ElectroCap Mid-Program Pitch Deck

Monitoring Air Quality in AC Units

TÉCNICO LISBOA

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Advisors and Mentor

- **Scientific Advisor:** Prof. Luís M. Correia
- **Coordinator:** Prof. Luís M. Correia
- **Co-coordinator:** Prof. João Felício

Problem definition

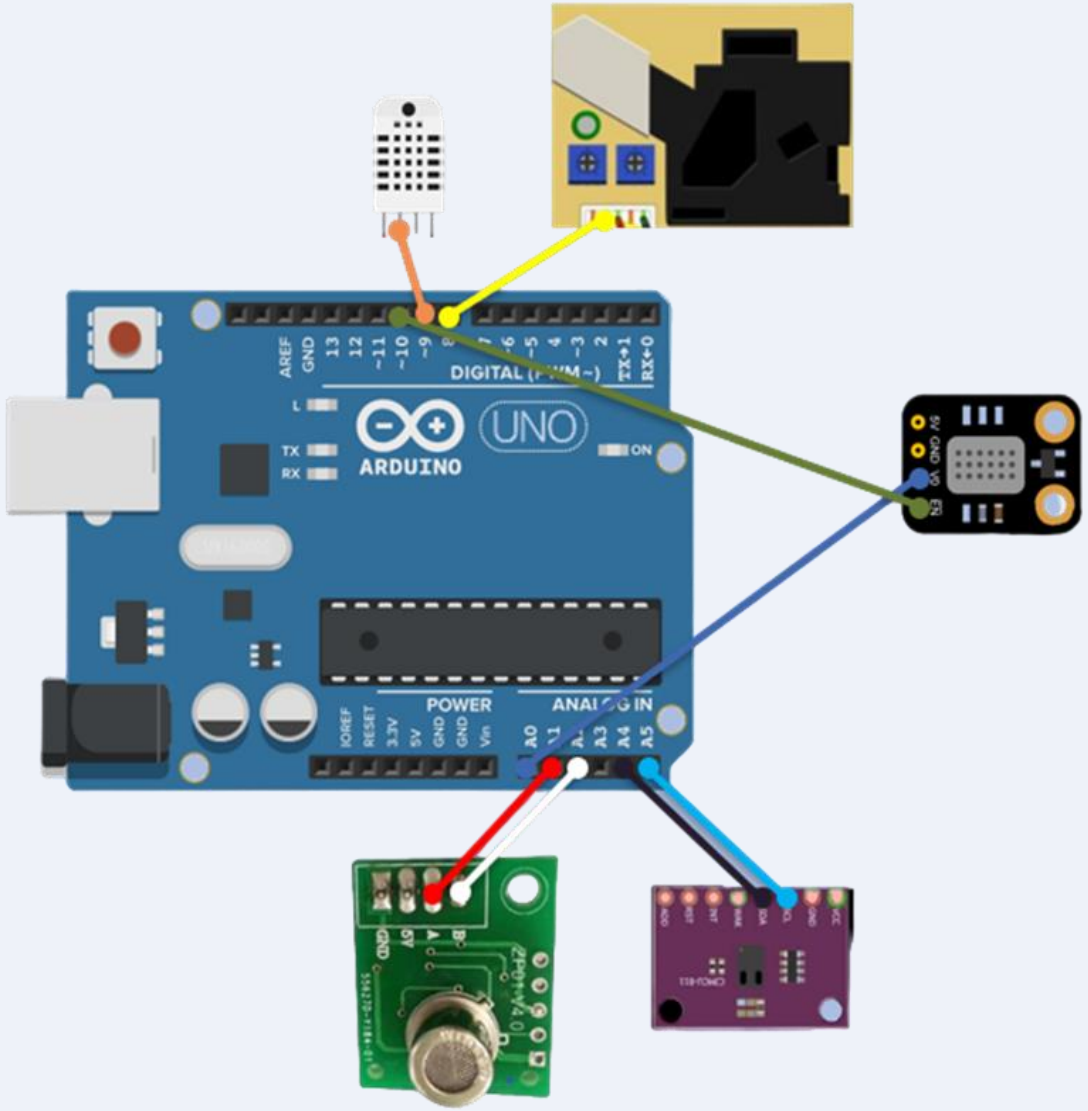
- Lack of Monitoring Devices for Air Conditioning Units
- Importance of Indoor Air Quality Monitoring
- Need for Real-time Assessment and Intervention
- Selection of Key Pollutants for Evaluation (CO_2, NO_2 and PM10)
- Adaptation of Existing Air Quality Index

Solution beneficiaries

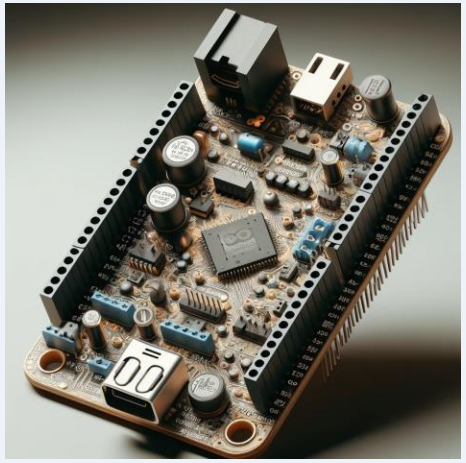
- Industrial workers (specially ones that suffer from allergies or asthma)
- Industrial companies

Technological solution

- ZP07-MP503: Formaldehyde and flammable gases
- DHT22: Temperature and Relative Humidity
- PPD42NS: PM10
- MiCS-2714: NO2
- CCS811: CO2 and TVOC



Technological solution (II)



- The user will obtain from our solution the following data:
  - Air Quality Index (AQI)
  - Air rating regarding formaldehyde and flammable gases
  - Air temperature
  - Relative air humidity
  - Total Volatile Organic Compounds (TVOC) concentration in the air.

- The user can access this data from the LCD1602 screen, and later on, from our website. We're going to transfer the data to a computer via Bluetooth, and then put it in the website.

Technological solution (III)

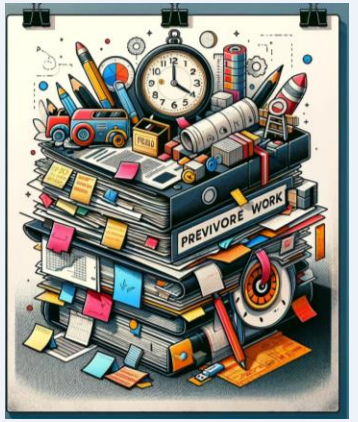
- In our proof of concept, our solution would include more parameters for calculating AQI: PM2.5, O3 and SO2

- It would also have more accurate sensors and every sensor would have the same sample size. Example of better sensors: ZPHS01B and "Gravity" sensors

Competitors

- There are some companies that offer air quality monitoring solutions, such as "Kaiterra," "Elpro," and "Vaisala." These companies provide professional solutions with comprehensive space monitoring, measuring air pollutants and particles to determine Air Quality.
- The solutions provided by these companies are different from ours because they do not measure all the pollutants that our solution measures, and they are not designed for AC units.
- Websites of the companies:
  - https://www.kaiterra.com/sensedge
  - https://www.elpro.com/en/on-site-monitoring
  - https://www.vaisala.com/en/industries-applications/hvac-measurement/indoor-air-quality

Previous work



- Some examples:
  - https://www.youtube.com/watch?v=esY_OtDLv7g&t=320s
  - https://projecthub.arduino.cc/abid_hossain/air-quality-monitor-14f9b4
  - https://how2electronics.com/measure-co2-tvoc-using-ccs811-gas-sensor-arduino/
  - https://www.hackster.io/infoelectorials/project-010-arduino-grove-dust-sensor-ppd42ns-project-ab5f5e

- These projects are not designed for AC Units because they are not positioned at the AC unit outlets, because they do not measure AC gas leakage, and some of these projects do not measure the necessary elements to determine whether the AC filter is dirty or not.

Solution requirements

- It needs to be capable of accurately measuring key air quality parameters (Temperature, Relative Humidity, CO2, CH2O, PM2.5, NO2, TVOC)
- Differentiate between normal variations in air quality (CO2, NO2, PM2.5) and variations potentially caused by issues related to air conditioner performance or maintenance
- We need to find a compatible sampling rate for displaying the data and sending it via bluetooth
- Be user friendly

Technical challenges

During the making of this project some difficulties may arise:

- Ensuring the accuracy of the various sensors
- Some sensors can influence the readings of others
- Create an intuitive and user-friendly interface to ensure that every user can easily understand how to interpret the provided information
- Balancing the cost of components and sensors with its accuracy and precision

Technical challenges (II)

- Each type of industry has different specifications and pollutants that must be considered in the product's development and sensor selection

- The way of attaching the product to the industrial AC unit also varies depending on the type of AC unit

Testing and validation metrics

To test if the particles sensor is operating normally we are going to conduct tests such as:

- Dirty filter in front of a fan to test the particles
- Lighter near the prototype to test the CO2

Rating	PM10 [µg/cm^3]	NO2 [µg/cm^3]	CO2 [ppm]
1 – Very poor	101 – 1200	401 – 1000	>1800
2 – Poor	51 – 100	201 – 400	1100 – 1800
3 – Moderately polluted	36 – 50	101 – 200	800 – 1100
4 – Satisfactory	21 – 35	41 – 100	600 – 800
5 – Good	0 – 20	0 – 40	0 – 600

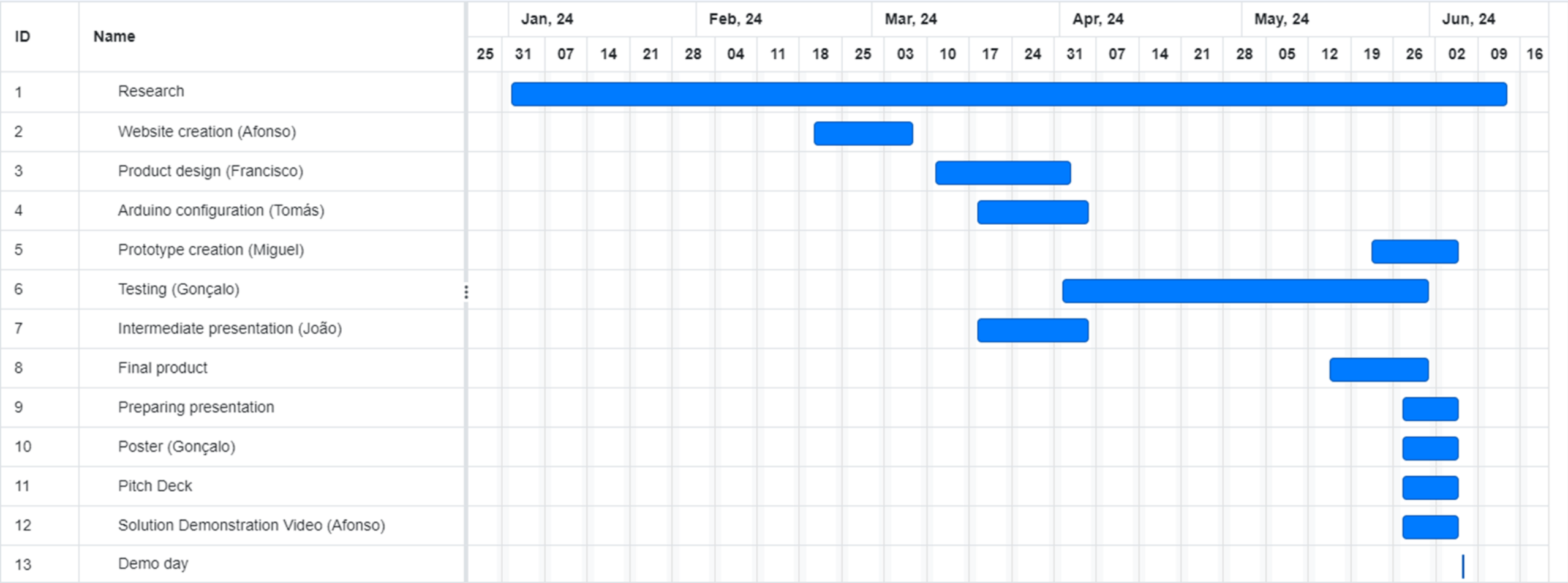
Division of labor (1)

Afonso Oliveira	Tomás Oliveira	Francisco Oliveira
Project manager	**Programmer**	**Design**
Sensor research	Arduino configuration	Product design
Sensor calibration and testing	Research	Prototype planning
Solution demonstration video	Programming	AC integration
Tasks management	Bluetooth Protocol Integration	Hardware Integration

Division of labor (2)

João Santos	Miguel Parreira	Gonçalo Mendes
Programmer	**Circuit planner**	**Test engineer**
Website creation	Sensor research	Develop test protocols
Arduino programming	AC integration	Arduino configuration
Presentation preparation	Prototype planning	Poster preparation
Blog writing	Hardware Integration	Data Analysis

Original Schedule

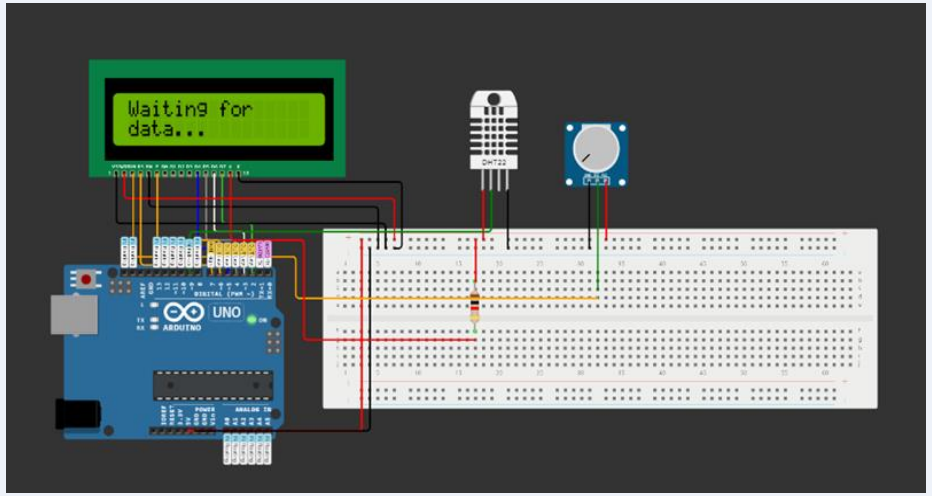


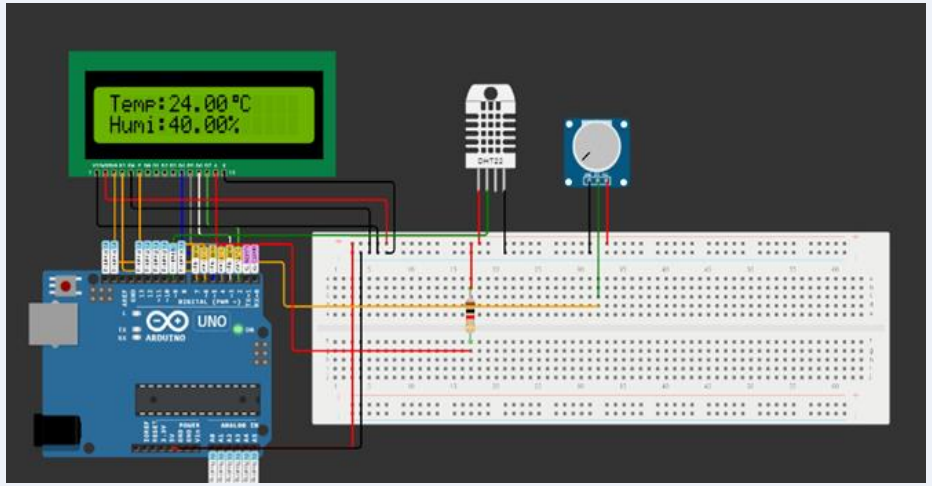
Mid-program status

- The initial idea was to measure air quality using the AQI (Air Quality Index) scale
- We conducted several researches on the operation of each sensor, how to implement its code, and how measurement errors could influence the obtained results
- We chose to prioritize the functioning of the prototype over its design
- We used our website as a means to update the status of our prototype

Achieved results

- Due to high costs in sensors, we decided to only measure the concentrations of PM10, NO2, CO2, TVOC, temperature, and humidity
- Cost reduction of approximately €470
- The reduction of economic costs leads to our prototype having a measurement error higher than anticipated
- We have codes for the sensors, but we were only able to test for the DHT22
- The test of this code was successful
- The runtime of our prototype will be one minute



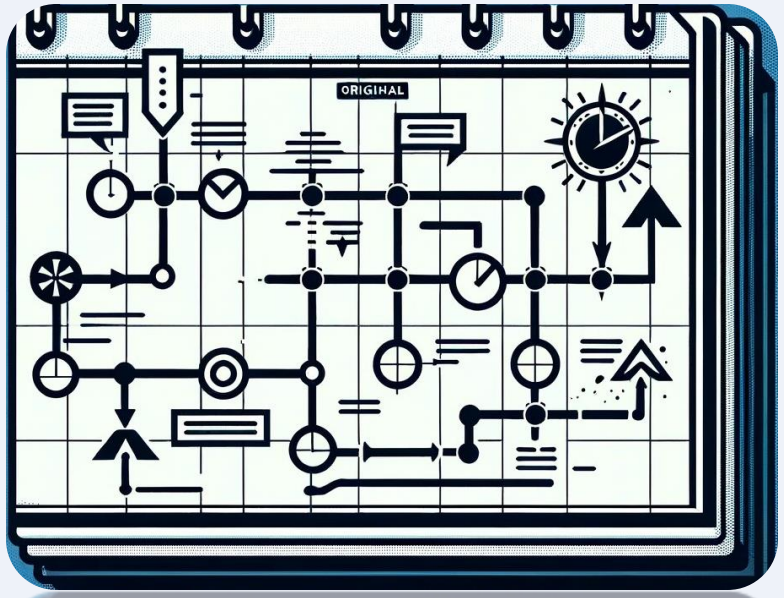


Challenges faced by the team

- Difficulty specifying in which situation we will measure air quality
- The proposed solution is too like the existing ones
- Lack of sensors and hardware
- There are no sensors in the simulators

Deviations from original schedule

- Unclear project scope and objectives
- Underestimation of task complexity
- Difficulty in programming the website
- Lack of sensors and hardware
- Personal commitments and workload



Contribution of each team member (1)

Afonso Oliveira	Tomás Oliveira	Francisco Oliveira
Project manager	**Programmer**	**Design**
Sensor research	Arduino configuration	Research
Tasks management	Research	Logo design
Hardware integration	Hardware integration	Prototype planning

Contribution of each team member (2)

João Santos	Miguel Parreira	Gonçalo Mendes
Website creation	**Research**	**Research**
Sensor research	Research	Research
Website creation	Arduino research	Website creation
Blog writing	Prototype planning	Arduino configuration

Corrected Schedule