ElectroCap Mid-Program Pitch Deck

Forest Fires Detection

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TÉCNICO LISBOA

Team

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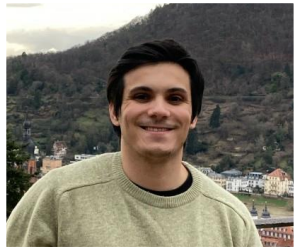


Pedro Rodrigues

Advisors and Mentors

Scientific Advisor: Professor Luís Correia

Scientific Co-advisor: Professor João Felício

Coordinator: Professor Luís Correia

Problem definition

One of the challenges in forest fire detection is the inability to detect them quickly and safely. This incapacity can lead to a rapid spread of fire in certain remote areas, resulting in a delayed immediate response and potentially causing damage of significant proportions. Our project is one solution for this challenge.

Solution beneficiaries

- Local communities by protecting their properties;
- Firefighters and rescue teams, who would benefit from real-time information;
- Agricultural businesses, who would also gain by safeguarding their properties;
- Municipal councils and local authorities who would experience an enhanced monitoring capability and swiftly identifying suspicious fire activities;

Technological solution

We propose a solution that involves the use of a drone equipped with an integrated thermal camera. The data collected by the thermal camera are transmitted to the control station. Based on the transmitted data, our software determines whether the area exhibits excessive heat. Should this be the case, the software issues an alert to the user along with the image captured at that moment.

When the alert is given, the competent authorities go to the scene to fight the fire.

Technological solution (Real Project)

Technological solution (Real Project)

T-motor M1200 Quad-copter:

- Suitable payload: 2 to 5 kg;
  - Flight time:
    - With 2 kg payload: up to 70 minutes;
    - With 5 kg payload: up to 60 minutes;
  - Wheelbase: 1230 m;
  - In-flight weight: 18.5 kg (including payload and battery);
  - Maximum range: 10 km;
  - Operating Altitude:
    - Maximum altitude: 1000 meters;
  - Speed:
    - Typical operating range: 10 to 35 km/h;
    - Maximum speed: 65 km/h;
  - Wind resistance: Equivalent to force 5;

Link do Drone

Technological solution (Real Project)

AT61P Remote Temperature Monitoring System Thermal Camera:

- Resolution: 640 x 512 pixels;
- Lens: 25 mm;
- Thermal sensitivity: 50 mK;
- Detection range: 1.05 km;
- Reconnaissance range: 260 m;
- Identification range for a human: 130 m;
- Weight: 430 g;
- Voltage: 10-36 V;
- Power: 3 W (at 25°C);
- Total transmission: 196.608 Mbps;

Link da Câmara Térmica

Technological solution (Real Project)

DJI Transmitter and Receiver (DJI Broadcast Kit - Standard Combo):

- Weight: 500 g;
- Latency Band: 5.725 GHz to 5.850GHz;
- Power Consumption: 9 W;
- Supply Voltage: 6 to 18 V;
- Transmission range: about 6 km;
- Encoding: H.264;
- Protocol: 03 Pro;
- Latency: 70 ms;
- Data Compression Protocol: H.264;
- Operating time: 3 hours and 50 minutes;

Link do Transmissor

Technological solution (Real Project)

LiPo Battery for Thermal Camera Power:

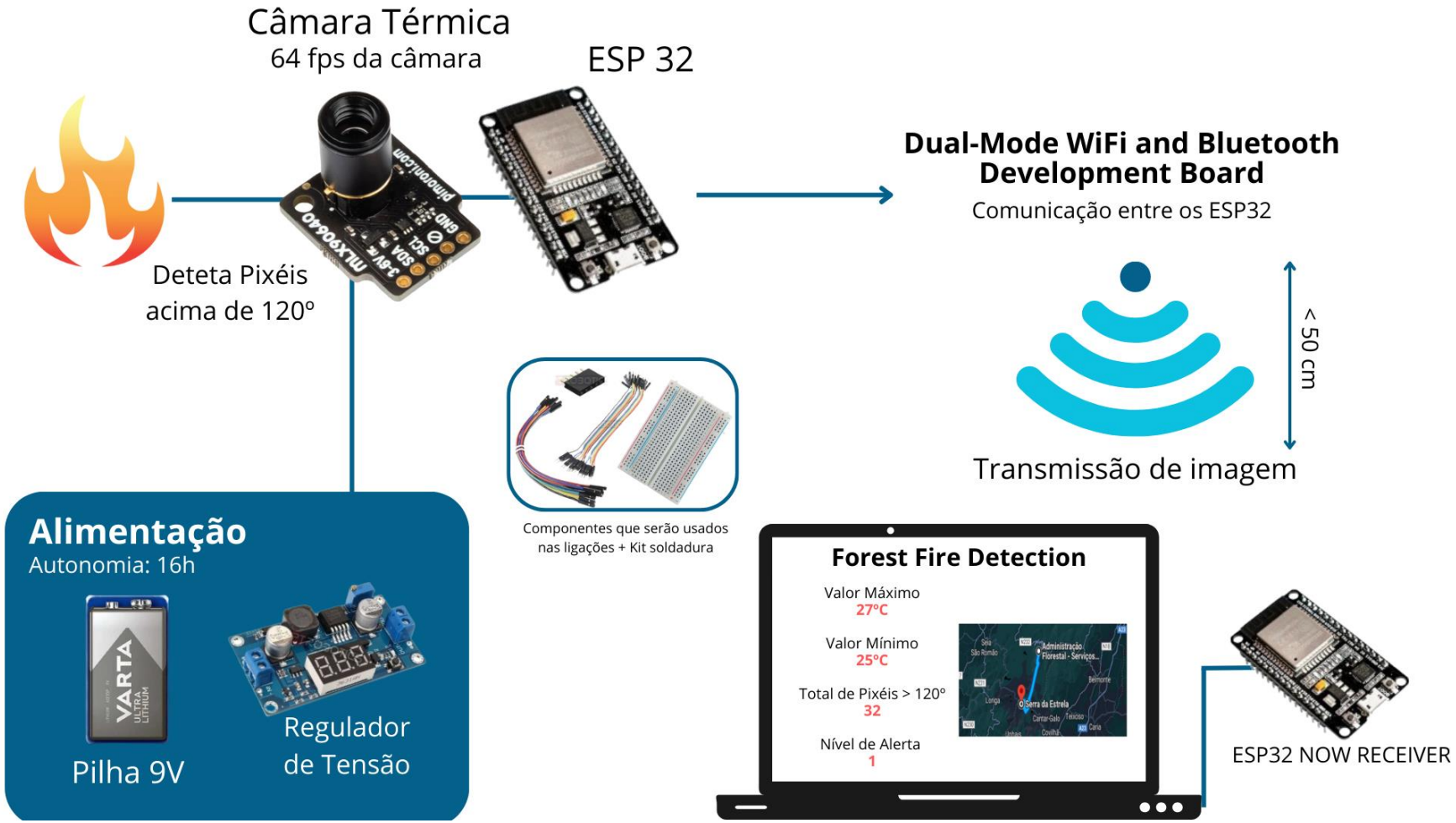
- Capacity: 1800mAh;
- Voltage: 22.2V;
- Cells: 6 s;
- Weight: 270 g;
- Feeding time: 6 hours;

Link da Alimentação

Technological solution (Proof of Concept)

We propose a solution that involves a thermal camera connected to one ESP32 to transmit the information to another ESP32. The second ESP32, upon receiving the information, sends it to the server. The server shows the route of the drone, the maximum temperature obtained, the average temperature, the number of pixels that exceeded 120 ºC, the alert level (0 to 10) and the coordinates in case the alert is greater than 0.

Technological solution scheme (Proof of concept)



Competitors and previous work

- DJIZenmuseH20N-https://grupoacre.com.pt/es/catalogo-productos/dji-zenmuse-h20n/

One of its functionalities consists in the possibility of simultaneously visualize thermal and stellar night image. This functionality may enable the utilization of the drone during night in case of need;

- Insight Robotics-https://inteccon.com/products/wildfires-detection-cameras/

AlertWildfire locates the source of a wildfire with a precision of 2 m2 and a range of 5 km. Additionally, the fire camera operates 24/7, searching for wildfires every 10 minutes;

Competitors and previous work

- DJI FlyCart - https://www.dji.com/pt/flycart-30

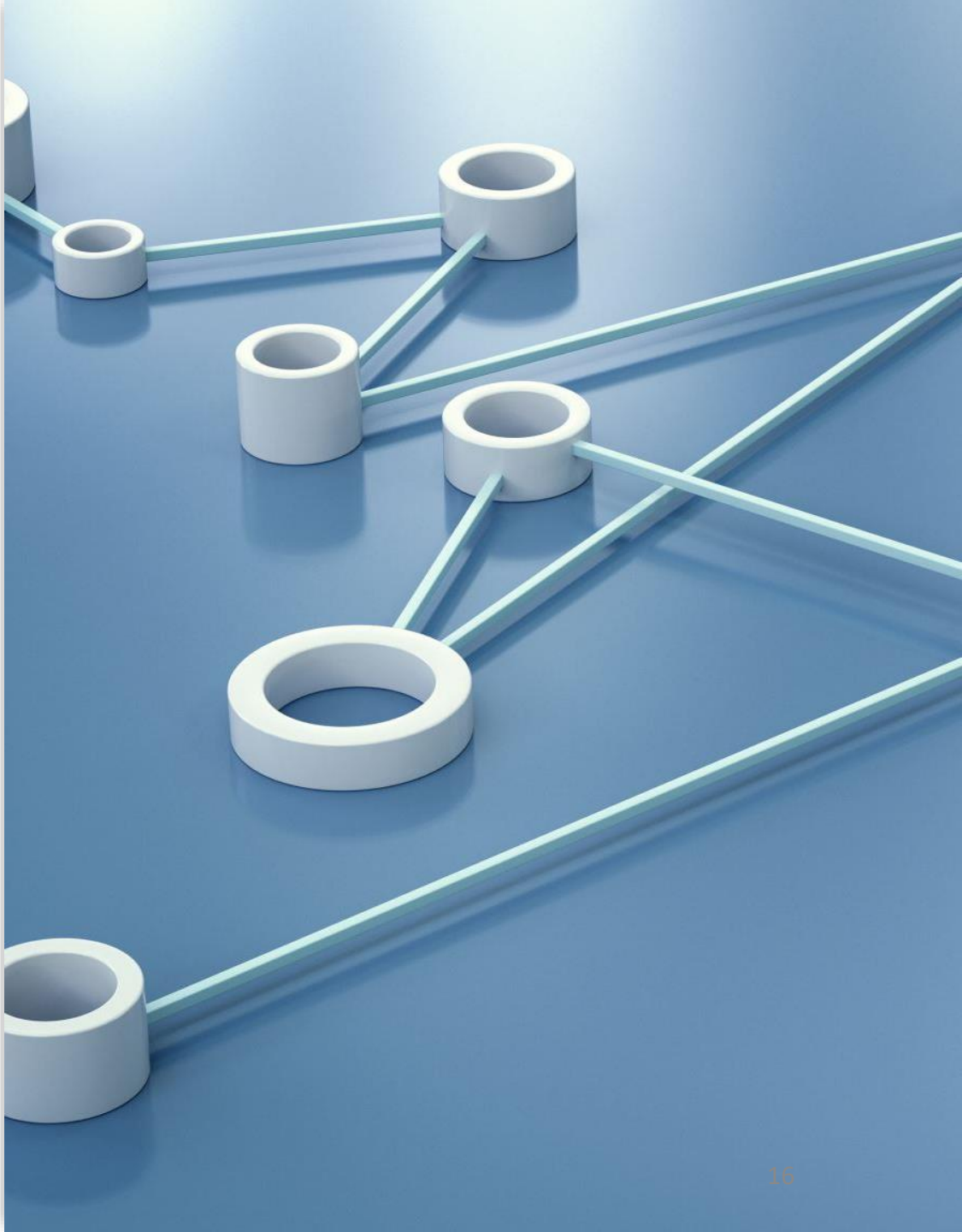
Flycart model from DJI is the perfect example of combination of load capacity (30Kg) and speed (15m/s), what makes this drone a really viable option to support a thermal camera and watch extense forest areas;

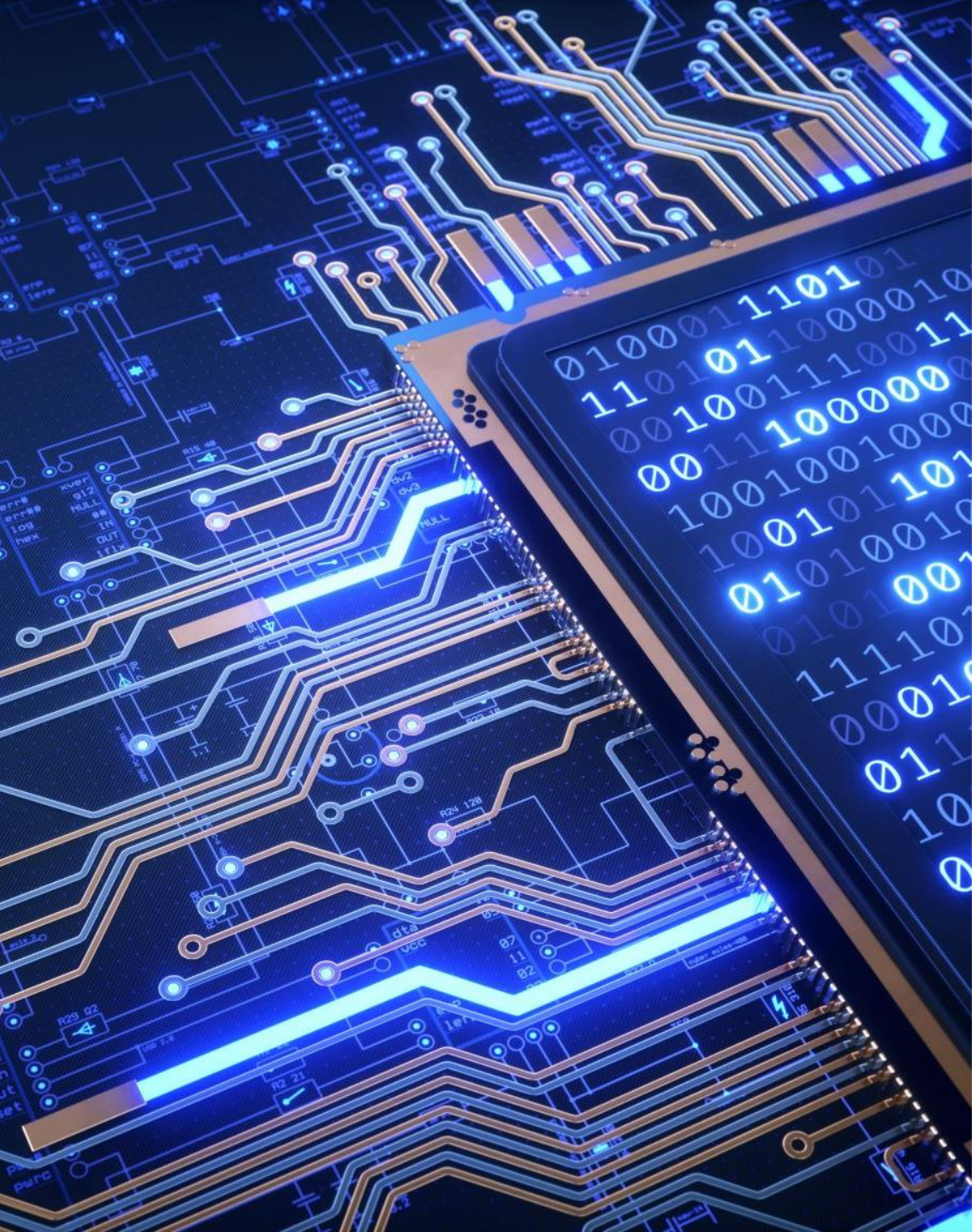
- Infinity Eletro-Optics -https://www.infinitioptics.com/cameras/eclipse

Eclipse has a human DRI rating of 8.6km, 2.9km, 1.45km, making it a potential thermal camera to be operated attached to a drone that would make possible a fast approach to any anomaly detected;

Solution requirements

We propose a solution that implements a software capable of collecting, processing, and analysing thermal images. This images will be transmitted along with other data to a receiver. At the receiver, a control system will forward alerts and thermal images to a display for operators to differentiate between fires and false alarms. For the drone, a long battery life is crucial for extended periods of surveillance, while an intuitive user interface is necessary for remote control and to simplify the configuration and implementation processes.

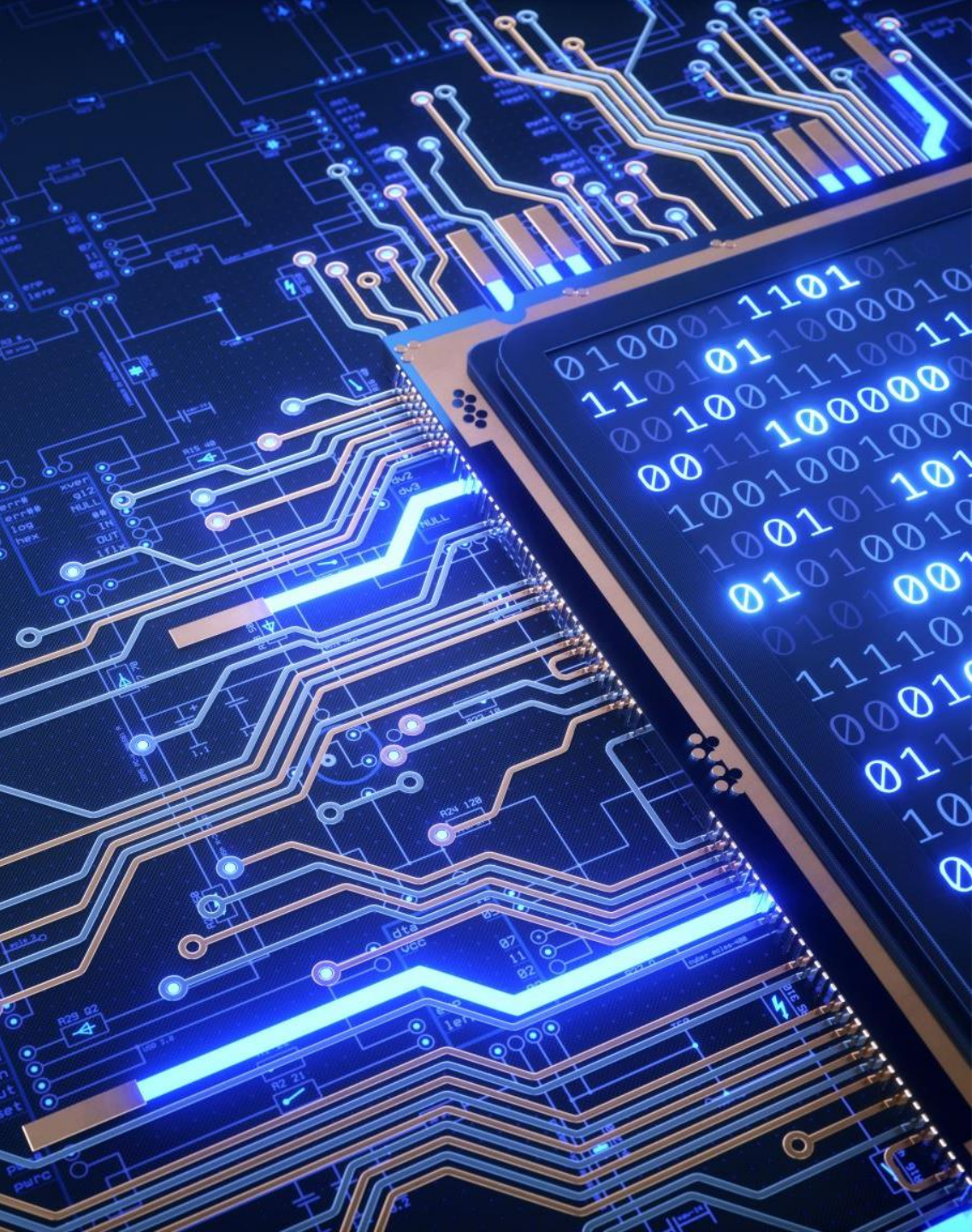




Technical challenges

- The technical challenges encountered include:

- Financial issues: Drawing up the actual project raised economic issues that compromised its feasibility, since the equipment inherent in the project was very expensive. We therefore addressed the problem, looking for the best solution that took into account the relationship between the functionality of the project and its cost.



Technical challenges

- Data protection: One of the most important issues, if not the most crucial, as it put the project at risk of becoming unviable due to the possibility of non-compliance with current data protection law.
- Simulating the code: To simulate the communication code between the electronic components, we used the Wokwi online platform. However, we encountered some limitations, such as the inability to add thermal cameras and to establish communication between 2 ESP32s.

Partners

- In contact with Partner networks of Técnico (NOS, Vodafone, Thales, etc.);
- A Startup, connected to maritime control - Sea.AI;
- Altice - Engineer Luís Lamela (https://www.linkedin.com/in/luislamela/?originalSubdomain=pt);
- We contacted ISR and IT for a possible drone loan;

Update: No answers

Testing and validation metrics

For our testing (proof of concept) we need:

- A thermal camera with a resolution of 768 pixels (32x24), a temperature range of -40° to 300°, a detection distance of up to 20 meters, and a weight of 4g.
- The ESP 32 weighs 3g and has a memory of 4 MB with a maximum range of communication of 2000m.
- A battery + voltage regulator set with 3.3V.
- So we need a drone that can carry at least 140,3g.

Testing and validation metrics

Key aspects to evaluate include:

- **Thermal Camera Evaluation**:
  - Assess thermal camera stability during drone flight;
  - Verify accuracy of thermal readings for reliable data capture;

- **Drone Effectiveness Assessment**:
  - Measure coverage efficiency for specific areas during missions;
  - Evaluate drone autonomy and extended mission capabilities;
  - Test resistance to weather conditions and safe return after fire detection;

Testing and validation metrics

- **Adverse Condition Testing**:
  - Conduct tests in strong wind, low visibility, and extreme temperatures;
  - Ensure reliable system performance in diverse scenarios.;
- **Integration with Alert Systems**:
  - Assess effectiveness of integrating drone system with existing alerts;
  - Enable rapid and accurate communication with relevant authorities;
- **Operational Context Adaptability**:
  - Test drone performance in urban, forest, and mountainous environments;
  - Ensure adaptability across various operational contexts;

Division of labor (1)

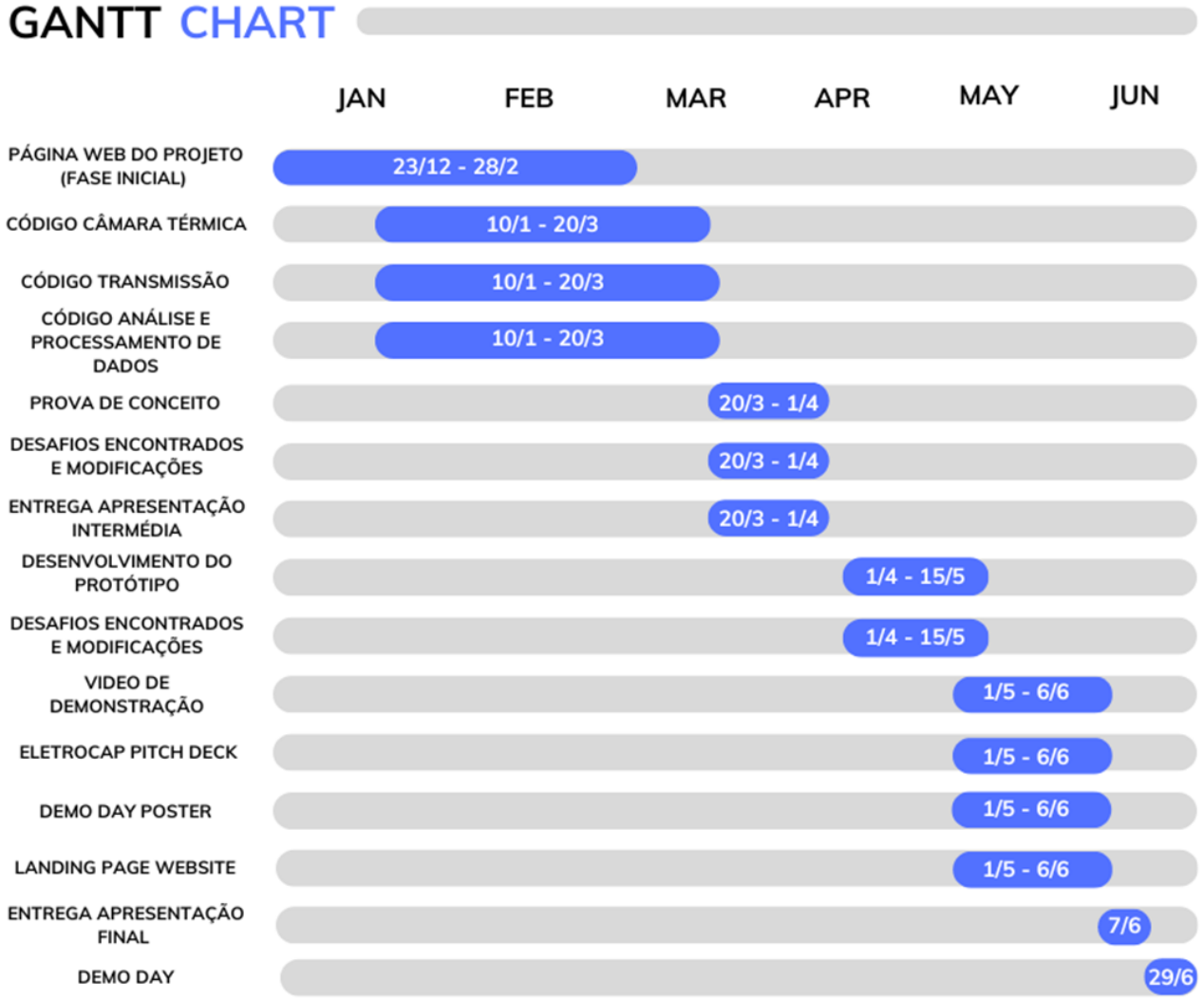
André Alves	Catarina Salazar	Inês Coelho
Main role	**Main role**	**Main role**
Eletrocap Project Proposal	Eletrocap Project Proposal	Eletrocap Project Proposal
Thermal Camera Code	Project Web Page	Project Web Page
Data transmission code between the two ESP32	Code for data analysis and processing	Code for data analysis and processing
Proof of concept	Proof of concept	Proof of concept
Mid-program pitch deck	Mid-program pitch deck	Mid-program pitch deck
Prototype development	Prototype development	Prototype development
Demo Video	Demo Video	Demo Video
Eletrocap Pitch Deck	Editing the demo video	Demo day poster
Landing page website	Landing page website	Landing page website

Division of labor (2)

Inês Martins	José Marques	Pedro Rodrigues
Main role	**Main role**	**Main role**
Eletrocap Project Proposal	Eletrocap Project Proposal	Eletrocap Project Proposal
Project Web Page	Thermal Camera Code	Thermal Camera Code
Code for data analysis and processing	Data transmission code between the two ESP32	Data transmission code between the two ESP32
Proof of concept	Proof of concept	Proof of concept
Mid-program pitch deck	Mid-program pitch deck	Mid-program pitch deck
Prototype development	Prototype development	Prototype development
Demo Video	Demo Video	Demo Video
Demo day poster	Editing the demo video	Eletrocap Pitch Deck
Landing page website	Landing page website	Landing page website

Original Schedule

This was the first Gantt Chart we presented:



Mid-program status

- **REAL PROJECT:** We currently have a real project plan whose main requirements are a drone, a thermal camera, a transmitter and a battery to power the camera.
- **PROOF OF CONCEPT:** For the proof of concept, we already have a data and image demonstration server and we are developing the data transmission and analysis codes while we wait for the material.
- **WEBSITE:** Regarding the website, we always have updated information and we also have a blog where we provide weekly updates about our work.
- **CHANGES:** Our initial approach to the concept (real project) was very expensive, one of the components cost around €20,000 and therefore, on the advice of our advisors, we changed the components to create a cheaper option.

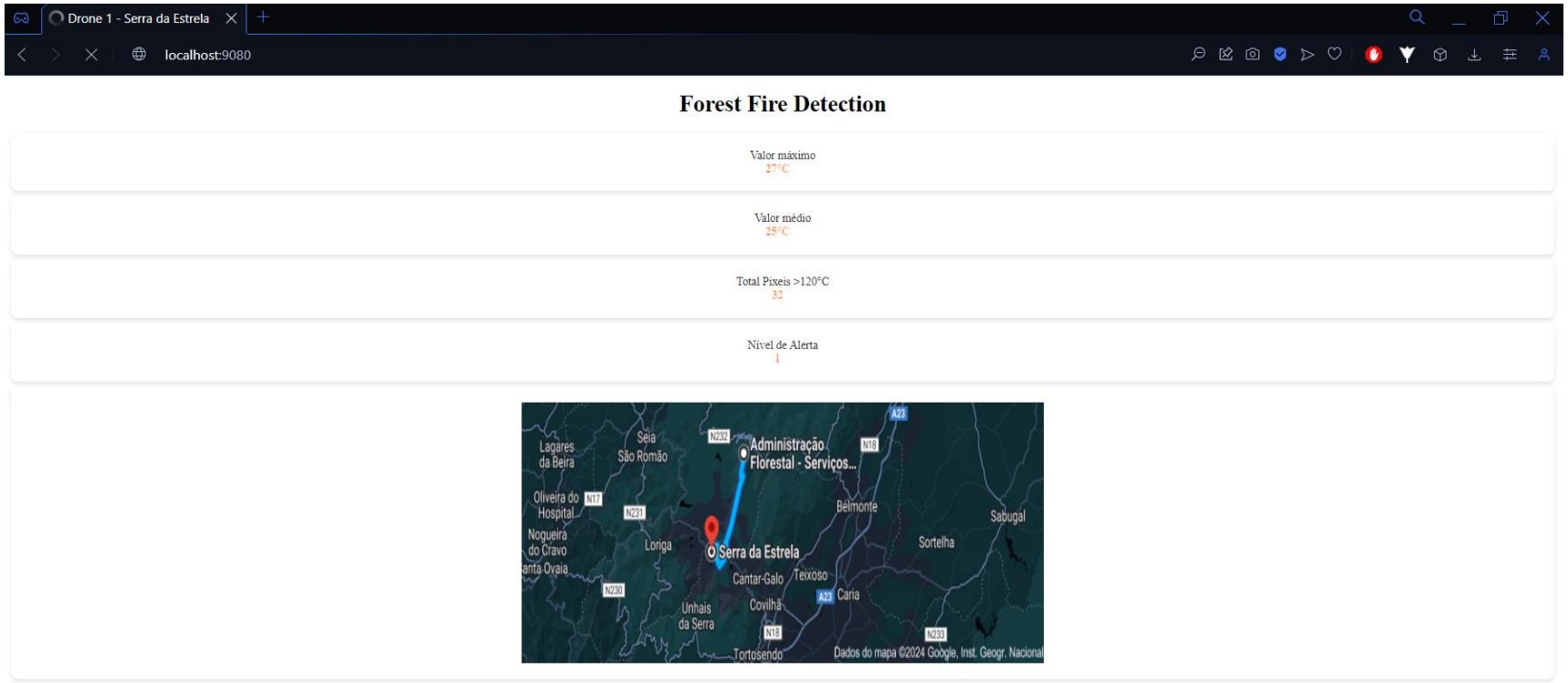
Achieved results

During the first phase of the project, we obtained the following results:

- **ESP32 Simulation:** We created a simulation website where information regarding the condition of the fire will appear, which will help operators obtain an accurate assessment of the situation

- **Communication code between the two ESP32:** contributes to the synchronization and coordination of data obtained from the thermal camera

Achieved results



ESP32 Simulation

Challenges faced by the team

During the first part of the project we encountered some challenges that we had to face, such as:

- Determining whether our project would be a fixed set or movable (drone) and all the implications and consequences that come with it;
- Discovering the best method of communication between the transmitter and receiver, both in the real project and in the proof of concept, due to a lack of knowledge on the subject;
- Choosing the material for the real project, considering affordable prices and quality;
- The whole issue of the drone and whether it was really necessary for the proof of concept.

Deviations from original schedule

- Consider whether or not to use a drone in the proof of concept;
- Changes to materials in the actual project.
- Delays in the delivery of materials or equipment.
- Changes in the organization's priorities.
- Lack of experience and technical knowledge to deal with certain tasks/calculations.
- Underestimation of the duration of certain activities or the dependencies between tasks.
- Limited access to equipment, software or expertise.
- Workload from other personal and academic obligations that overloaded project deadlines.

Time Deviations from original schedule

1/02-5/02: Define the drone and thermal camera to be utilized.

5/02-12/02: Develop an algorithm/process to detect whether it is a fire or not.

5/02-12/02: Establish the communication process between the thermal camera and the user.

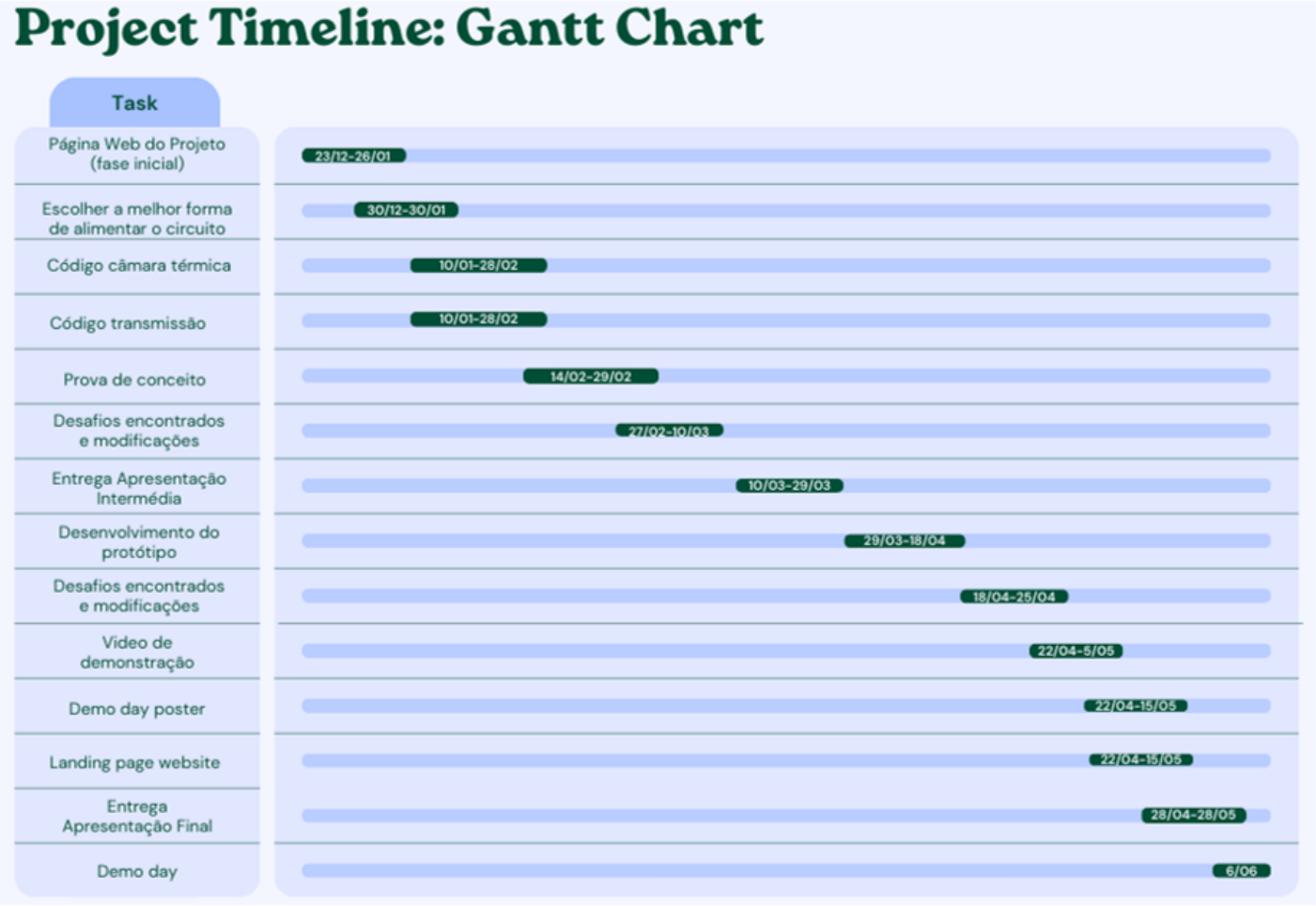
5/02-12/02: In the event of a fire, outline the process to alert the relevant authorities.

Data: Test the respective camera and drone.

First schedule(22/12/2023):

- Embryonic stage.
- Incomplete and underdeveloped.
- It represents the first attempt.

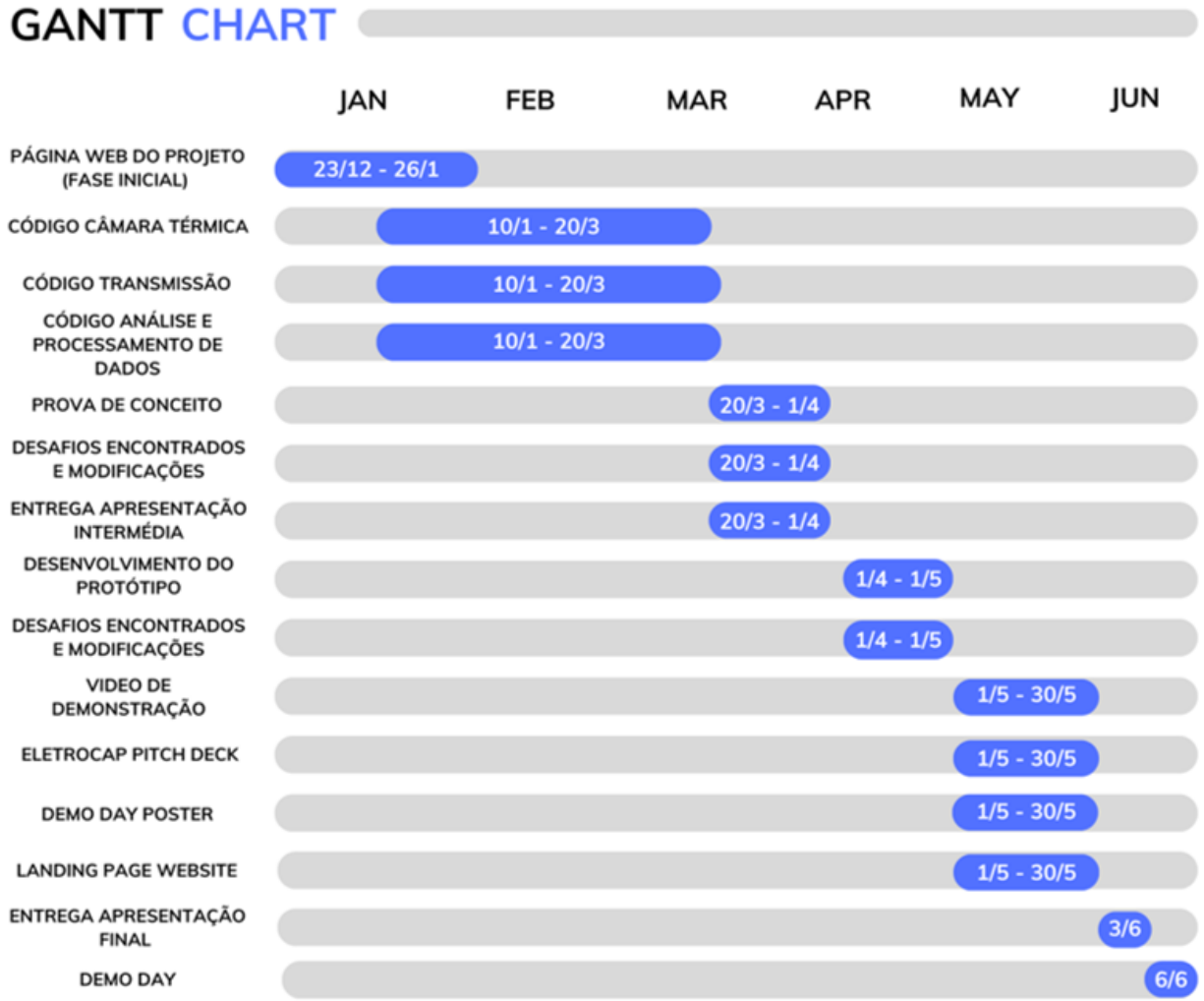
Time Deviations from original schedule



Second schedule(26/01/2024):

- Closer to what was requested in terms of structure and functionality.
- Reflects adjustments recommended by advisors.
- Still requires updates to task dates and the introduction of new tasks.

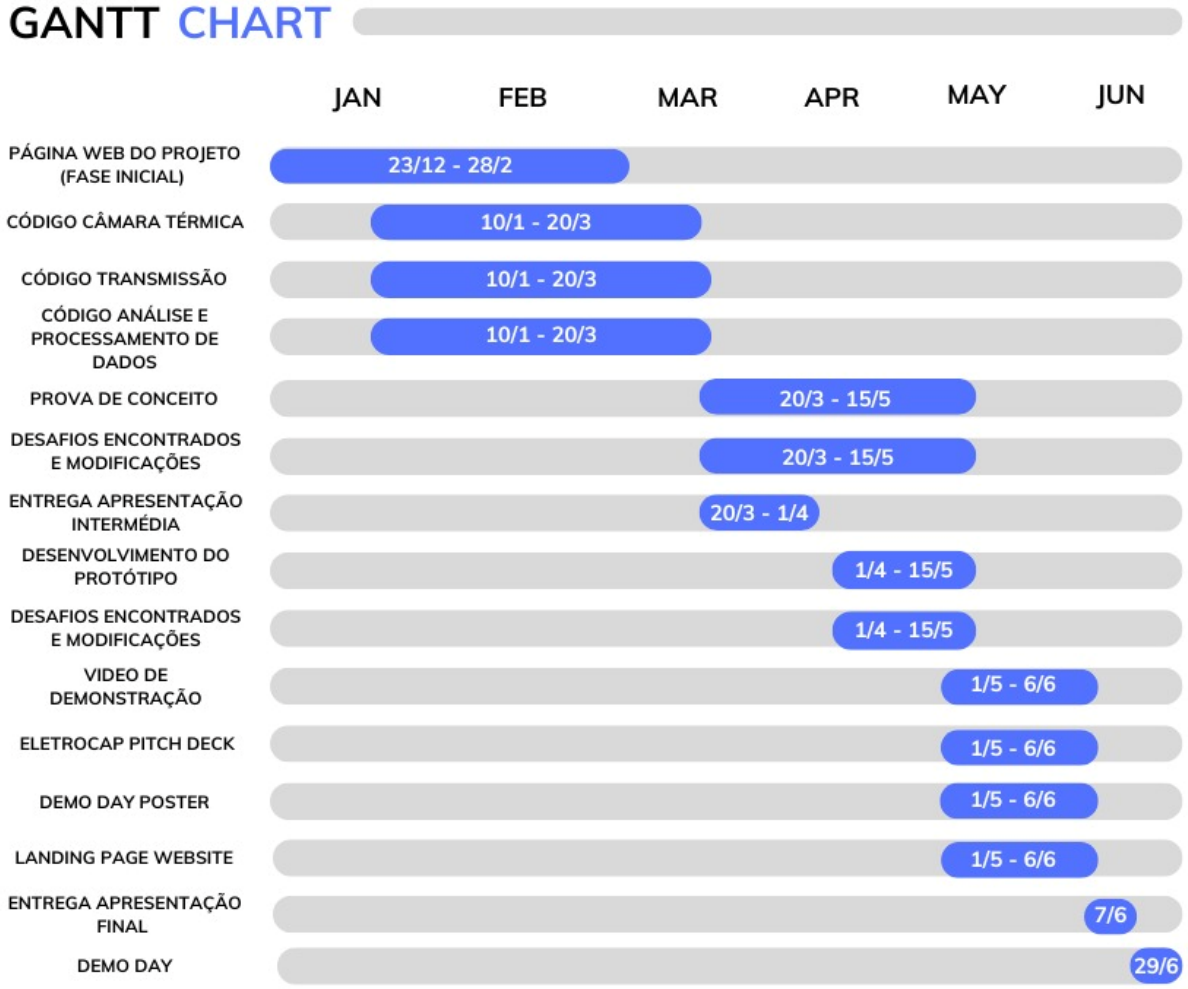
Time Deviations from original schedule



Third schedule(09/02/2024):

- Meets the changes suggested by the advisors.
- Date format has been changed and updated.
- Introduction of new tasks such as the electrocap pitch deck and data analysis and processing code.

Time Deviations from original schedule



Current schedule:

- Reflects the current Gantt chart.
- Changes to dates such as the demo day and the delivery of the final presentation have been made due to the postponement of these events.
- It probably incorporates the final adjustments after all the previous revisions.

Contribution of each team member (1)

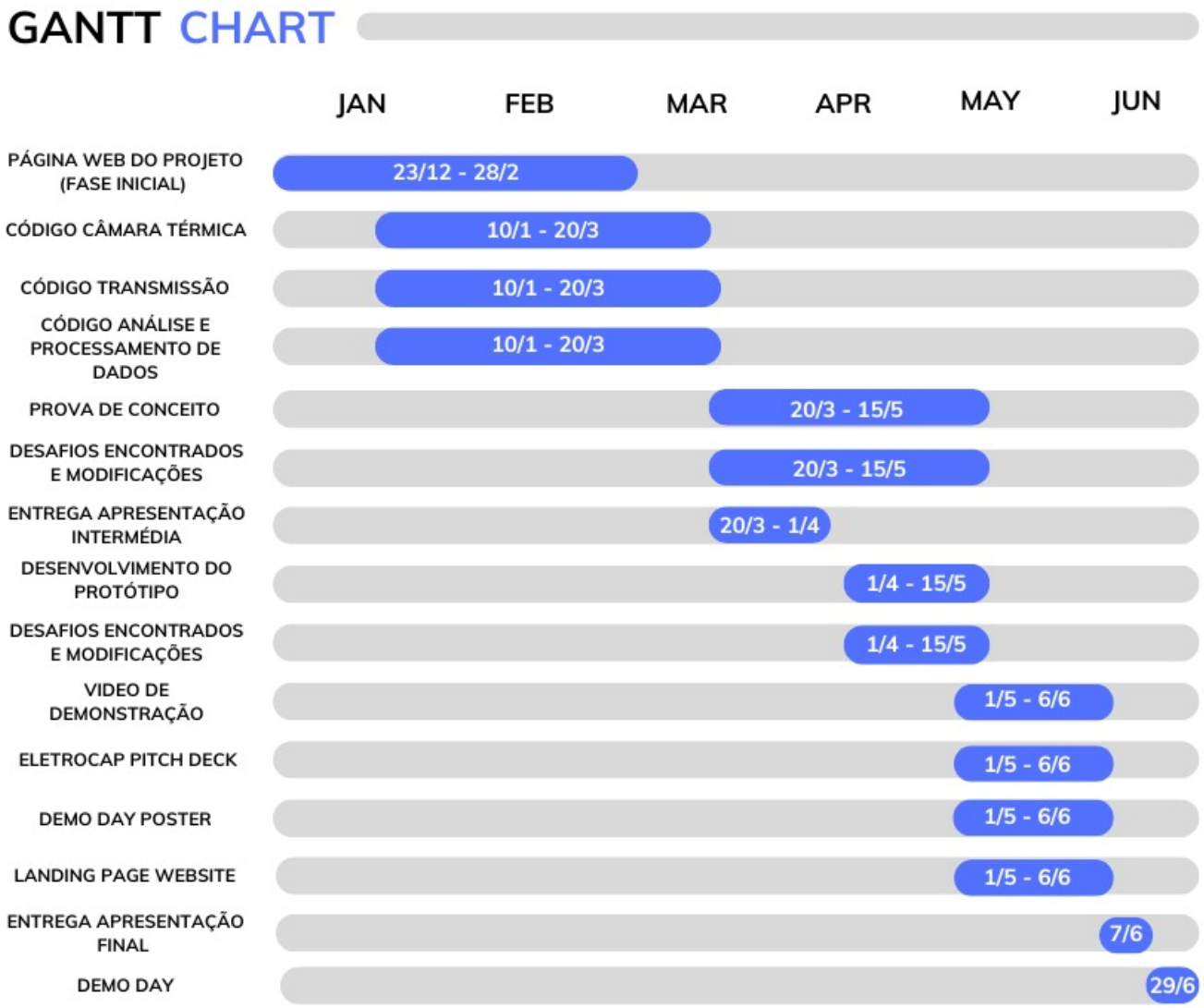
André Alves	Catarina Salazar	Inês Coelho
leader		
Eletrocap Project Proposal	Eletrocap Project Proposal	Eletrocap Project Proposal
Code: Thermal Camera Data Collection	Project Web Page	Project Web Page
Code: communication between the 2 ESP32	Code: Thermal Camera Data Analysis and Processing	Code: Thermal Camera Data Analysis and Processing
Code: Thermal Camera Data Analysis and Processing	Searching components to the Real Project	Searching components to the Real Project
Code: sending the information to the server	Mid-program pitch deck	Mid-program pitch deck
Bill of Material and Budget		
Real Project		
Mid-program pitch deck		

Contribution of each team member (2)

Inês Martins	José Marques	Pedro Rodrigues
Eletrocap Project Proposal	Eletrocap Project Proposal	Eletrocap Project Proposal
Project Web Page	Code: Thermal Camera Data Collection	Code: Thermal Camera Data Collection
Code, Data Analysis and Processing	Code: communication between the 2 ESP32	Code: communication between the 2 ESP32
Searching components to the Real Project	Code: Thermal Camera Data Analysis and Processing	Code: Thermal Camera Data Analysis and Processing
Mid-program pitch deck	Mid-program pitch deck	Code: sending the information to the server
		Mid-program pitch deck

Corrected Schedule

Updated version of the Gantt Chart:



Schedule

Schedule of activities until the end of the project of the Gantt Chart: