# AERODEL: Autonomous Drone for Efficient and Safe Delivery

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**Abstract -- The Aerodel: drone project has been redesigned for manual control using a transmitter and receiver, eliminating reliance on autonomous navigation. A key addition is Failsafe Landing, ensuring a controlled descent during signal loss to prevent crashes. Equipped with a KK Flight Controller, brushless motors, and ESCs, the drone maintains stability and efficiency. This streamlined design enhances safety while reducing complexity, making it easier to operate in real- world conditions. The drone is well-suited for campus logistics, research applications, and controlled delivery environments. By balancing manual control with essential safety features, the project provides a practical and adaptable solution for drone-based deliveries.**

**KEYWORD:** KK Flight Controller, Alerodel Drone, Manual Control, Failsafe Landing, Stable and Efficient Flight, Safe Delivery System

## I. INTRODUCTION:

The rapid advancement of Unmanned Aerial Vehicles (UAVs) has revolutionized industries like logistics, surveillance, and emergency response. Drones are increasingly used for safe and efficient deliveries, especially in controlled environments such as campuses and research facilities. This project, "Aerodel: Autonomous Drone for Efficient and Safe Delivery," focuses on transporting light payloads while providing manual control through a transmitter and receiver system, ensuring reliability in areas with weak GPS signals.

Unlike conventional delivery drones that rely on autonomous flight via GPS and mapping APIs, Aerodel operates through manual control using the Fly Sky FS-CT10B transmitter and FS-R6B receiver. The KK Flight Controller, known for its stability and ease of use, is used instead of advanced controllers like the Omnibus F4, which supports autonomous features. To enhance safety, a Failsafe Landing system ensures a controlled descent in case of signal loss, preventing crashes. Additionally, four ultrasonic sensors help detect obstacles, assisting the operator avoiding collisions.

By eliminating dependence on GPS-based automation and integrating essential safety mechanisms, this project provides a practical, stable, and user-controlled drone delivery system. It is designed for real- world applications, including research, testing, and controlled delivery operations, making UAV technology more accessible and efficient.

## II. LITERATURE SURVEY:

Drongelen et al. (2017) offers an ultrasonic sensor and signal analysis metric-based obstacle detection system. The authors proposed a scheme based on the use of time-of-flight data from the ultrasonic sensors to sense obstacles in a drone's operating environment. Through the application of signal analysis methods like cross-correlation and power spectral density, the system convincingly detects obstacles, thus improving the autonomous navigation of the drone [1].

Ma (2023): Ma designed a framework for autonomous robots to sense and avoid obstacles through the use of multiple ultrasonic sensors. Real-time sensor data was processed by the system to correctly identify and determine distances to obstacles, controlling the path modifications of the robot. The results showed that multiple ultrasonic sensors improve the accuracy and robustness of obstacle detection and avoidance in autonomous systems [2].

Rahman and Sasongko (2018) suggested an ultrasonic sensor and servo-based obstacle avoidance system for quadcopters. Their system combined existing flight controllers with a suggested avoidance approach to allow the quadcopter to sense obstacles and change its path. The study emphasizes the role of manual control systems with real-time obstacle sensing in improving UAV safety [3].

Rible et al. (2020): The researchers designed fail-safe controller structures for quadcopters with motor failures. They introduced control schemes that allow quadcopters to achieve flight stability despite being in operation with decreased motor capabilities. Through the application of these structures, the research adds to the improvement of UAV operation reliability and safety under faulty scenarios [4].

Quan et al. (2017): In this study, the authors designed failsafe control mechanisms for multicopters through supervisory control theory. To tackle safety concerns, the authors represented user requirements through modeling and synthesized a supervisor to control the multicopter behavior during failures. Their method provides assurance that multicopters effectively manage unwanted failures, thus enhancing operational safety [5].

Yu (2021) proposed an agricultural UAV obstacle detection approach through the integration of ultrasonic sensors with monocular vision. The framework used ultrasonic sensors for rapid obstacle detection and monocular vision for sophisticated image processing to enable the UAV to autonomously plan its flight trajectory and avoid obstacles. This research highlights the superiority of using ultrasonic sensors together with other technologies in detecting obstacles accurately [7].

From the consolidated analysis of all these studies, we have gained knowledge that integrating human-in-the-loop control and automated processes raises adaptability as well as safety in drone flying. Efficient power management through streamlined energy usage is vital for improving UAV flight endurance and operational sustainability. The investigation on failsafe mechanisms indicates autonomous emergency procedures play a significant role in guaranteeing safe landings in case of system failure to increase the drone's reliability. Knowledge of regulatory and technical issues is critical to the successful integration of drone delivery systems into current logistics systems. The comparison between manual and autonomous control systems shows that a hybrid system provides the best compromise between real-time adaptability and accuracy. Moreover, the application of ultrasonic sensors greatly enhances obstacle detection and avoidance, making drone navigation safer and more efficient. These observations informed the design of our Aerodel drone, merging manual operation with necessary safety measures for secure delivery missions.

## III. PROPOSED TECHNIQUE:

This project introduces a manual control-based UAV system for safer and more reliable drone deliveries. Using a transmitter and receiver, it allows direct human control, ensuring operation in GPS- limited areas. A Failsafe Landing system prevents crashes by initiating a controlled descent during signal loss. Four ultrasonic sensors detect obstacles in real time, improving flight safety. By removing reliance on autonomous systems.

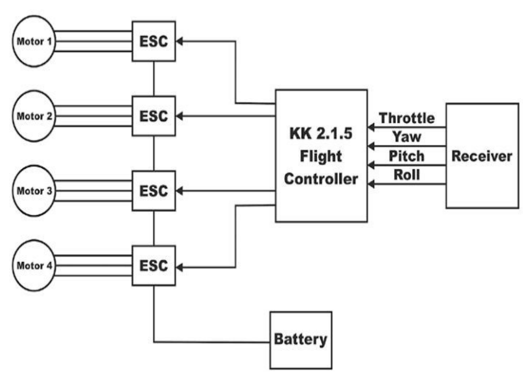


**Fig 3.1 Block diagram**

As shown in Fig 3.1, This drone offers a simple, efficient, and scalable solution for deliveries in controlled environments.

**A. Manual Control for Reliable Operations:**

To address the challenges of autonomous drone delivery, this project introduces a manual control- based UAV system that enhances reliability, safety, and adaptability. Instead of relying solely on GPS and Al-based navigation, the drone operates through a transmitter and receiver system, allowing direct human control. This ensures uninterrupted operation, even in areas with poor GPS connectivity or regulatory restrictions.

Fig. 3.2 shows the manual transmitter and receiver system employed to operate the drone. This system offers immediate human control, allowing for accurate maneuvering and guaranteeing safe operation in areas where GPS signals are weak or non-existent. The FlySky FS-CT6B transmitter and FS-R6B receiver enable real-time communication, supporting responsive and accurate navigation of the drone


**Fig 3.2 Manual transmitter and receiver**

**B. Failsafe Landing and Obstacle Avoidance:**

**Fig 3.3 Failsafe Landing**

As seen in Fig 3.3, By reducing reliance on autonomous flight, this system simplifies operation while improving safety and scalability. The manual control system, combined with failsafe mechanisms and obstacle detection, offers a versatile, efficient, and safer alternative for real-world drone deliveries

**IV. PERFORMANCE EVALUATION AND ANALYSIS:**

The pre-flight setup involves powering the drone using a Li-ion battery, which supplies voltage to essential components like the KK kit flight controller, ultrasonic sensors, and ESCs. The FlySky FS-CT6B transmitter communicates with the FS-R6B receiver, enabling full manual control.

During takeoff and flight, the pilot manually controls throttle, pitch, yaw, and roll via the transmitter. The brushless motors ensure smooth lift-off, while ultrasonic sensors provide real-time obstacle detection. If an obstacle is detected, the pilot can adjust the flight path accordingly. In the event of signal loss, the Failsafe Landing system is triggered, gradually reducing throttle to ensure a controlled and safe landing, preventing crashes.

**Fig 4.1 Multi quadcopter**

For delivery execution, the operator manually lands the drone, and the payload is either retrieved or released via a servo-controlled mechanism. Once the delivery is complete, the drone is flown back to base, powered off, and recharged for the next mission. This streamlined system ensures efficient, safe, and reliable drone operations for delivery tasks.

**V. COMPARATIVE ANALYSIS WITH OTHER MODELS:**

Unlike fully autonomous drones, which rely on GPS and Al-based navigation, our manual-controlled UAV offers greater reliability in areas with poor GPS signals or regulatory restrictions. It allows real-time human control, ensuring quick decision-making and adaptability in dynamic environments. Additionally, failsafe landing and obstacle detection improve safety, reducing the risk of crashes. Compared to traditional autonomous delivery drones, our model is more cost-effective as it eliminates the need for complex Al systems and expensive sensors. It also requires less regulatory approval, making it easier to deploy in controlled environments like campuses and research facilities. This approach balances efficiency, safety, and affordability, making it a practical alternative for drone-based deliveries.

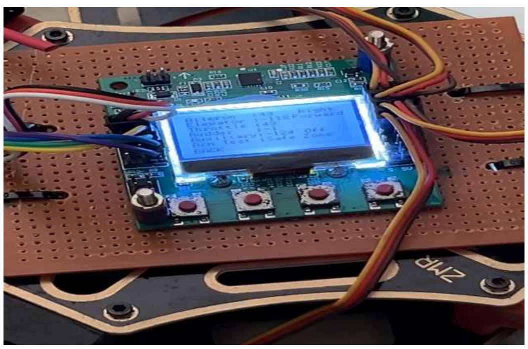

**Fig 5.1 Calibration setup**

As seen in Fig 5.1, The drone features a lightweight, durable frame with four brushless motors for stable lift and precise control. A KK flight controller ensures efficient power management and navigation, while green LED lights indicate system status. During takeoff, the motors generate upward thrust, and the flight controller maintains balance and orientation for a smooth ascent.


**Fig 5.2 Drone Delivering Packages**

As shown in Fig. 5.3, the drone is designed to deliver small payloads efficiently. It features a dedicated payload-carrying mechanism capable of transporting items up to 500 grams. This delivery system is ideal for applications in campuses, research facilities, and industrial zones, ensuring secure and reliable transportation over short distances.

**Fig 5.3 Drone Performing Delivery Task**

The power distribution board optimally supplies power, ensuring seamless operation. A failsafe landing mechanism activates during signal loss to prevent crashes. The design prioritizes stability, efficiency, and adaptability for various delivery applications**.**

## VI. SUMMARY:

The manual-controlled drone delivery system provides a cost-effective, safe, and flexible alternative to fully autonomous UAVs. With failsafe landing, ultrasonic obstacle detection, and live manual control, it enhances reliability, reduces regulatory challenges, and lowers operational costs. This approach is especially useful in campus logistics, medical supply transport, and short-range deliveries, where autonomous navigation may not be practical. The Failsafe Landing feature ensures safety, making the system efficient and easy to operate in real-world scenarios.

Additionally, real-time obstacle detection allows smooth navigation even in congested environments, reducing the risk of collisions. The system's simplified design makes maintenance easier, minimizing downtime and operational complexity. By combining manual control with essential automation features, this drone delivery model offers a reliable and adaptable solution for diverse applications.

## VII. FUTURE WORK:

- **Enhanced Flight Stability -** Improve control mechanisms for smoother and more stable flights.
- **Increased Payload Capacity -** Upgrade the drone to carry heavier loads efficiently.
- **Optimized Power Efficiency -** Implement better battery management for longer flight time.
- **Advanced Obstacle Detection -** Integrate Al-assisted sensors for improved navigation.
- **Automated Payload Release -** Develop a more precise and secure delivery system.
- **Expanded Testing -** Conduct trials in diverse environments to refine performance.
- **Improved Failsafe Mechanisms -** Strengthen emergency landing and signal loss protocols.

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