

Development & Fabrication of Multipurpose Drone for the surveillance of Agricultural & to avoid Human & Animal conflict

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Abstract --This project focuses on the development and fabrication of a multipurpose drone designed for the surveillance of agricultural lands to mitigate human-animal conflicts. The proposed drone will integrate advanced imaging and sensing technologies to detect and monitor the presence of wild animals near farmlands. Equipped with thermal and night-vision cameras, motion detection sensors, and an automated alert system, the drone will help farmers take preventive measures to protect their crops. Additionally, the drone will be designed to cover large areas efficiently, providing real-time data through wireless transmission. The research will include developing the drone structure, selecting appropriate sensors, programming autonomous flight capabilities, and testing the system in real-world agricultural environments. The goal is to offer an innovative, cost-effective, and sustainable solution to reduce human-animal conflicts while ensuring agricultural productivity.

Index Terms- Multipurpose Agricultural Surveillance Drone – Development & Fabrication to Mitigate Human-Animal Conflict

I.INTRODUCTION

The development and fabrication of a multi-purpose drone for agricultural surveillance offer a promising approach. Drones, equipped with advanced sensors and cameras, provide a cost-effective, efficient, and non-intrusive way to monitor large agricultural areas. These drones can detect the presence of wild animals, track their movement, and deliver real-time data to farmers, enabling quick response actions to prevent crop damage or harm to livestock. Additionally, drones can be equipped with non-lethal deterrents, such as sound or visual signals, to discourage animals from entering critical areas without causing them harm.

Agriculture is a crucial sector that supports food production, economic growth, and rural livelihoods. However, human-animal conflicts have emerged as a significant challenge, particularly in regions where farmlands border forests and wildlife habitats. These conflicts arise when wild animals, such as elephants, deer, wild boars, and other species, intrude into agricultural fields, leading to crop destruction, property damage, and potential threats to human life. Farmers often resort to manual patrolling, fencing, or harmful deterrent methods, which are either ineffective, labor-intensive, expensive, or environmentally damaging. Ultimately leading to safer and more sustainable transportation solutions.

II. LITERATURE REVIEW

Study Title	Research Gap	Ref No.
The application of small unmanned aerial systems for precision agriculture: a review	Addresses precision agriculture alone; omits wildlife monitoring or deterrence.	1
Remote sensing with unmanned aircraft systems for precision agriculture applications	Focused solely on crop management; lacks integration with environmental or wildlife threat detection.	2
Sensor planning for a symbiotic UAV and UGV system for precision agriculture	Constrained to agricultural sensing; does not address wildlife intrusion or multifunctional payloads.	3
Use of drones for mitigation of human-elephant conflict in India	Limited to wildlife conflict; lacks any crop-health monitoring or dual-use sensor integration.	4
Modular design of unmanned aerial vehicle systems for multifunctional agricultural monitoring	Prototype stage only—missing live AI analytics, real-time alerting, and field validation for dual tasks.	5
Comparison of UAV platforms for vineyard monitoring	Restricted to vineyards; does not explore cross-crop applicability or wildlife encroachment detection.	6
Thermal imaging from UAVs for irrigation management	Ignores active deterrence mechanisms for wildlife that also exploit water sources.	7
Unmanned aircraft systems in precision agriculture: a review	Primarily hardware-centric; lacks case studies on wildlife conflict zones or	8

	combined-use scenarios.	
Drones for conservation: mapping, monitoring and management	Focuses exclusively on conservation; misses opportunities for simultaneous crop health surveillance.	9
Agricultural applications of UAVs for disease detection using multispectral imaging	Targets plant pathology; does not integrate wildlife activity data or active deterrent systems.	10

III. ARCHITECTURE DESIGN

Airframe & Propulsion Subsystem

- Frame: S550 hexacopter chassis provides six motor-mount points in a symmetric layout for stability and redundancy.
- Propulsion: Six 2212 920 KV brushless motors (3 CW, 3 CCW) paired with 10×4.5" propellers deliver lift and thrust.
- ESCs: Six 30 A 2–6 S brushless ESCs regulate motor speed based on flight-controller commands.

Power Subsystem

- Battery: 11.1 V 4200 mAh 35 C LiPo supplies up to 147 A peak current for motors and electronics.
- Power Distribution: Bullet-connector wiring and a PDB distribute battery power to each ESC and onboard electronics.
- Charger: iMax B3 Pro balances and charges 2 S/3 S packs safely between missions.

Flight Control & Navigation Subsystem

- Flight Controller: Radiolink CrossFlight board runs stabilization algorithms, sensor fusion, and waypoint navigation.
- RC Link: FlySky FS-i6 transmitter + FS-iA6B receiver for manual override and mode switching.
- GPS/Compass: UBlox NEO M8N module with compass on a foldable mast provides geolocation and heading for autonomous flight.

Payload & Sensing Subsystem

- Agricultural Sensors: (Optional) Multispectral/thermal camera payload for crop-health monitoring.
- Conflict-Mitigation Deterrents: Audio speaker or LED strobe module to scare off wildlife on command or automatically when threats are detected.
- Data Link: Telemetry radio or Wi-Fi uplink streams sensor data and live video to the ground station.

Onboard Compute & Software Subsystem

- Autopilot Software: Open-source firmware (e.g., ArduPilot) running on the CrossFlight controller manages flight modes, failsafe routines, and geofence alerts.
- AI Module: Optional companion SBC (e.g., Raspberry Pi or Jetson Nano) processes imagery in real time—detecting crop stress or approaching animals—and commands deterrents or return-to-launch.
- Ground-Station Interface: QGroundControl or Mission Planner GUI for mission planning, live telemetry, and alert management.

Planner GUI for mission planning, live telemetry, and alert management.

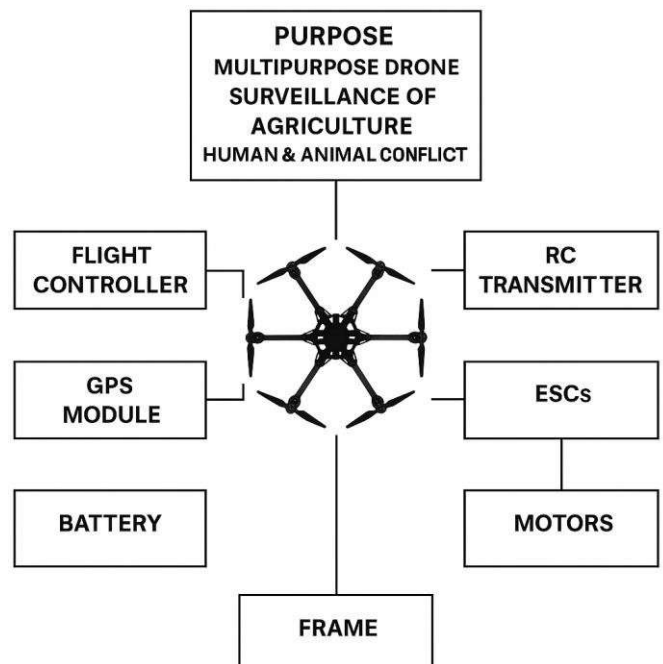


Fig1 : Architecture Design

IV. METHODOLOGY

1. Component Selection and Sourcing

Key flight and control components were selected for compatibility and performance. Brushless motors (2212 920KV) and 30A ESCs were used for propulsion, paired with 1045 propellers. A Radio link cross-flight flight controller and Fly Sky FS-i6 transmitter-receiver set provided navigation and remote control.

2. Frame Assembly

The Readytofly S550 hexacopter frame was assembled, integrating the APM/PIX shock absorber mount to minimize vibrations affecting flight control. The motors were mounted with the correct CW and CCW orientation for a balanced lift.

3. Electronics Integration

ESCs were connected to each motor and routed to the flight controller. Power was supplied using an 11.1V 4200mAh LiPo battery, with bullet connectors used for secure electrical connections. The GPS module with a compass was installed on a foldable bracket to ensure accurate positioning data.

4. Control System Configuration

The flight controller was calibrated with the FS-i6 transmitter via the FS-iA6B receiver. GPS functionality and failsafe features were set up to ensure autonomous navigation and recovery capabilities.

5. Testing and Calibration

The entire system was tested on the ground to validate motor direction, transmitter responsiveness, GPS lock, and system

stability. Final adjustments were made before conducting a controlled flight test.

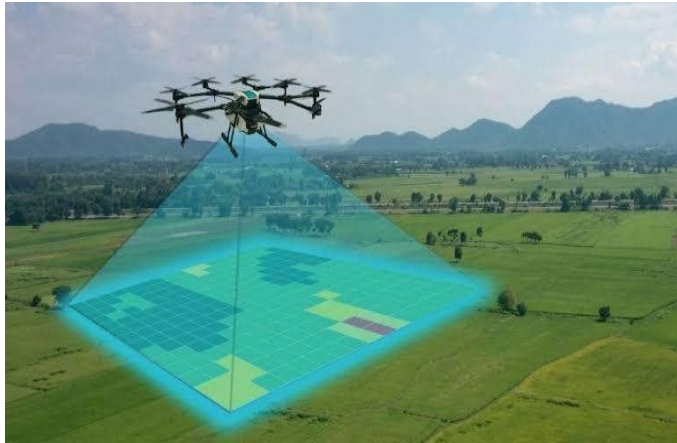
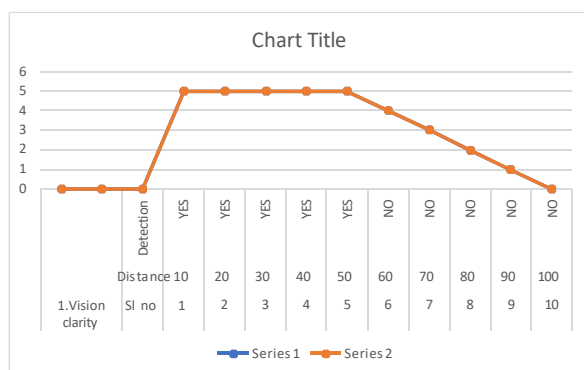


Fig.2 Surveillance

V. Experimental work

1. Vision clarity

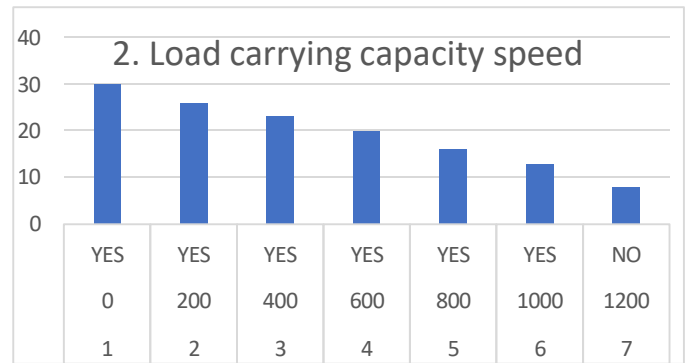
Sl no	Distance	Detection	Vision clarity
1	10	YES	5 HIGH
2	20	YES	5 HIGH
3	30	YES	5 HIGH
4	40	YES	5 HIGH
5	50	YES	5 HIGH
6	60	NO	4 MEDIUM
7	70	NO	3 LOW
8	80	NO	2 LOW
9	90	NO	1 LOW
10	100	NO	0 LOW



2. Load carrying capacity

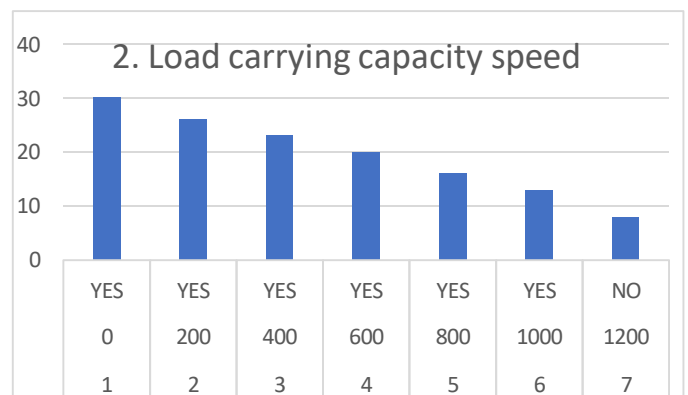
Sl no	load	fly	speed
1	0	YES	30
2	200	YES	26
3	400	YES	23
4	600	YES	20
5	800	YES	16

6	1000	YES	13
7	1400	NO	8



3. Response time

Distance in Meters	Time for response
10	0
20	0.2
30	0.3
40	0.5
50	0.6
60	1
70	2



VI. RESULTS

Development and Fabrication of Multipurpose Drone for Agricultural Surveillance and Human-Animal Conflict Mitigation" focuses on designing a hexacopter-based UAV system capable of performing dual roles in agricultural monitoring and wildlife deterrence. The system architecture integrates five main subsystems—propulsion, power, control, sensing, and payload deployment—into a cohesive and modular design. The drone's structural foundation is built on the S550 Hexacopter frame, which offers stability, redundancy, and lift efficiency through six 2212 920KV brushless motors (three clockwise and three counter-clockwise) controlled by six 30A ReadytoSky ESCs. These motors drive 1045 HD propellers, which generate the necessary thrust and allow for smooth maneuvering.

The flight control and navigation subsystem is managed by the Radiolink CrossFlight flight controller, working in tandem with a Ublox NEO M8N GPS module and an onboard

compass for precise orientation and autonomous navigation. Manual control and flight mode switching are handled using the FlySky FS-i6 transmitter and FS-iA6B receiver, which provide a reliable 2.4GHz radio link. A glass fiber shock absorber mount ensures that vibrations from motors do not interfere with the sensitive sensors in the flight controller, improving overall flight stability and sensor accuracy.

Power is supplied by a high-capacity 11.1V 4200mAh 35C LiPo battery, which ensures sufficient energy for motors and electronics. It is supported by 3.5mm banana plug bullet connectors for efficient power distribution and an iMax B3 Pro charger for safe and balanced battery recharging. The modular design allows for the addition of agricultural sensors such as multispectral or thermal cameras to monitor crop health, detect irrigation issues, or identify disease patterns.

To address human-wildlife conflict, especially in forest-adjacent farmlands, the drone is equipped with wildlife monitoring capabilities. An AI module (e.g., Jetson Nano) can be integrated to process real-time video or thermal imagery, detect animal presence (like elephants or wild boars), and automatically activate deterrent systems such as high-intensity LED strobes or speakers to scare away intruding wildlife. Additionally, telemetry systems relay alerts and live video to a ground control station, enabling real-time decision-making and minimizing damage to crops and risk to human lives.

The complete process—from design and component selection to integration—culminates in a versatile drone system that provides precision in agricultural surveillance while actively mitigating wildlife intrusion risks. The project also outlines a potential expansion pathway using autonomous AI, real-time threat detection, and remote field data collection to enhance sustainability and food security in vulnerable agricultural zones.



Fig.3 Drone model



Fig. 4 Drone model

VII. CONCLUSION

This hexacopter project was successfully designed and tested, combining various essential components for stable flight, precise control, and effective navigation. The ReadytoSky S550 hexacopter frame provided the structural foundation, while brushless motors (2212 920KV) and 30A ESCs delivered sufficient power and control. The Radiolink Cross Flight flight controller, along with the FlySky FS-i6 transmitter and FS-iA6B receiver, ensured stable manual control and reliable communication. For navigation, the ReadytoSky Ublox NEO M8N GPS module with a compass facilitated accurate positioning, making the drone suitable for outdoor and GPS-dependent missions.

The power system, consisting of an 11.1V 4200mAh LiPo battery and the iMax B3 Pro charger, allowed for adequate flight duration and easy recharging. Bullet connectors ensured secure and efficient electrical connections for the power system.

Testing confirmed that the drone performed well in terms of flight stability, control, and GPS functionality, demonstrating the viability of the current design. However, there is significant potential for future enhancements to further improve the system's capabilities. These include adding an automatic dart shooting mechanism for non-lethal wildlife tagging, pest control, or other precision tasks. Additionally, future upgrades could involve autonomous flight using computer vision or AI, obstacle avoidance for safer operation in complex environments, and the incorporation of solar panels or more efficient batteries for extended flight time.

The future scope also includes swarm capabilities for collaborative operations, enabling the use of multiple drones for large-scale tasks such as environmental monitoring or search and rescue. The integration of advanced communication systems could enable real-time telemetry, allowing for more dynamic and remote control.

In conclusion, this project serves as a solid foundation for developing a versatile, high-performance drone with the potential for numerous applications in research, agriculture, surveillance, and disaster management. Future upgrades will expand its functionality and ensure it meets the demands of specialized and autonomous task

The future scope of this hexacopter project includes several exciting upgrades to expand its functionality and applications. Key enhancements could include:

1. **Automatic Dart Shooting Mechanism:** Adding a dart launcher for tasks like wildlife tagging, pest control, or non-lethal defense simulations.
2. **Autonomous Navigation:** Integrating AI and computer vision systems for fully autonomous flight, enabling tasks like object tracking and automatic target identification.
3. **Obstacle Avoidance:** Implementing sensors like LiDAR or ultrasonic sensors for safer navigation in complex environments, including indoor and outdoor missions.
4. **Extended Flight Time:** Upgrading to higher-capacity batteries or incorporating solar panels for longer flight durations and increased payload capacity.
5. **Swarm Technology:** Enabling multiple drones to work together autonomously for large-scale operations like mapping, search and rescue, or environmental monitoring

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