

## Low-cost, Versatile, Autonomous UAV Flight Controller

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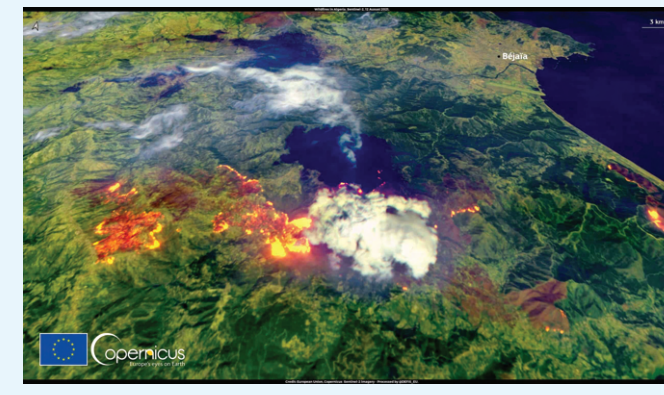
Manuel Dias

### Problem

#### Wildfires

The delay between fire ignition, detection, and the alerting of authorities, which often allows fires to escalate uncontrollably.

Active monitoring can significantly reduce response times, but it is expensive and requires highly trained field operators and costly technology.



### Solution

#### Versatile & Autonomous System:

- Controls small fixed-wing aircraft (radio-controlled model airplanes)
- Includes both hardware and software components

#### Affordable Solution:

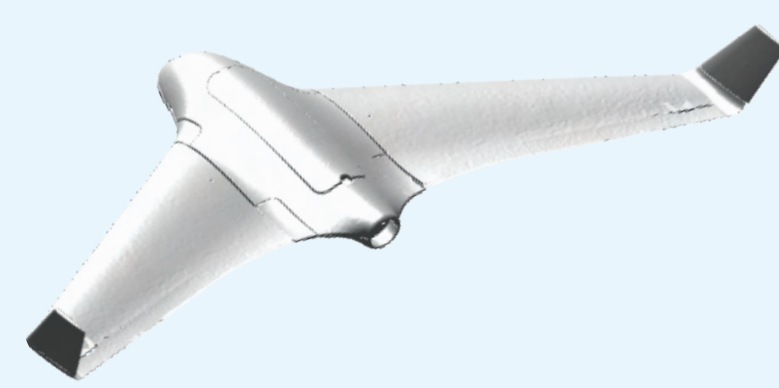
- Leverages high availability and low cost of fixed-wing aircraft
- Facilitates development of a matching low-cost flight controller

#### Enhanced Monitoring:

- Deploy multiple UAVs for autonomous high-risk area surveillance
- Relays critical information to firefighters

#### Operational Efficiency:

- Minimizes need for manned interventions
- Improves response time and firefighting effectiveness



### Results

#### Flight Controller System

##### Versatile Flight Controller System:

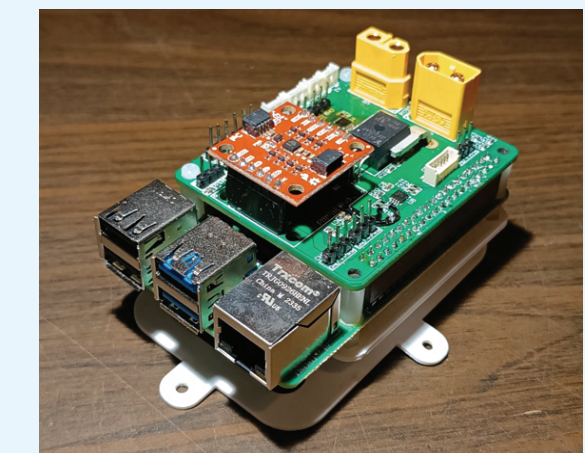
Flexibility to adapt to different vehicle types, ensuring compatibility and versatility

##### Future-Proof Design:

Capability to accommodate new software deployments on the on-board computer  
Seamless integration with new or different hardware configurations

##### Simple Operation:

Autonomous flight capability based on a pre-planned route  
Easy and real-time operation through a user interface



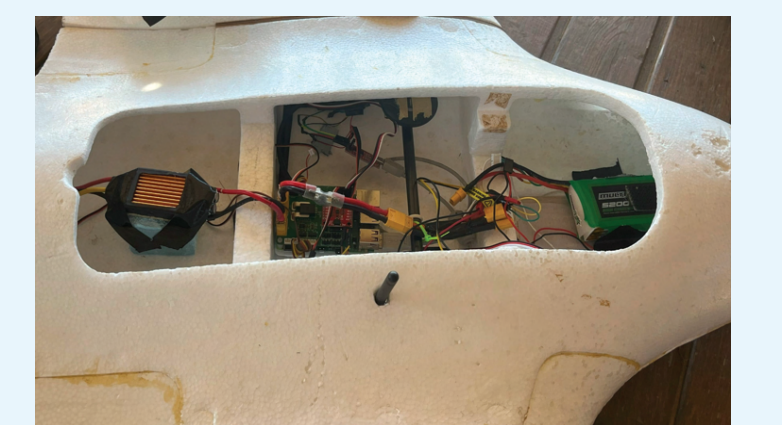
#### Flight System Integration

##### UAV characteristics:

- Flying wing
- Wingspan 2.12m
- Flight endurance 1h (50Km)
- Hand launch
- Belly landing

##### On board system:

- Our flight controller
- GPS
- Other critical external flight sensors
- Electric propulsion system
- Full HD camera



### Previous work

The Portuguese Air Force employs large, internal combustion engine-powered UAVs for forest surveillance.

Currently, they collaborate with firefighters to provide aerial images upon request.

### Target audience

This solution can be highly advantageous for firefighters by providing more information about high-risk areas before, during, and after a fire event.

It benefits individuals living in rural areas, as well as wild-life and infrastructure in regions with a high wildfire risk, by reducing the time needed to initiate fire suppression and control operations.

### Costs and benefits

#### Benefits:

- Reduced delay time of aerial image support
- Increased user independence
- Reduced risk compared to land-based monitoring
- Reduced cost compared to manned and other unmanned aerial monitoring
- Low maintenance
- Simple to operate

#### System cost breakdown:

- Our flight controller – (≈180€)
- Camera – (≈ 30€)
- Communication modules – (≈ 60€)
- Flying wing – (≈ 300€)
- Propulsion system – (≈ 120€)
- Miscellaneous parts – (≈ 50€)
- Total: ≈740€

#### Full System

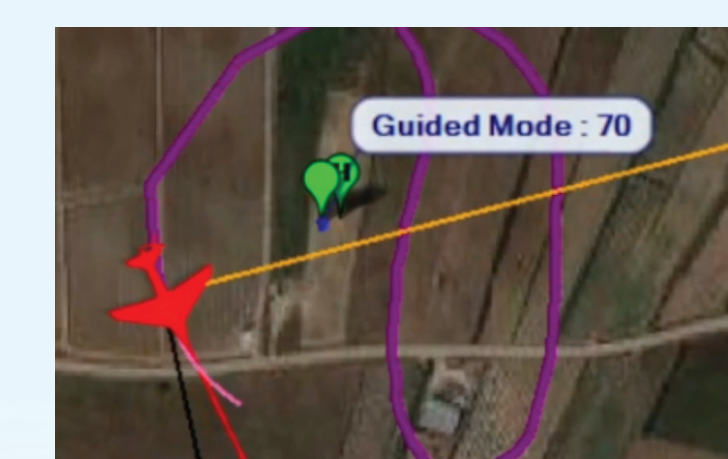
##### Mission start:

- Assisted hand launch
- Automatic home loiter pattern
- Follow pre-planned route or wait for commands



##### Mission command (User Interface):

- UAV position monitoring
- Camera data monitoring
- Commands to change route and altitude



##### Flight mission end:

- Automatic landing
- Ability to land in unprepared pavement
- Compatible with parachute landing system

