ESP-Drone Test Plan

1. Objectives

To verify that all implemented software modules (AutoNav, Safety Landing, Obstacle Avoidance, and CRTP Interface) meet the defined safety and operational requirements prior to prototype deployment.

2. Test Environment

Component	Description
Microcontroller	ESP32-S3 on custom PCB
Sensors	VL53L1X, VL53L0X (ToF), PMW3901 (Optical Flow)
Power Source	2S Li-Po Battery (max 3 min flight)
Software	ESP-IDF 5.2, AutoNav Module, iOS App Interface
Test Tools	iOS App (manual override), idf.py monitor, simulation mode

3. Safety Requirements Reference

Requirement Description	Safety Priority
The drone must auto-land safely after 30 seconds of no command.	Critical
The drone must detect and stop upon obstacle detection (ToF < 0.8 m).	Critical
The drone must hover at 1.2 m during AutoNav operation.	High
Manual override must interrupt any ongoing autonomous mission.	Critical
If obstacle persists for >30 s, the drone must land safely.	High
All safety LEDs and communication signals must indicate system status clearly.	Medium

4. Test Cases

Test Name	Procedure	Expected Result
Power-On Safety Check	Power on the drone and observe LED and system logs.	LEDs blink in standby pattern; system initializes safely without motor spin.
Auto-Land Timeout Test	Run the system without sending commands for 30 s.	Drone automatically descends and disarms motors after timeout.
Obstacle Hold Test	Place obstacle < 0.8 m in front of ToF sensor during AutoNav.	Drone halts flight path, maintains altitude (1.2 m), resumes after obstacle clears.
Persistent Obstacle Test	Keep obstacle in front for 30 s.	Drone initiates landing sequence and powers down safely.
Manual Override Test	During autonomous flight, trigger override via iOS app.	AutoNav mission stops immediately; control returns to manual mode.

Test Name	Procedure	Expected Result
CRTP Communication Test	Send control packets via iOS app (up, down, shape selection).	Drone responds correctly to CRTP commands with minimal latency.
Hover Stability Test	Enable AutoNav mode with no obstacles.	Drone maintains stable altitude at ~1.2 m ± 0.05 m for 60 s.
Battery Fail-Safe Test	Reduce battery voltage below threshold.	Drone performs controlled landing and shuts down motors.
Simulation Pre-Check	Run the AutoNav simulator (tools/sim/run_sim).	Console output confirms shape paths and safety triggers execute correctly.

5. Test Completion Criteria

- All critical safety requirements must pass before live testing.
- Any failure will result in test suspension.
- Logs and telemetry will be captured for all tests using idf.py monitor.

6. Safety Compliance

This testing process ensures the ESP-Drone adheres to:

- **CASA RPAS safety guidelines** for indoor autonomous flight prototypes.[1]
- **RMIT Engineering Design Ethical Code** – prioritizing user and environmental safety.[2]

References

[1] Civil Aviation Safety Authority (CASA), *RPAS (Remotely Piloted Aircraft Systems) Safety Guidelines for Indoor Flight Prototypes*, Civil Aviation Safety Authority, Canberra, Australia, 2024.

[2] RMIT University, *Engineering Design Ethical Code: Safety, Sustainability and Responsibility in Engineering Practice*, RMIT University, Melbourne, Australia, 2024.