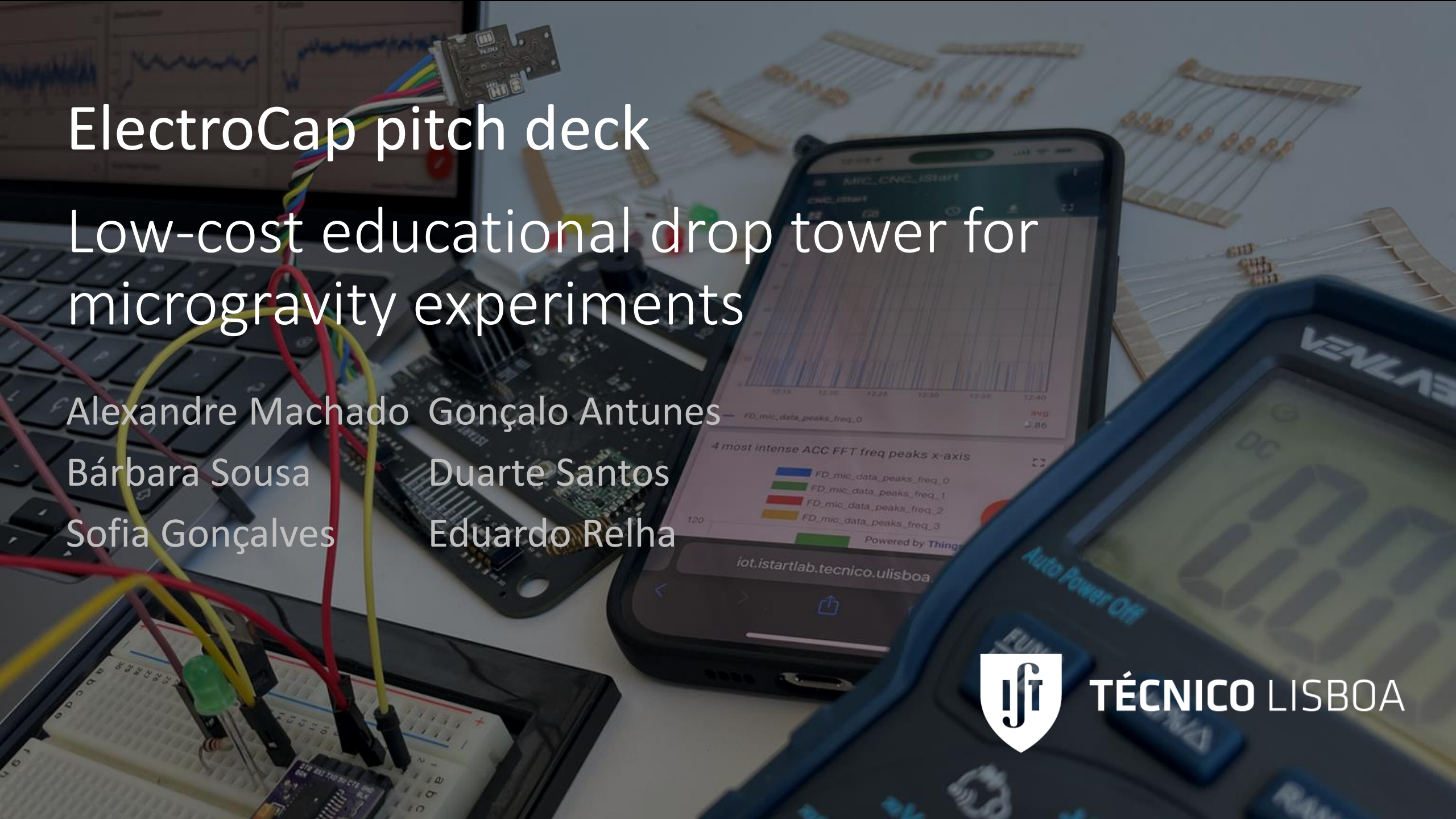
# ElectroCap pitch deck

## Low-cost educational drop tower for microgravity experiments

Alexandre Machado  Gonçalo Antunes
Bárbara Sousa  Duarte Santos
Sofia Gonçalves  Eduardo Relha




TÉCNICO LISBOA

# 1. Introduction

In a world made by science, driven by science, a lot of people, especially young students, lose interest or don´t delve deep enough in the STEM area to properly develop their capabilities and interests.

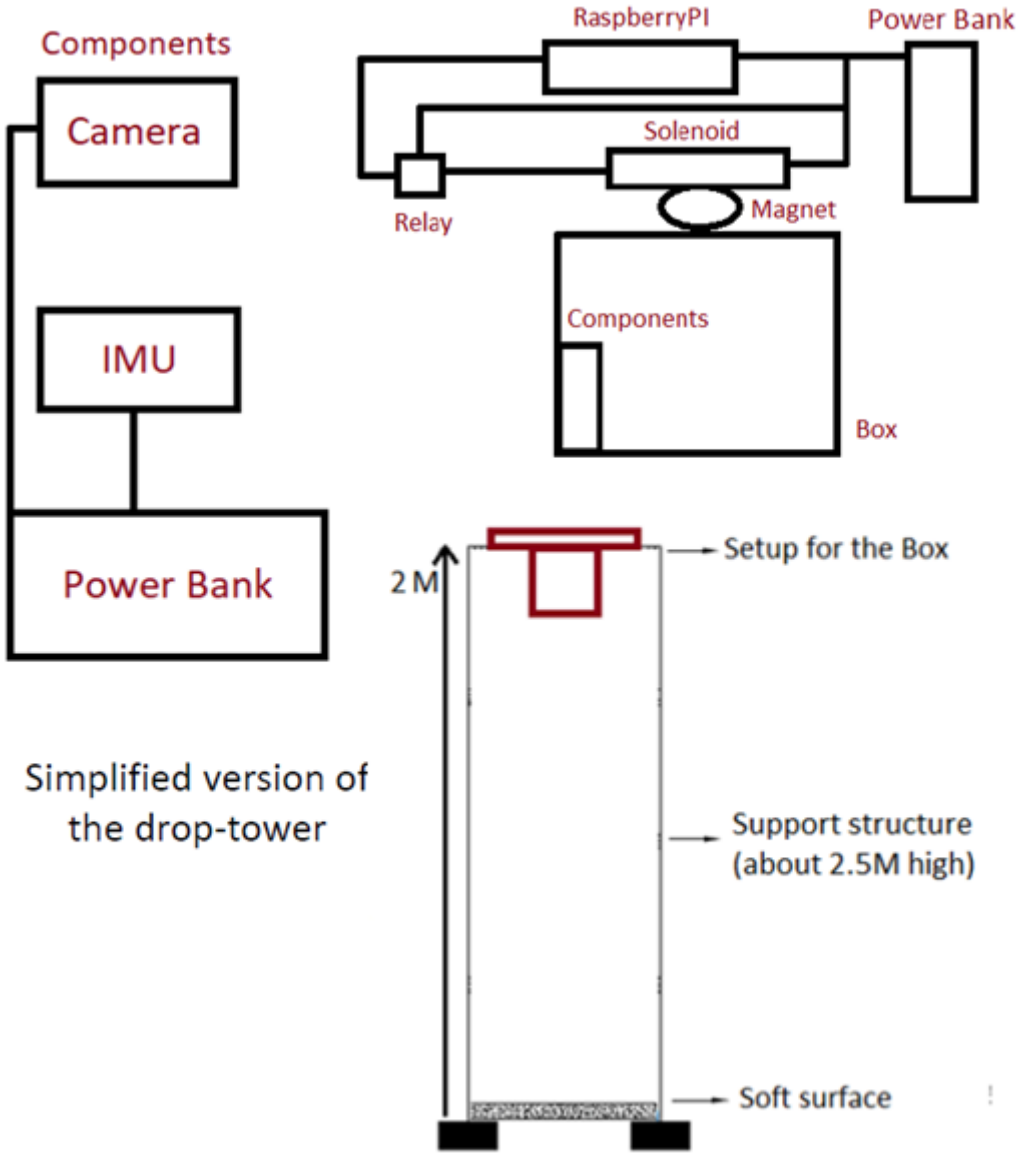
This project aims to primarily develop interest in the physics and electrotechnical areas by encouraging users to partake in easy and intuitive experiments.

# 2. Problem definition

- Microgravity effects, such as liquids forming spheres and flames becoming spherical, generate scientific curiosity across all age groups
- Microgravity experiments are currently reproducible using drop towers
- Drop towers are expensive and limit public engagement in this area
- The restricted accessibility to explore these effects underscores the need for affordable and user-friendly drop towers
- **Developing low-cost and easily deployable drop towers would enable the scaling up of microgravity experiments**

# 3. Technological solution

- Use a reinforced Plexiglas box that can easily handle experiments inside with a camera and IMU inside
- Use an easily deployable structure that can handle the free-falling box
- Stick the Plexiglas box to the structure using a solenoid
- Use a RaspberryPI server to handle the experiments remotely and receive data into a database
- Remotely control the solenoid through the RaspberryPI
- Use a soft surface, for example, a net to soften the fall of the Plexiglas box
- The result would be an intuitive drop tower that can handle experiments



# 4. Target audiance

People across all ages that have an interest in STEM and students from primary school to undergraduate levels who are starting to learn about these topics for the first time would benefit greatly from having firsthand experiences with microgravity effects.


# 5. Previous work

- The drop tower developed by the ISU is a small unit that can be dropped from a ceiling using an electromagnet, however it is currently outdated and requires a lot of human intervention to run experiments.

# 6. Team

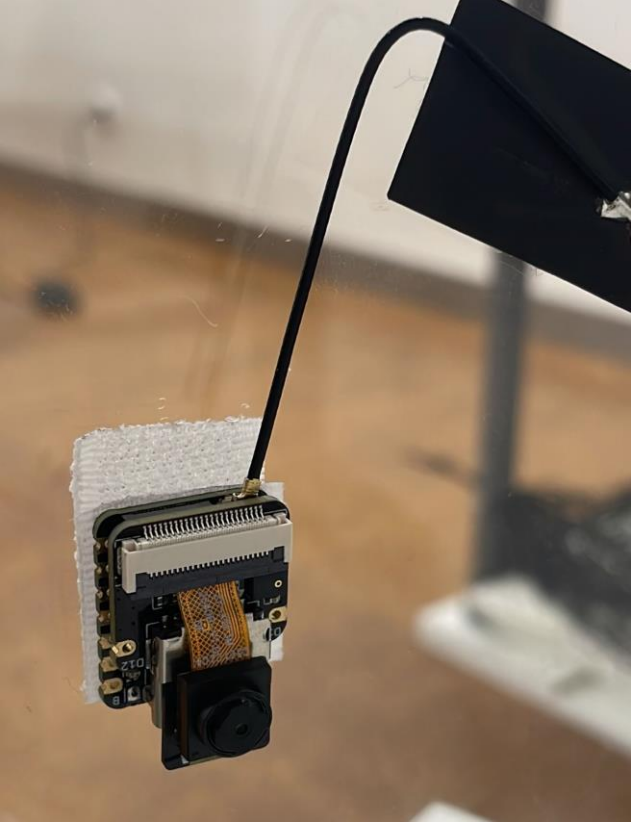
## Students:

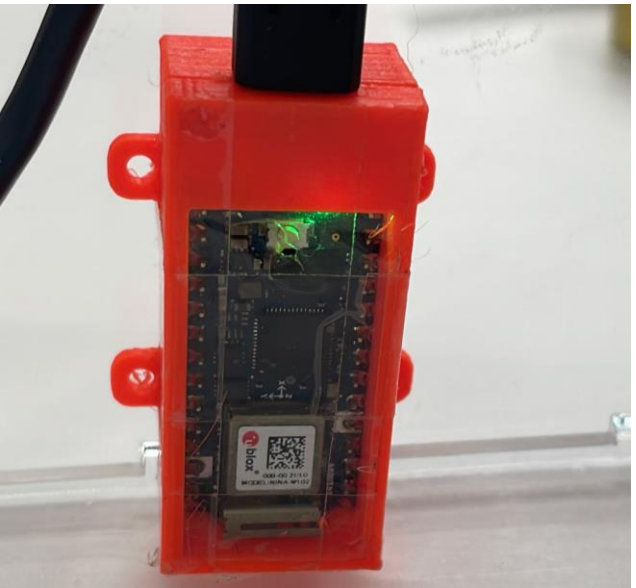
- Alexandre Machado
- Bárbara Sousa
- Gonçalo Antunes
- Duarte Santos
- Eduardo Relha
- Sofia Gonçalves

## Coordenation:

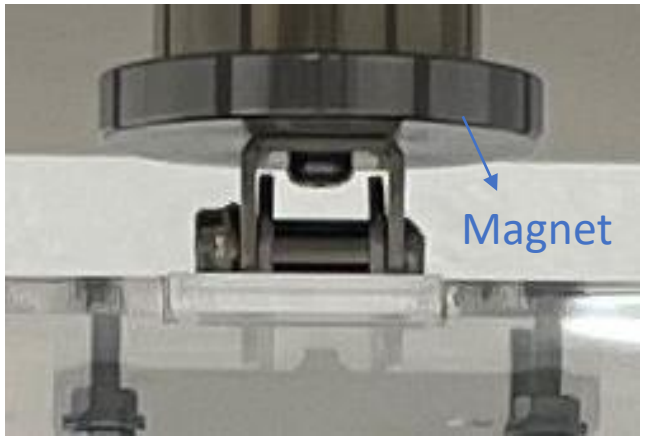
- Scientific Advisor: Prof. Rodrigo Ventura
- Scientific Co-advisor: Prof. Luís Caldas de Oliveira
- Coordinator: Prof. Luís Caldas de Oliveira
- Mentor: Rafael Cordeiro

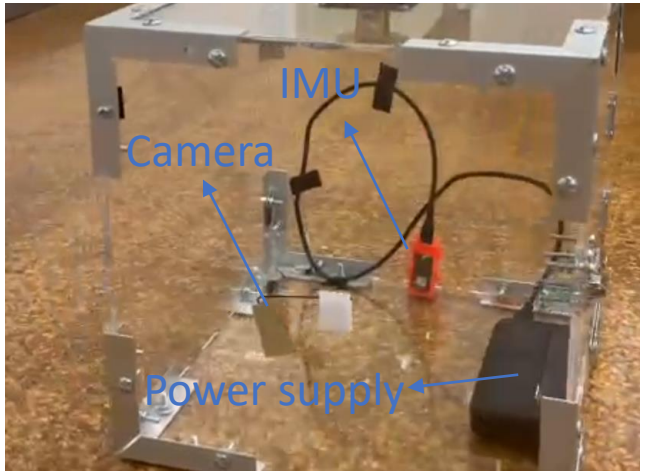
## Partners include the ISR and ISU





Various components of the Plexiglas box

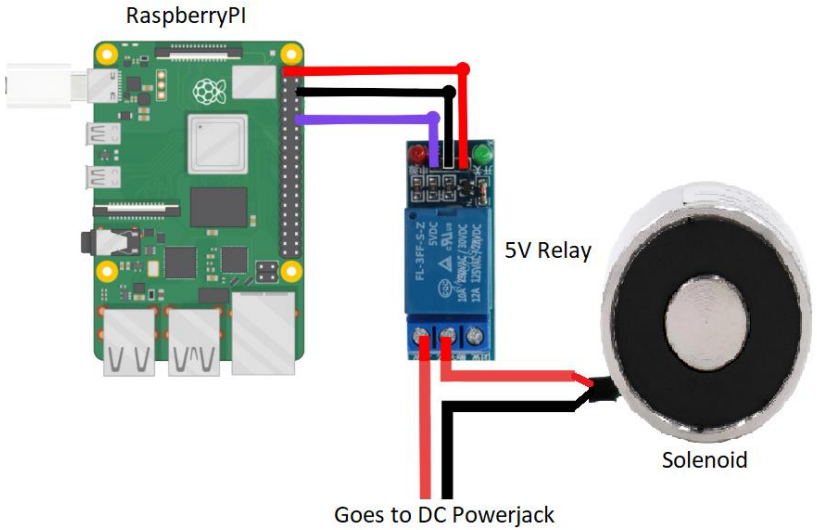


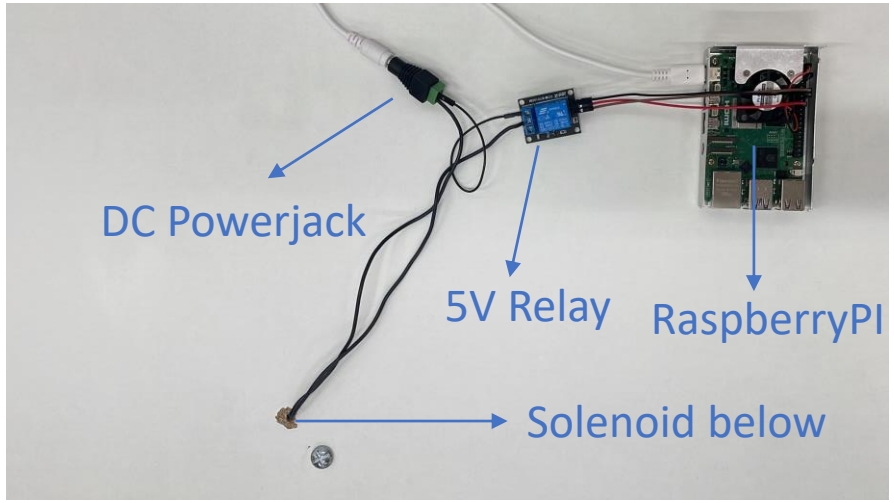




# 7. Results (I)

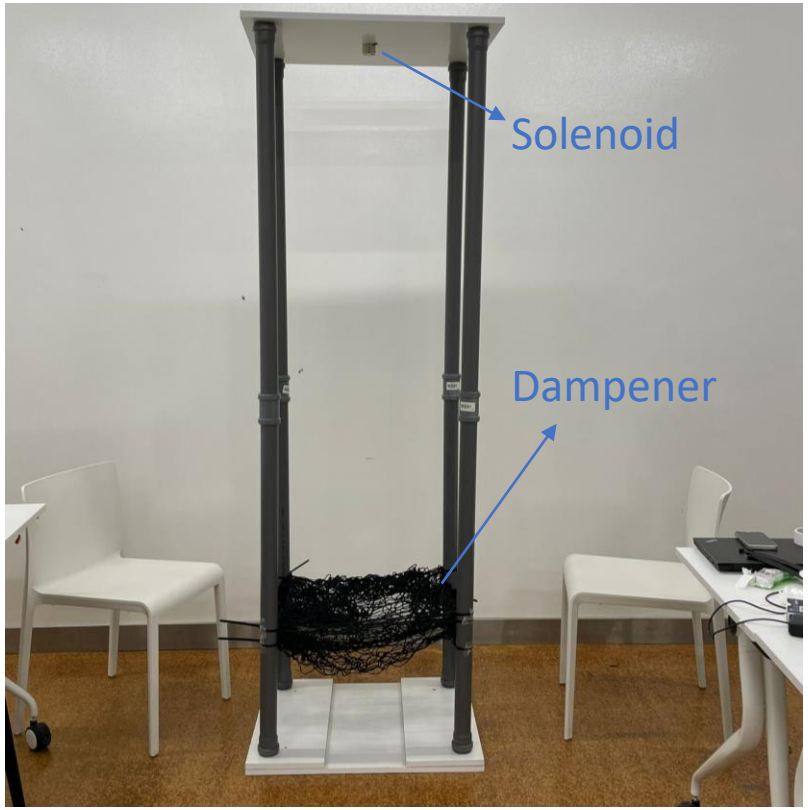
- Developed a sturdy acrylic box using 3D printing with a small door to place the IMU, camera and experiments.
- Developed a deployable support structure about 2M high to place the box.
- Developed a solenoid control system remotely controlled by a RaspberryPI.
- Developed a database where IMU, video and several other data is sent through WI-FI and stored.
- Developed a website where we can control the solenoid, IMU, camera and various other aspects such as name of the user and experiment as well as visualize IMU graphs in real time.

# 8. Results (II)




Solenoid control system remotely controlled by a RaspberryPI

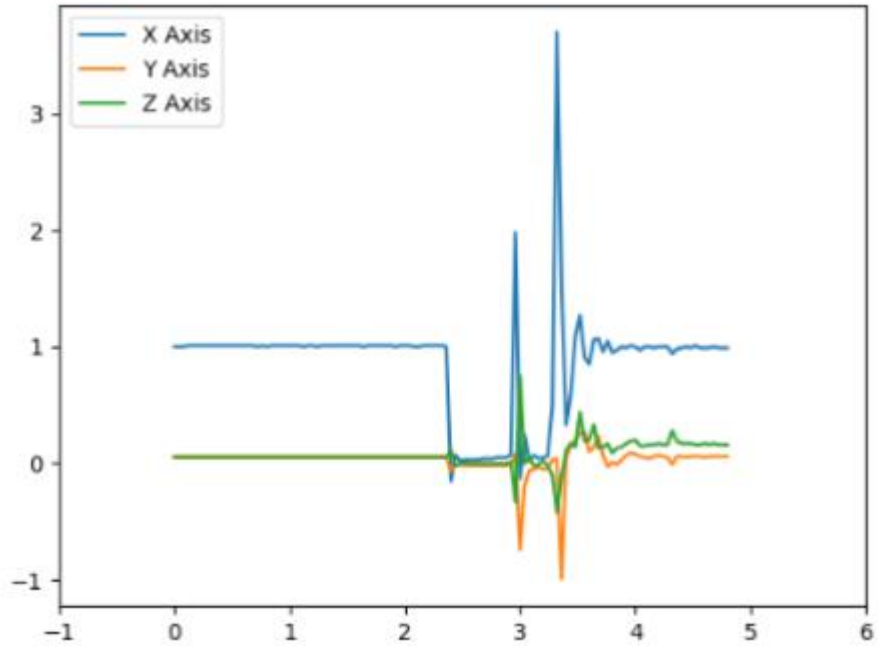



Support structure used about 2M tall

Full drop tower with Plexiglas box attached

# 9. Results (III)

Side to side photos of an experiment with a candle (candle during free fall)




Obtained graph from the experiment nominal 1 = 1g (9.8) and with a free fall reading (value of 0)

# 10. Contribution of each team member(I)

<table>
<tr><th>Alexandre Machado</th><th>Duarte Santos</th><th>Eduardo Relha</th></tr>
<tr><td>Detective (problem finder)</td><td>Executor (focused on the work and the urgency of obtaining results)</td><td>Gadget (problema solver)</td></tr>
<tr><td colspan="2">Development of IMU data handling and live website graph</td><td rowspan="3">Development of video camera data handling</td></tr>
<tr><td colspan="2">Development of solenoid control system</td></tr>
<tr><td>Development of the website and blog updates</td><td>Development of RaspberryPI control website</td></tr>
<tr><td>Development of video</td><td colspan="2">Sourcing of materials</td></tr>
<tr><td colspan="3">Testing</td></tr>
</table>

# 11. Contribution of each member (II)

<table>
<tr><th>Sofia Gonçalves</th><th>Bárbara Sousa</th><th>Gonçalo Antunes</th></tr>
<tr><td>Dreamer (production of new ideas)</td><td>Politician (communication and conflict solver within the group)</td><td>The Skeptical (challenges ideas and questions their viability)</td></tr>
<tr><td colspan="3">Sourcing of materials</td></tr>
<tr><td rowspan="2">Development of RaspberryPI control website</td><td>Development of poster</td><td></td></tr>
<tr><td colspan="2">Development of acrylic box</td></tr>
<tr><td>Development of RaspberryPI database and data handling</td><td>Development of support structure</td><td>Development of fall dampner</td></tr>
<tr><td colspan="3">Testing</td></tr>
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# 12. Costs and benefits

## Costs

- Drop tower is inexpensive to make using cheap and easily accessible materials
- Easily made and adaptable able to use different components if desired
- Easily upgradable by using higher heights if desired or more robust components for more serious research

## Benefits

•Easily portable for the scale of the prototype
•Intuitive and ease of use with 24/7 access to all data ran by every experiment
•Close to zero human intervention to run experiments

# 13. Links to web addresses with additional information

Main website page:
https://web.tecnico.ulisboa.pt/ist1103530/public/

Main website blog page:
https://web.tecnico.ulisboa.pt/ist1103530/public/blog/

Website page for data handling and control:
https://jaybird-just-early.ngrok-free.app/

Video link:

https://youtu.be/wQADXNXom_0