ElectroCap Project Proposal

Low-cost, versatile, autonomous UAV flight controller

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1. Advisors and Mentor

- Scientific Advisor: Prof. Luís Caldas de Oliveira
- Coordinator: Prof.ª Alexandra Moutinho
- Mentor: Rafael Cordeiro

2. Problem definition

Due to their inherently difficult predictability and exponential fashion growth, wildfires consume various hectares of land every year, endangering wildlife, infrastructure, and individuals in rural areas.

Fires often get out of control due to the long interval between fire deflagration, detection, and communication with the authorities.

Active monitoring can reduce this crucial response time, but often at a high cost, requiring highly trained field operators and expensive technology.

3. Solution beneficiaries

This possible solution can directly benefit individuals who reside in rural, along with wildlife and infrastructure in areas where there is a high wildfire risk, by reducing the time taken to start fire extinguishing and control operations.

It can also be highly beneficial for firefighters by providing more information about high-risk areas before, during, and after a fire event, thus reducing the risk of injury and death.

4. Technological solution

A low-cost, versatile, autonomous Unmanned Aerial Vehicle flight controller is an electronic system, comprised of hardware and software, able to fully control any type of small fixed-wing aircraft often known as radio-controlled model airplanes.

Given the high availability and low cost of these fixed-wing aircraft, by developing a matching low-cost flight controller system, it could be possible to deploy various UAVs at a time to actively monitor high-risk areas autonomously, relaying critical information to firefighters while having few manned interventions in the surveillance process.

5. Competitors and previous work

- Competitors:
  - Leitek – Provides ground and areal based fire detection systems;
  - Portuguese Air Force – Using big internal combustion engine powered UAVs for forest surveillance;
  - Satellite Surveillance – Multiple agencies using this type of data.
- Previous work:
  - ATLAS Systems and Aeronautics (former UAV-Alameda Research Team) – Academic project of AeroTéc developing an unmanned aircraft for autonomous fire detection.
  - Eye in The Sky – A project of IDMEC (Instituto de Engenharia Mecânica) – Using small fixed-wing aircraft launched from high altitude weather balloons to monitor fires.

6. Solution requirements

A solution to this problem must be a system with the ability to perform active surveillance of a vast forest area and capture images/video to detect new fire instances or monitor the aftermath of a wildfire to improve the response time from the firefighting team.

For this solution to be effective, the system must be easy to set up and operate while relatively easy to scale up.

7. Technical challenges

One of the technical challenges this solution faces is the testing criteria and the high amounts of time required to have a proper assessment of the overall system stability and performance that satisfies the regulatory bodies (Autoridade Nacional de Aviação Civil and European Union Aviation Safety Agency) to operate an aerial vehicle without a safety-pilot involved.

Electronic component availability can also be stated as a technical challenge due to the unpredictable behavior of specialized integrated circuit stock in the European Union.

8. Partners

Project – Eye in the Sky

- This project aims at the design and development of an aerial platform to support wildfire operations.
- The system reinforces the emergency communications network while providing real-time geo-referenced images from high altitude.
- The system constitutes a glider attached to a high-altitude balloon, giving another point of view for wildfire surveillance.

Website: https://adai.pt/eyeinthesky/

Source: https://www.idmec.tecnico.ulisboa.pt/projects/eye-in-the-sky/

9. Testing and validation metrics

The flight controller should be affordable, compatible with different aerial platforms, and feature-proof to have the possibility of adding more software/hardware-based functionalities.

The system should be relatively easy to set up and use, requiring only one to two people with limited knowledge of drones to operate it.

Electronical testing should take place to assess the performance and quality of the system from an electrical point of view.

Operating system stability testing should also take place along with telecommunications redundancy and security testing.

Extensive real-world testing should take place to assess the performance and stability the system.

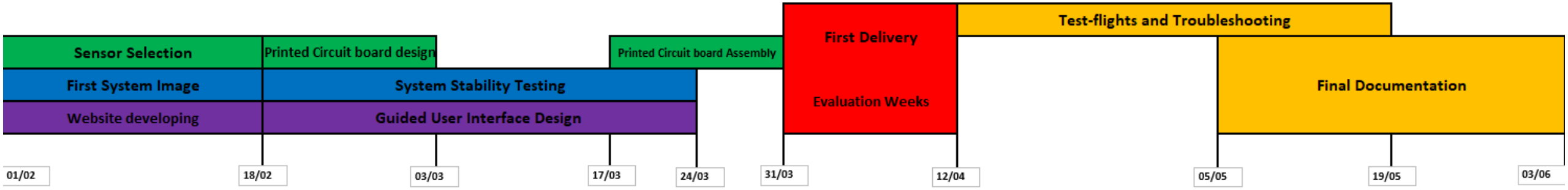
10. Division of labor (I)

Francisco Loureiro	João Matos	Manuel Dias
Electronics supervisor and Team Leader	**Code Review and Compiling**	**Real-Time OS Supervisor**
Printed circuit board design	Cross-compile environment setup	OS image preparation and boot
Printed circuit board assembly	Sensor code modification and compilation	Real-Time OS system patching
System stability assessment	User interface software stability assessment	Real-time OS system testing
Test-flight safety-pilot		

11. Division of labor (II)

Inês Santos	Ana Pinto	Marina Nóbrega
Electronic circuits design and testing	**Back-end development**	**Front end development**
Bench sensor testing	Website back-end development	Website front end development
Schematic design	Aircraft communication with the ground station	Updating website information
Ground control station operation	Guided User interface back-end development	Guided User interface front-end development

12. Schedule



Key by colour:

- Electronics
- Operating Systems
- User Interface
- Work schedule reduction
- Participation of all Specialties