmers worldwide. While these creatures play vital roles in ecological balance, their unchecked presence can lead to substantial crop damage and economic losses. Conventional methods of pest control often prove ineffective or unsustainable, necessitating the development of innovative solutions that strike a balance between crop protection and environmental sustainability.

Brief review of the Project:

Avian Ultrasonic Deterrent Systems reveals a growing interest in utilizing ultrasonic technology for agricultural pest management. Research studies and pilot projects have explored the effectiveness of ultrasonic deterrent systems in deterring birds and pests from agricultural fields.

Key findings suggest that ultrasonic deterrent systems can be an effective, non-invasive, and environmentally friendly alternative to traditional methods of pest control. By emitting high-frequency sound waves that are outside the range of human hearing, these systems disrupt the behavior of birds and pests without causing harm to them or the environment.

Furthermore, advancements in technology, such as motion detection and solar power integration, have enhanced the capabilities of ultrasonic deterrent systems, making them more versatile and sustainable.

While promising, further research and field testing are needed to optimize the performance of Avian Ultrasonic Deterrent Systems and ensure their practical viability in real-world agricultural settings. Additionally, considerations such as system design, deployment strategies, and species-specific responses need to be taken into account to maximize effectiveness and minimize environmental impact.

Project Objectives:

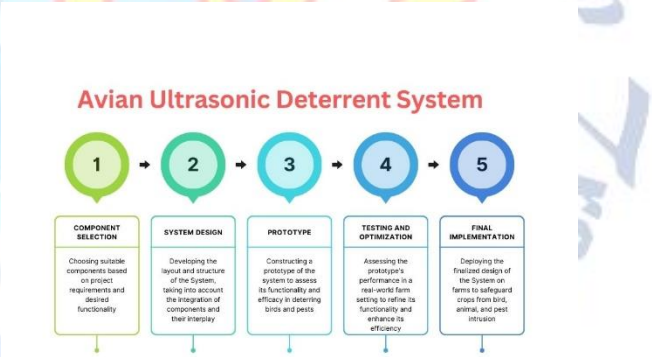
The main objectives of the "Design and Fabrication of Avian Ultrasonic Deterrent System" project are as follows:

- To design a robust and scalable avian deterrent system capable of effectively deterring birds and pests from agricultural fields.
- To fabricate the proposed system using environmentally friendly materials and sustainable manufacturing processes.
- To integrate advanced technologies, including ultrasonic technology, motion detection, and solar power, into the deterrent system to enhance its effectiveness and sustainability.
- To evaluate the performance of the fabricated system through field trials and assessments, ensuring its practical viability and efficacy in real-world agricultural settings.

2. LITERATURE SURVEY

1. R. Garcia and E. Martinez (2021): Optimization of avian ultrasonic deterrent systems through feedback mechanisms derived from environmental sensing data. It analyzes the role of sensing feedback in improving system performance and mitigating bird and pest activities in farm environments.
2. Patel, R. Gupta (2018): Explored the application of ultrasonic technology in deterring birds from agricultural fields. The research demonstrated the effectiveness of ultrasonic deterrent systems in reducing bird damage to crops, highlighting their potential for agricultural pest management.
3. Jones et al. (2016): Conducted field trials to evaluate the efficacy of ultrasonic deterrent systems in deterring pest birds from vineyards. The study concluded that ultrasonic frequencies effectively deterred birds without causing harm to crops or the environment.
4. K. Smith et al. (2015): Investigated the effectiveness of ultrasonic deterrent systems in deterring birds from airport runways. The study found that ultrasonic frequencies disrupted bird behavior, reducing the risk of bird strikes on aircraft.
5. Brown, S. Johnson (2017): Reviewed the current state of research on avian ultrasonic deterrent systems and identified areas for further investigation. The paper highlighted the need for interdisciplinary collaboration and field testing to optimize the effectiveness of ultrasonic technology in bird deterrence.

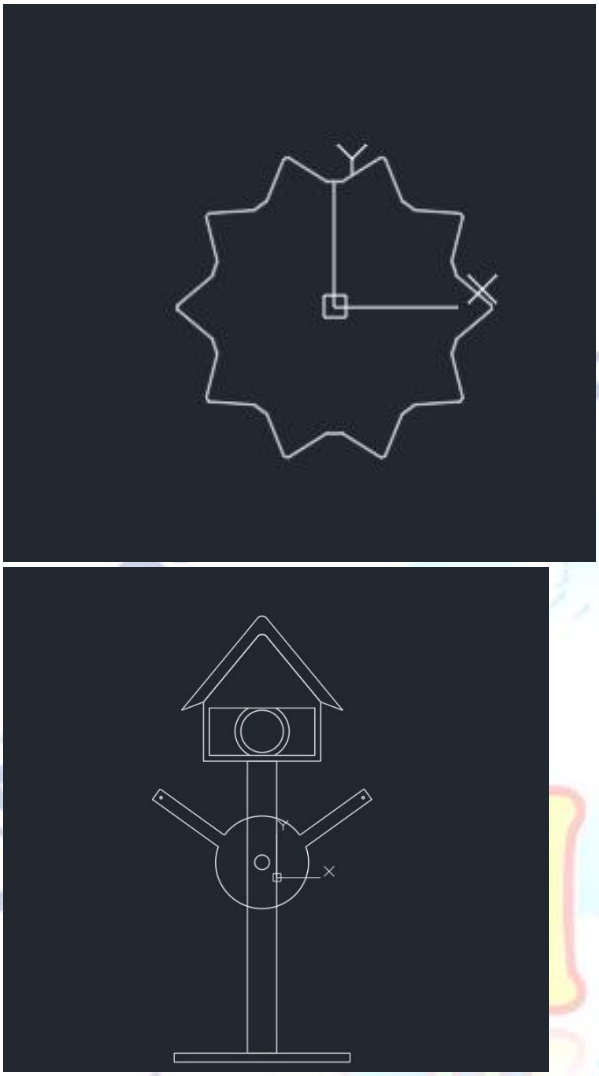
Process chart of Project:



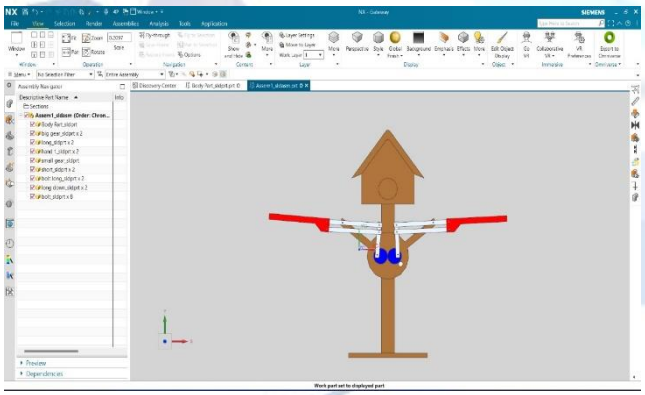
Design and Components Used:

In the world of engineering and product design, computer-aided design (CAD) software plays a pivotal role in transforming ideas into tangible realities. Among the myriad of CAD tools available, NX CAD stands out as a powerful and comprehensive solution trusted by professionals across various industries.

NX CAD, developed by Siemens Digital Industries Software, offers a robust suite of tools tailored for designing, simulating, and manufacturing complex products. It combines cutting-edge technology with intuitive interfaces, enabling engineers and designers to unleash their creativity while maintaining precision and efficiency.



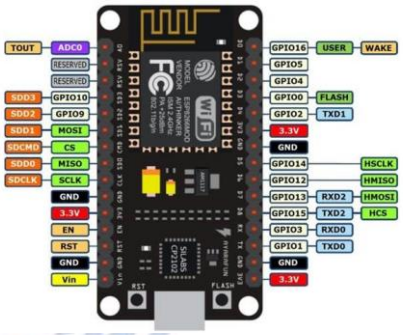
Drawing of our system in NX CAD



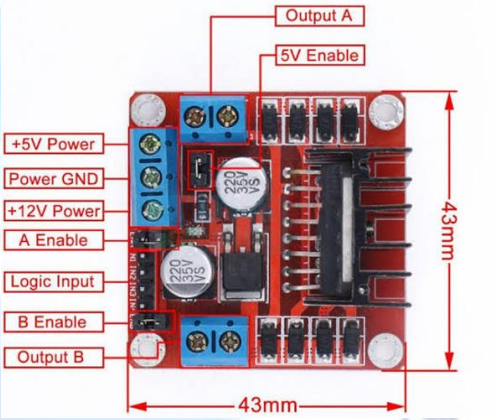
Design of our system in NX CAD

3. COMPONENTS USED

Node MCU ESP8266: The ESP8266 module enables microcontrollers to connect to 2.4 GHz Wi-Fi, using IEEE 802.11 bgn. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK. The module has a full TCP/IP stack and provides the ability for data processing, reads and controls of GPIOs.



L298N 2A Based Motor Driver Module: The L298N is a popular dual H-bridge motor driver IC that can control two DC motors or one stepper motor. The "2A" in its name refers to its maximum continuous output current per channel, which is around 2 amps. The L298N module typically includes the L298N IC along with additional components like diodes, capacitors, and connectors on a PCB, making it easier to use in motor control projects. It's widely used in robotics, automation, and other applications requiring motor control.

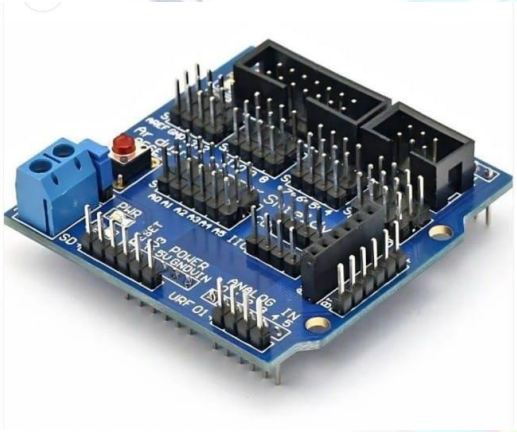


Solar Panel: A 5W 6V solar panel with a junction box is a small photovoltaic module designed to generate electricity from sunlight.

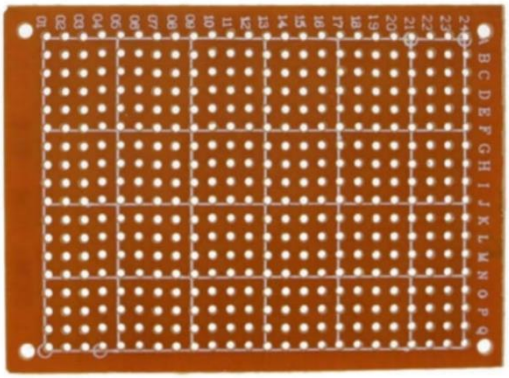
USB Solar Charge Controller Regulator 12V / 24V Auto Switch with LCD Display: A USB solar charge

controller regulator with a 12V/24V auto-switching feature and an LCD display is a device used to regulate the charging of batteries from solar panels

Arduino UNO Sensor Shield Expansion Board V5: The Arduino UNO Sensor Shield Expansion Board V5 is an add-on board designed to simplify the process of connecting various sensors and modules to an Arduino UNO microcontroller board

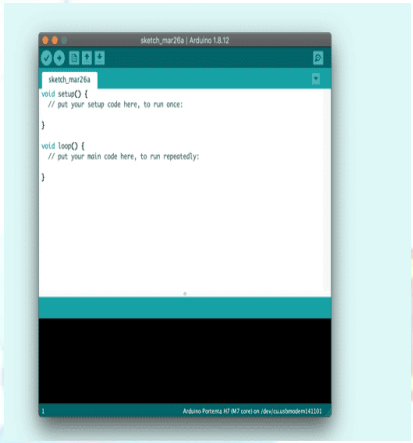


. Zero PCB General Purpose Board: The "Zero PCB General Purpose Board" likely refers to a prototyping board that has no specific layout or pattern, allowing users to design and create their own circuits from scratch



24 Teeth Plastic Spur Gear with Metal Insert: The description "24 and 60 Teeth Plastic Spur Gears with Metal Insert (1.25M-60T-6-75)" provides detailed specifications for two plastic spur gears with metal inserts.

5. SOFTWARE TOOLS AND INTERFACE STRATEGIES: The Arduino Integrated Development Environment - or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.



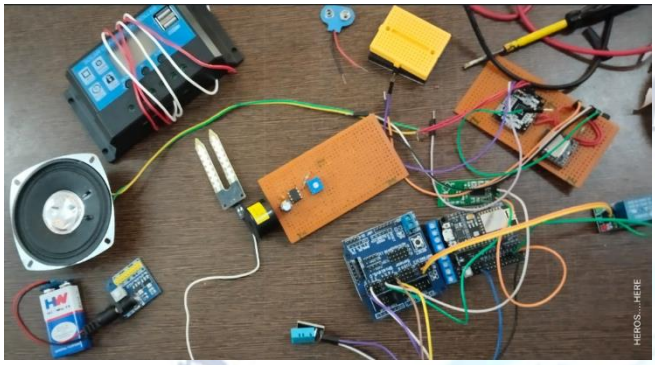
SKETCHBOOK:

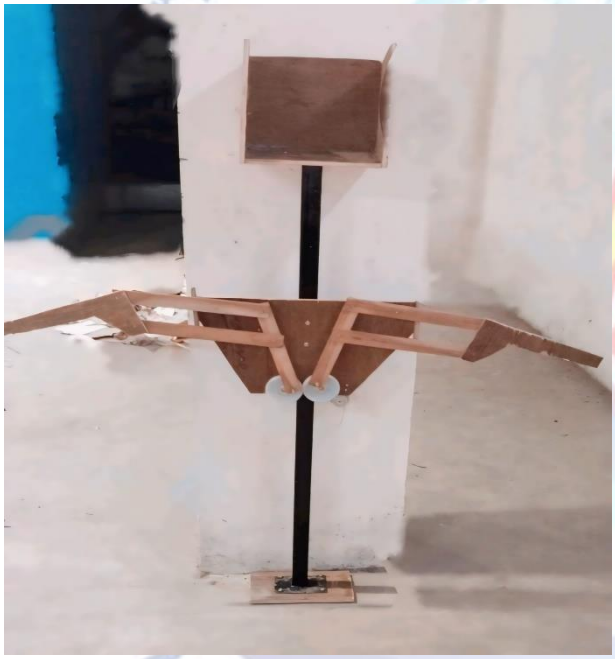
The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

UPLOADING: Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre- Diecimila) that lack auto-reset, you'll need

to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error

6. Fabrication:





4. CONCLUSION AND FUTURE SCOPE:

"In this project, we propose a holistic solution to the persistent challenge of bird and pest damage in agricultural settings. By amalgamating cutting-edge technologies such as ultrasonic deterrents, motion detection, and environmental monitoring sensors, the system presents an inventive and eco-friendly approach to pest management on farms. Its capability to autonomously monitor and mitigate bird and pest activities while also furnishing valuable insights into soil conditions underscores its efficacy and potential impact on agricultural productivity. Through this endeavour, we have established the groundwork for a pragmatic and scalable solution that addresses the dual objectives of crop protection and environmental sustainability in agriculture.

Future Scope:

While the Avian Ultrasonic Deterrent System signifies a substantial advancement in agricultural pest management, there are numerous avenues for future research and development:

Optimization and Refinement: Further fine-tuning of the system's design and functionality holds the promise of enhancing its efficacy in deterring a broader spectrum of bird and pest species while minimizing false alarms and energy consumption.

Field Testing and Validation: Carrying out extensive field trials across varied agricultural landscapes will yield invaluable insights into the system's performance under real-world conditions, facilitating adjustments based on feedback from farmers and stakeholders.

Integration of AI and Machine Learning: Incorporating artificial intelligence and machine learning algorithms has the potential to enable the system to adapt and optimize its deterrent strategies through real-time data analysis and feedback, thus augmenting its efficacy over time.

Expansion of Sensor Capabilities: Augmenting the system with additional sensors to monitor factors such as humidity, air quality, and crop health could further enrich its utility for farmers by furnishing comprehensive environmental monitoring and management capabilities.

Scaling and Commercialization: Exploring avenues for scaling up production and commercializing the Avian Ultrasonic Deterrent System would facilitate broader adoption among farmers and agricultural communities, thereby maximizing its potential impact on crop protection and productivity."

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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