ODYSSEUS
EUROPEAN YOUTH SPACE CONTEST

Orbital Point of View

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Who am I?

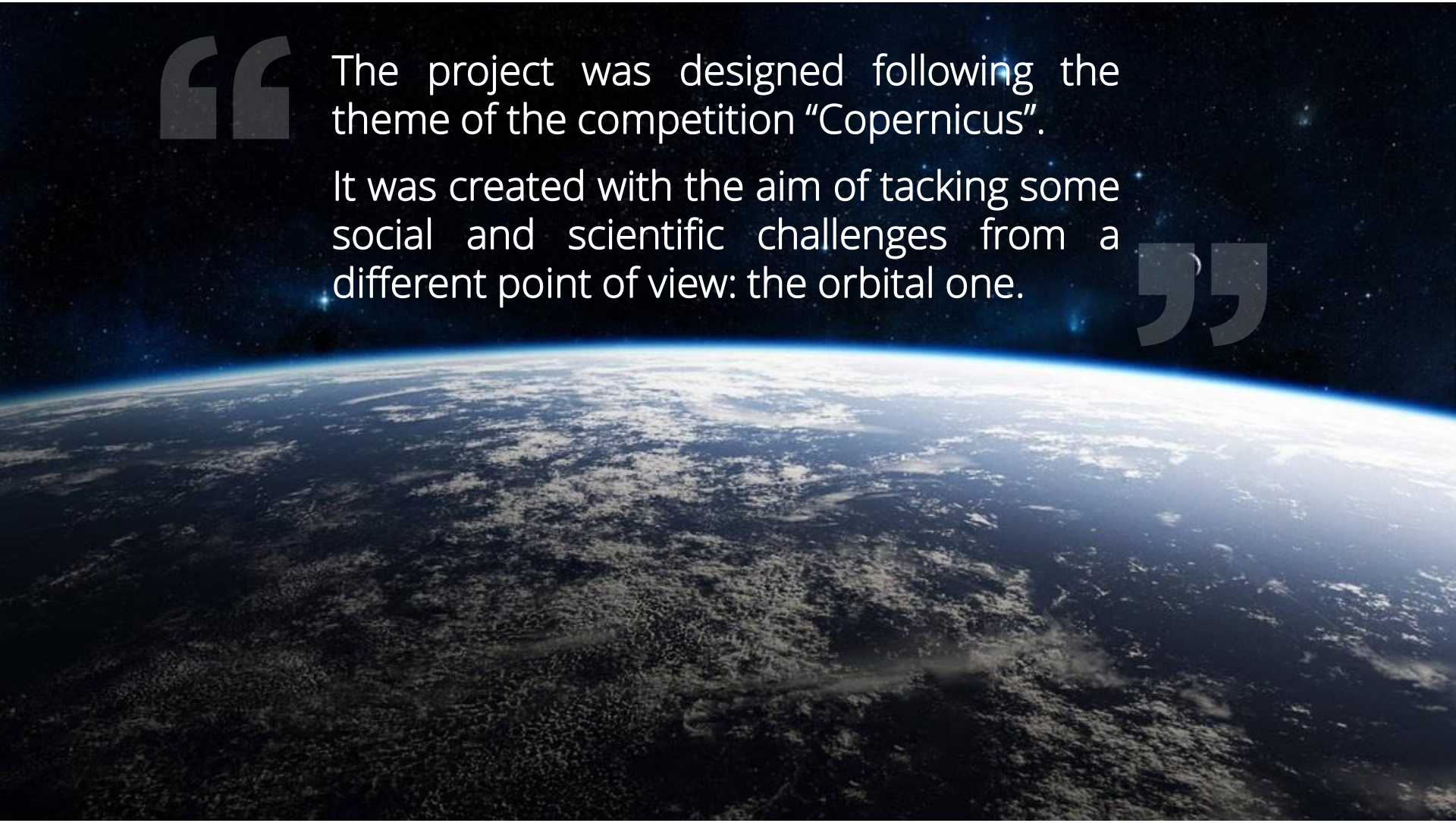
Hi! I am Alice Antonelli!

I'm 18 and I attend the last year of high school.

I come from Montescudaio, an Italian town in Tuscany.

I love rowing and creating (and destroying!) aircraft models.

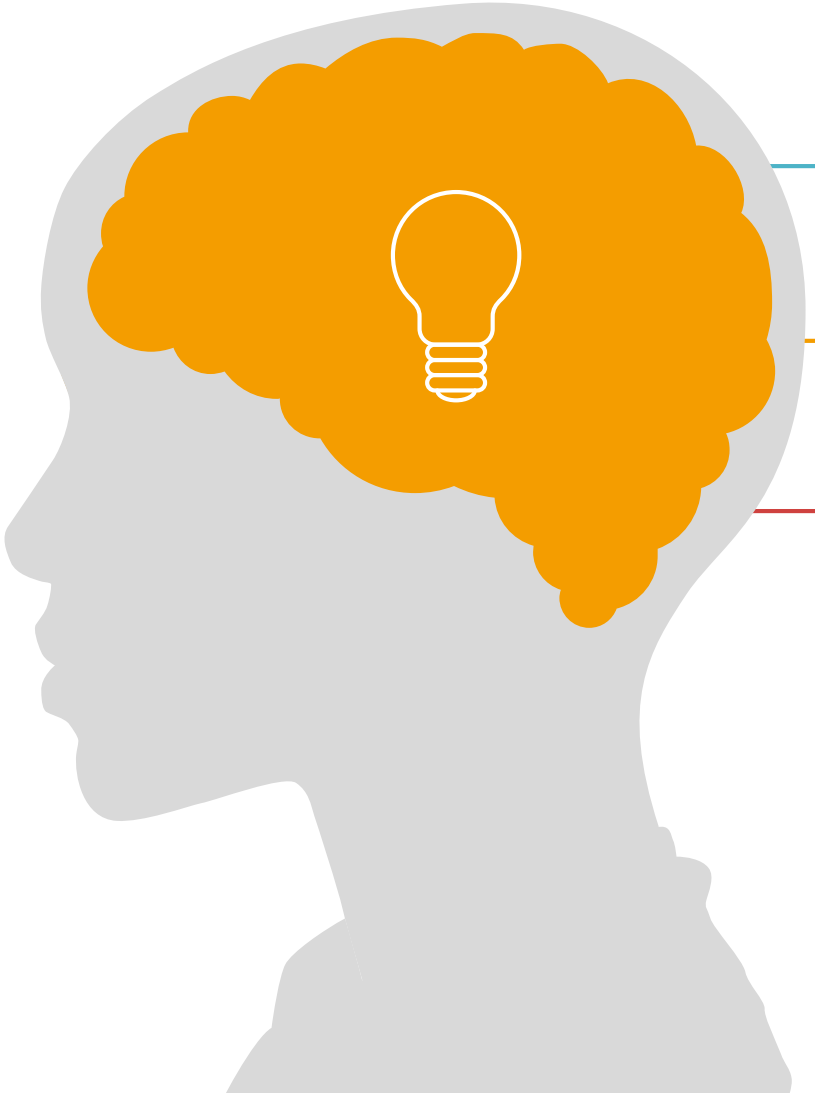
“Orbital Point of view”



The project was designed following the theme of the competition “Copernicus”.

It was created with the aim of tacking some social and scientific challenges from a different point of view: the orbital one.

An Idea: the seed of advancement



Can raise interest about space among young people

Young, fertile and motivated minds will lead future advancements of space technology

Creates awareness with a stereoscopic vision of the world.

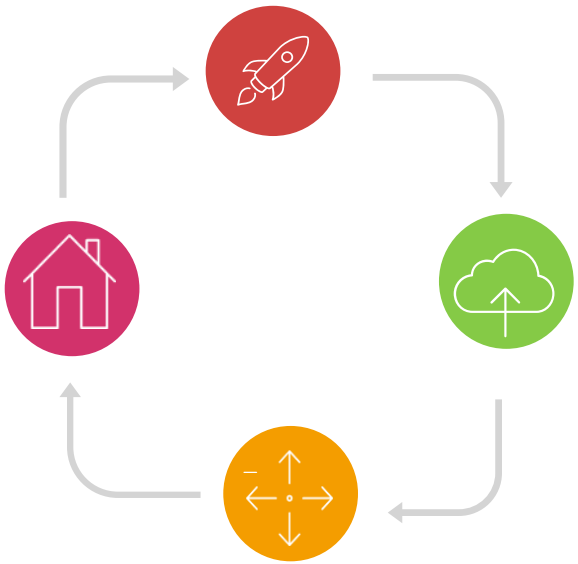
Sharing:

On 18 June I had the opportunity to talk about Odysseus and my project “Orbital point of view” on the radio, in the program “L’altra Europa” of Radio24. So 123 000 people heard me and have known something more about this contest, and the space observation.

A project that reaches the stratosphere

The project consists of a weather balloon in latex connected to an aircraft model with an electronic platform placed over it.

1)The **weather balloon** is filled with helium at launch

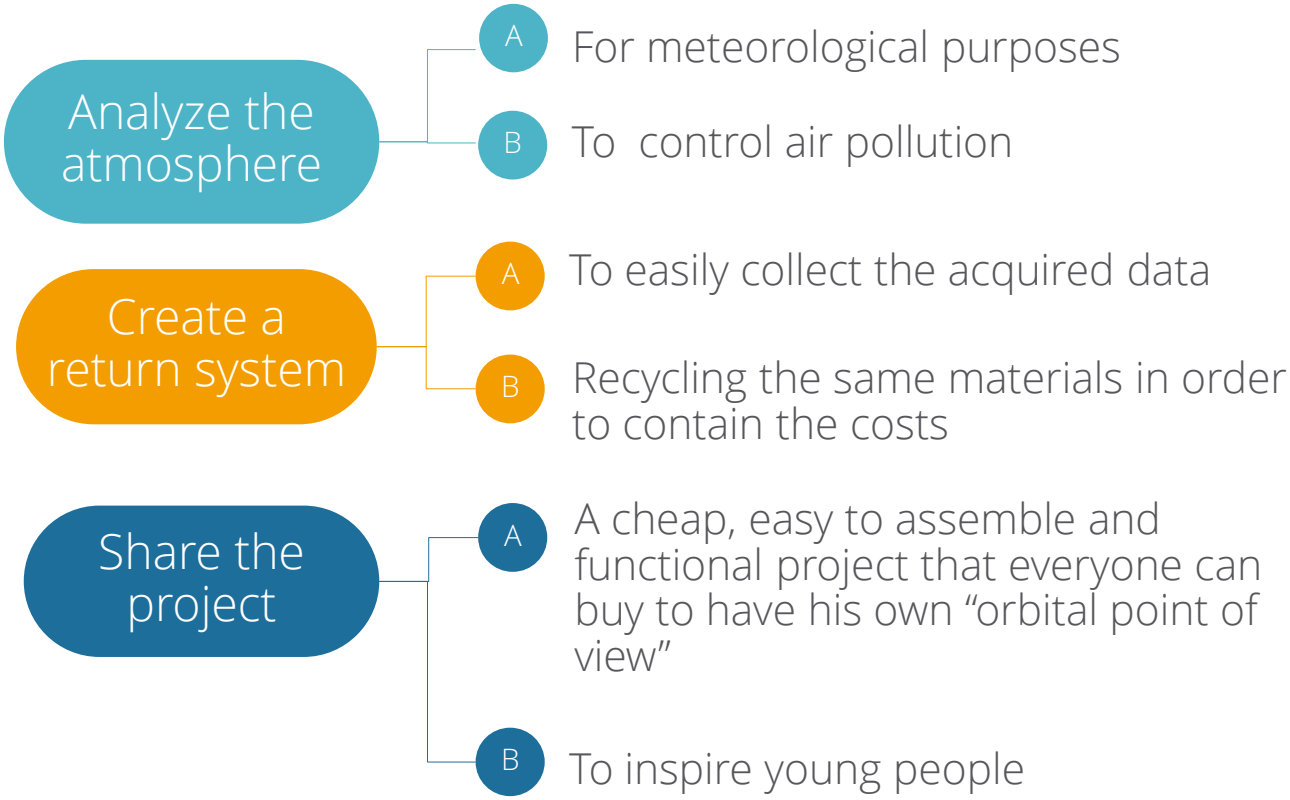


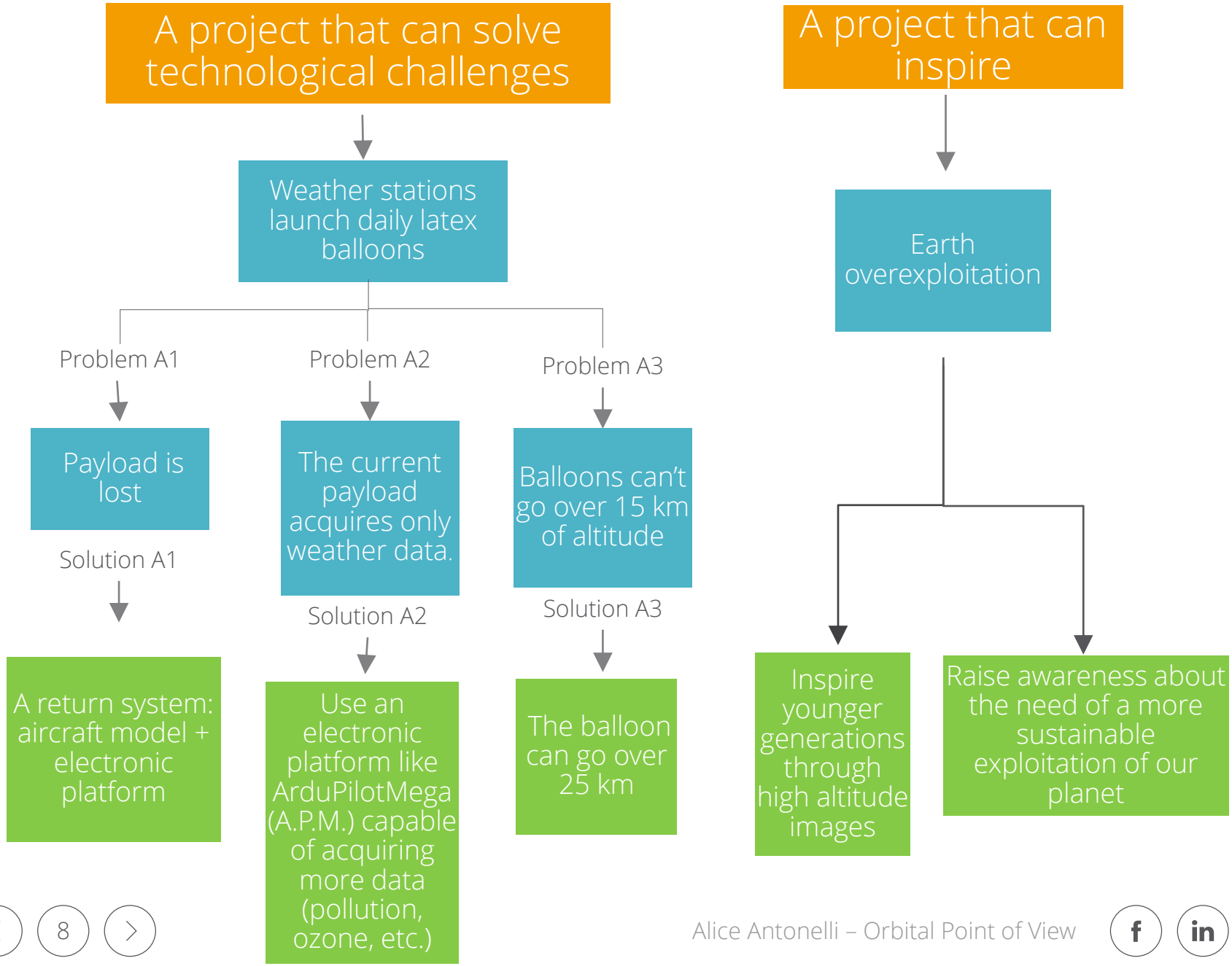
2)The balloon with the attached aircraft model **goes up acquiring data**

3)When the balloon reaches the burst diameter, a **hook will automatically open**, detaching the balloon from the aircraft model

4)The aircraft model will **come back** thanks to the on-board electronics

Aims of the Project




A project that can solve technological challenges
Weather stations launch daily latex balloons
Problem A1
Problem A2
Problem A3
Payload is lost
The current payload acquires only weather data.
Balloons can't go over 15 km of altitude
Solution A1
Solution A2
Solution A3
A return system: aircraft model + electronic platform
Use an electronic platform like ArduPilotMega (A.P.M.) capable of acquiring more data (pollution, ozone, etc.)
The balloon can go over 25 km
A project that can inspire
Earth overexploitation
Inspire younger generations through high altitude images
Raise awareness about the need of a more sustainable exploitation of our planet

Materials and cost analysis:

01 BALLOON:

- 1 Latex balloon Pawan 600g
- Helium
- Nylon cord
- Autozip

Partial price:
36.40 euro

02 AIRCRAFT MODEL:

A monowing made by:

- Polystyrene
- Balsa
- Epoxy glue
- 2 servos

Partial price:
15,00 euro.

03 ELECTRONICS:

- 1 APM
- GPS
- Compass
- Power module
- Temperature sensor
- Pressure sensors
- MQ7 (CO sensor)
- MQ131 (O3 sensor)
- Battery

Partial price:
97,00 euro

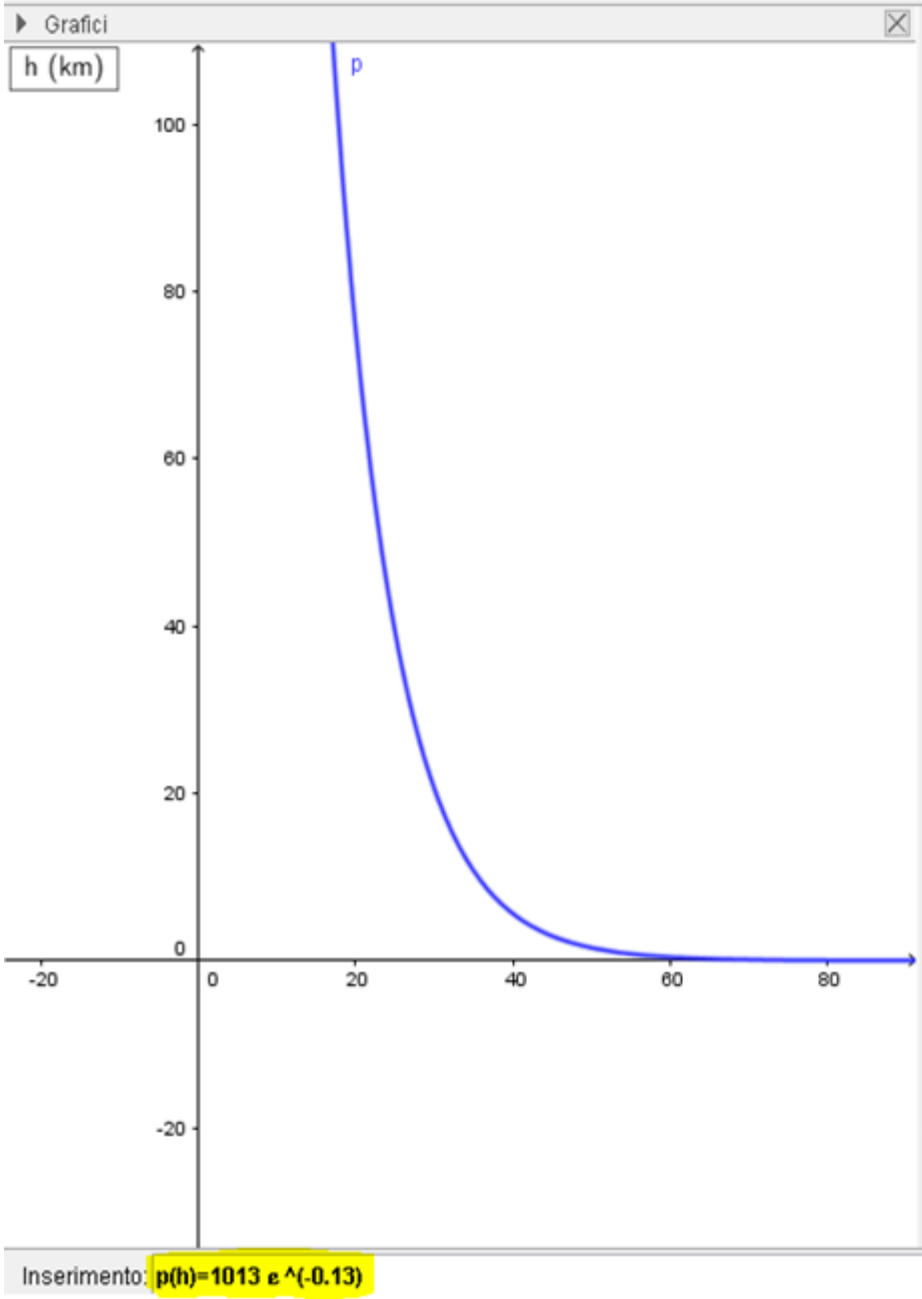
Total price: 148,40 EURO

p(h)=1013e^(-0,13h)

P=atmospheric pressure (mbar)
h= altitude over sea level of Earth (km)

With this information we can know the medium speed of ascent, how much it will expand, and the lift of the monowing in every different quote.

- ρ = air density
- *V*= speed;
- *S= wing surface*
- *L*= lift
- *Cl=lift coefficent*



	A	B
1	h (km)	pressione (mbar)
2	0.5	949.25
3	1	889.51
4	2	781.08
5	5	528.83
6	8	358.05
7	9	314.4
8	10	276.07
9	15	144.12
10	20	75.24
11	25	39.28
12	30	20.51
13		
14		
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24		
25		

Balloon's features:

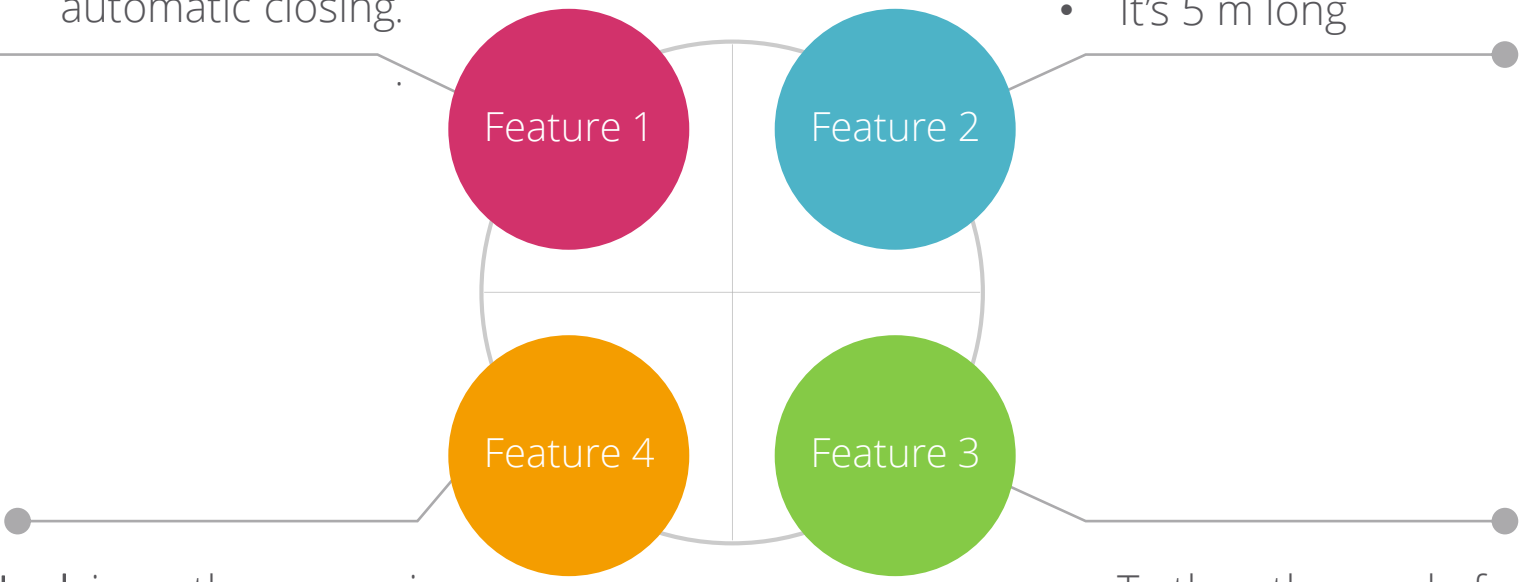
Balloon type:	Helium (m^3):	Max altitude: (m)	Time to burst: (min)	Upward speed: (m/s)	Price: (€)	Weight: (kg)
600g Pawan	3,233	24 996	83	5.0	24	1,5

Balloon's features

Balloon's neck is closed with 2 **tapes autozip** for automatic closing.

To the neck is connected a **nylon cord:**

- It withstands up to 220 N/m
- It's 5 m long



The **Hook** is on the monowing:

- It has an U form
- Its end is closed by a servo, linked to the APM.

To the other end of cord there is a **plastic ring,** that is inside a hook.

The aircraft model: monowing

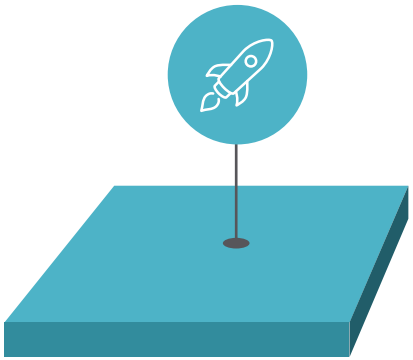
That's the "Prandtl-M", a reference model, designed to fly in low pressure conditions (7-9 hPa on Mars)

This shape allows to **add additional weight** on it, like electronics

It does not have a defined fuselage, so it has **less weight** and **less aerodinamic drag** if compared to other models.

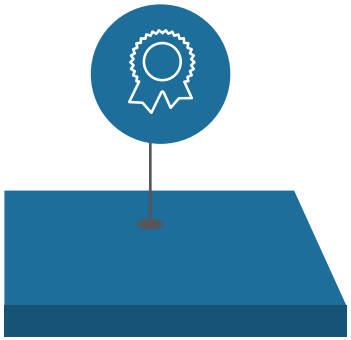
- Wingspan: 1300mm
- Surface: 30 dm^2
- Weight: 450g
- Wing loading:15g/dm^2
- Profile:sn28
- Elevons' lenght: 30 cm
- Winglet:15cm

How to create a monowing: 4 easy steps

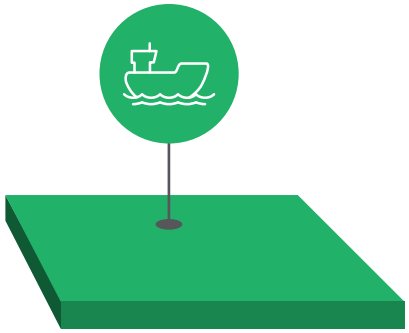


To create the wing, first create **the root and the tip profiles**

Attach the draw to a polyester block and, following the **profile, cut the polyester** with a hot wire. Now you have a wing!



To realise the arrow, cut the raw wing keeping an angle of 60° between the tip and the root



Place a rib of balsa between the two wings to give **rigidity** and create the landing support. Place a **spar** at 20% of the length of the wing mean chord and...

IT'S DONE! ☺

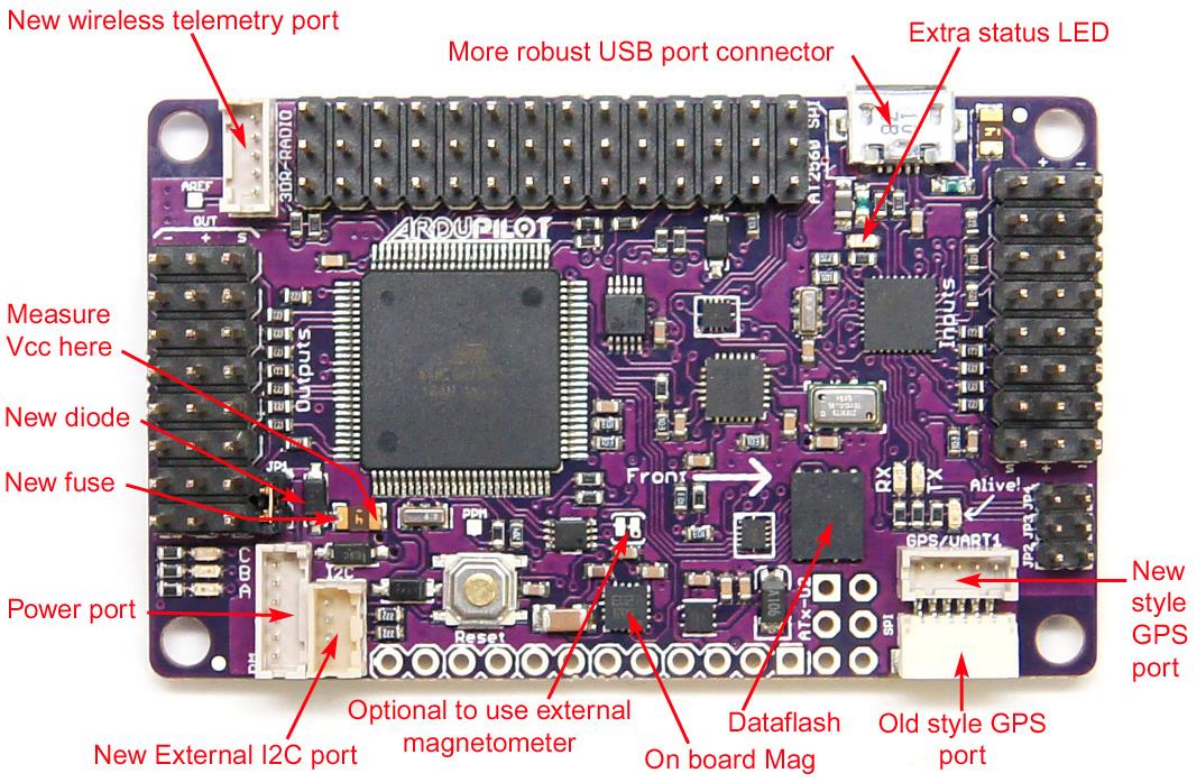
Electronics: the A.P.M.

Features:

It is like an Arduino, but with a different hardware.

We can connect:

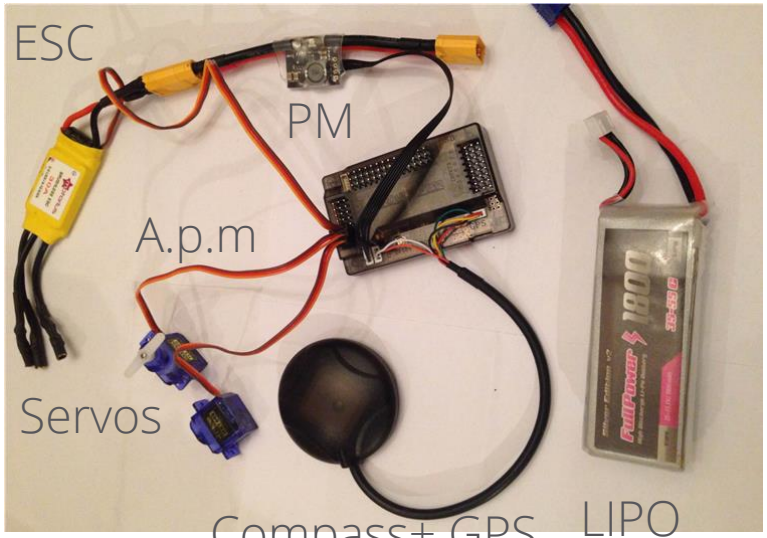
- GPS ublox Lea-6
- Compass
- Powermodule
- A triaxial accelerometer (included inside)

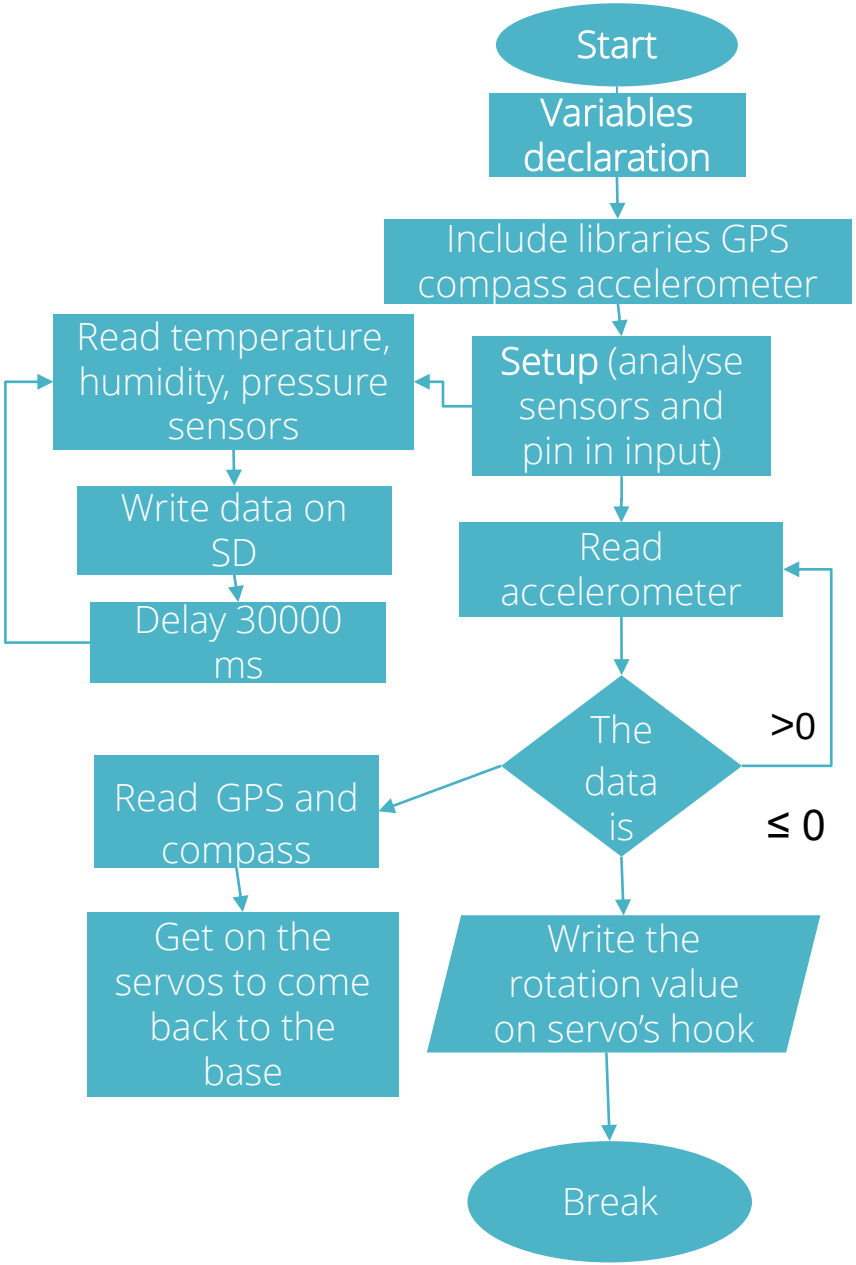


Functions:

Store data during the ascent phase, provide the **autopilot** during the descent phase. It allows the monowing to come back to the base (waypoint)

How it works:


ESC
PM
A.p.m
Servos
Compass+ GPS
LIPO


Start
Variables declaration
Include libraries GPS compass accelerometer
Setup (analyse sensors and pin in input)
Read temperature, humidity, pressure sensors
Write data on SD
Delay 30000 ms
Read accelerometer
The data is
>0
≤ 0
Read GPS and compass
Get on the servos to come back to the base
Write the rotation value on servo's hook
Break

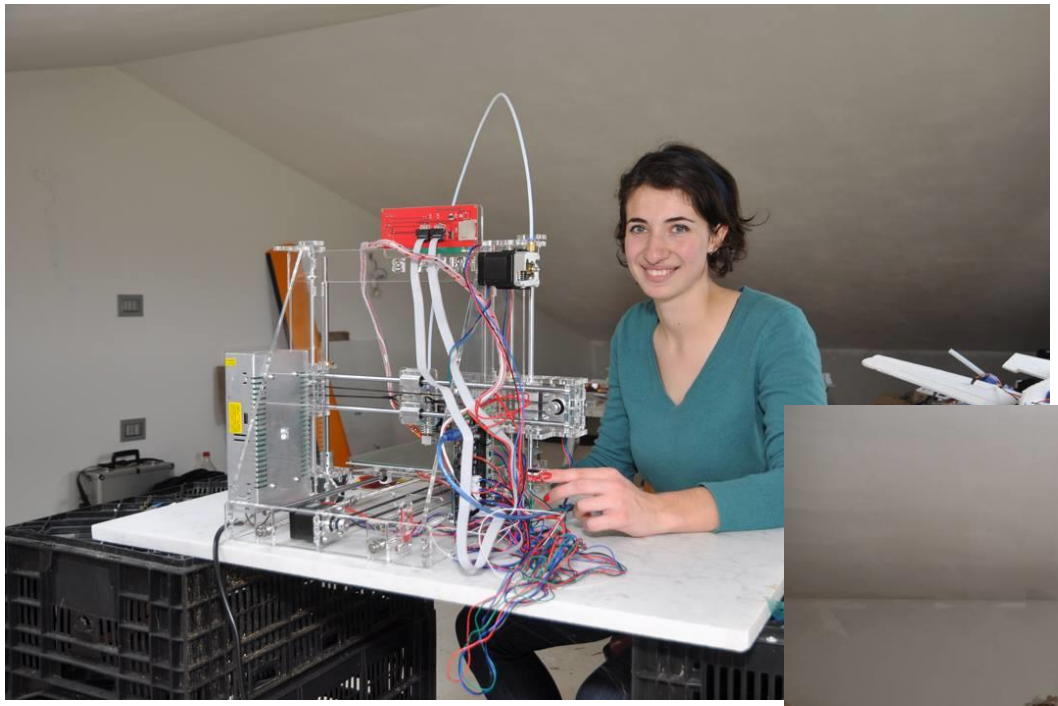
Let's open the hook's servo:

The hook opens when the balloon bursts, so when the accelerometer reads 0, the hook's servo turns.

Sketch:

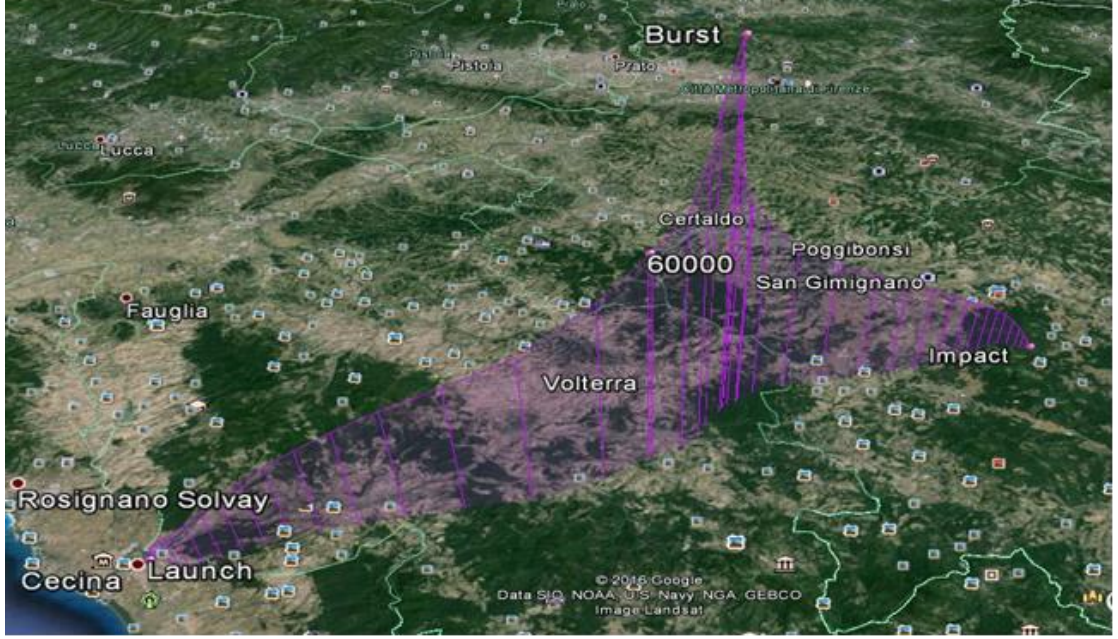
```
# include <servo.h> // include la libreria servo
int inpin=2 ; // l'accelerometro è collegato al pin 2
int reading ; // la lettura corrente del pin in input
servo myservo;// crea un nuovo oggetto chiamato servo

void setup()
{
myservo.attach(9); // collega il servo al pin 9
PinMode (inPin,input); // il pin 2 va in input
}
void loop ()
{reading=digitalread (inPin); //legge i dati digitali e li salva in una variabile
    if (reading = =0) {myservo.write (180); //  se i dati digitali dell'accelerometro
                                sono uguali al valore impostato il servo ruota di 180°
delay (1000); //aspetta 1s }
else { myservo.write (0);
delay (1000);
}
}
```



Images about the monowing
and the 3d print to build the hook

Balloon trajectory forecast



Balloon Trajectory Forecasts

Which initial GFS model time? 18Z 09 June 2016

The forecast is extracted from the Global Forecast System (GFS) which is run four times per day. The times listed are Universal Time.

Which forecast period? 24 hour

The valid time for the forecast is the sum of the model initialization time and the forecast period.

What location?

Specify Lat/Lon Latitude: 43.314 Longitude: 0.0964

Values must be decimal degrees with west negative.

Balloon Ceiling: 30000 meters

Calculate drop speed ☐

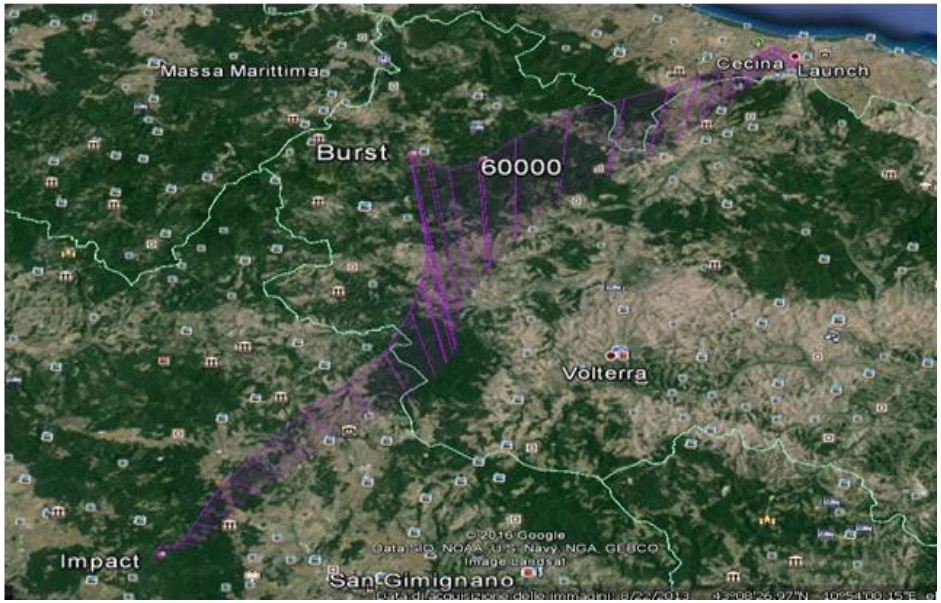
Gondola mass [kg] 45

Chute diameter [m] 5.5

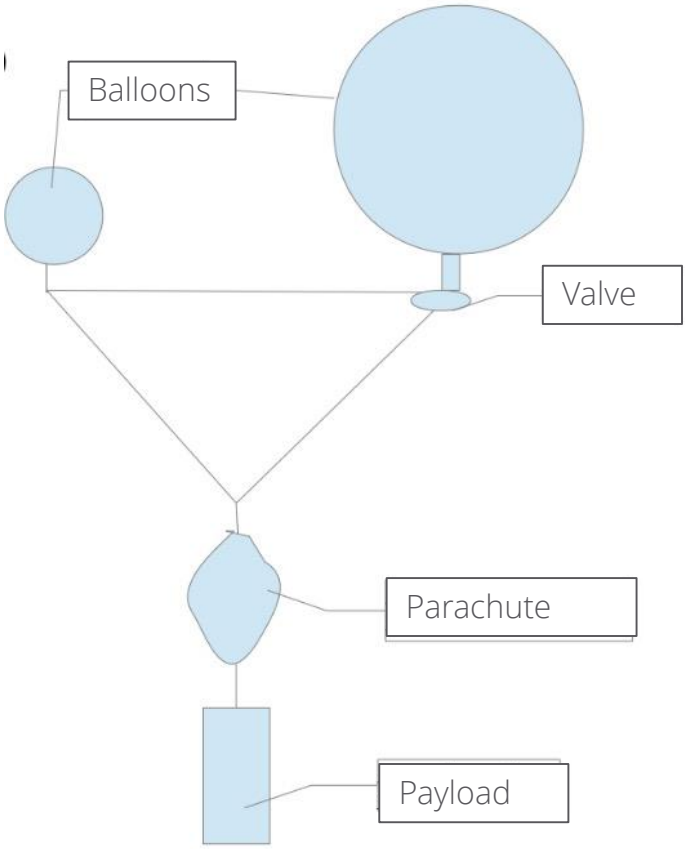
Drag coefficient 0.7

Output Format: ○ List ◉ GoogleEarth KML

Submit



Further project developments:



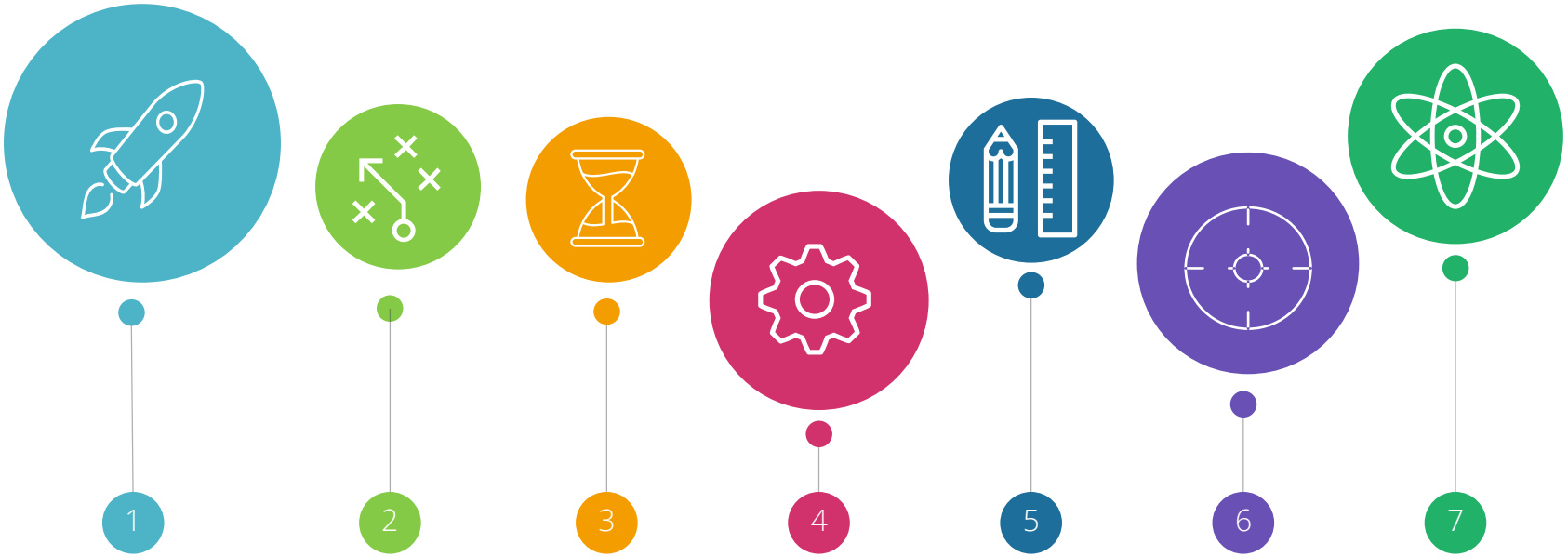
1) *Aim*: To reach a bigger altitude (45km)

2) How: connecting two balloons and control the helium flow between them with a valve.

When one of the two balloons is about to burst, the valve will open allowing the helium to flow into the empty balloon. The volume of the primary balloon will decrease and the ascent force will remain the same.

Further project developments:

Mission Timescale



1

At launch: one of the two **balloons** is filled with 3m^3 of helium, the other one is empty

2

Ascent: The filled **balloon expands** while the altitude increases

3

25 km: the biggest balloon is about to burst

4

25 km: the **valve** opens , helium flows from a balloon to the other, until they reach equilibrium and go up again.

5

45Km: the system reaches the mesosphere and **bursts**

6

45km: The **parachute** is opened

7

Landing: we can retrieve the system thanks to the GPS module included in the payload

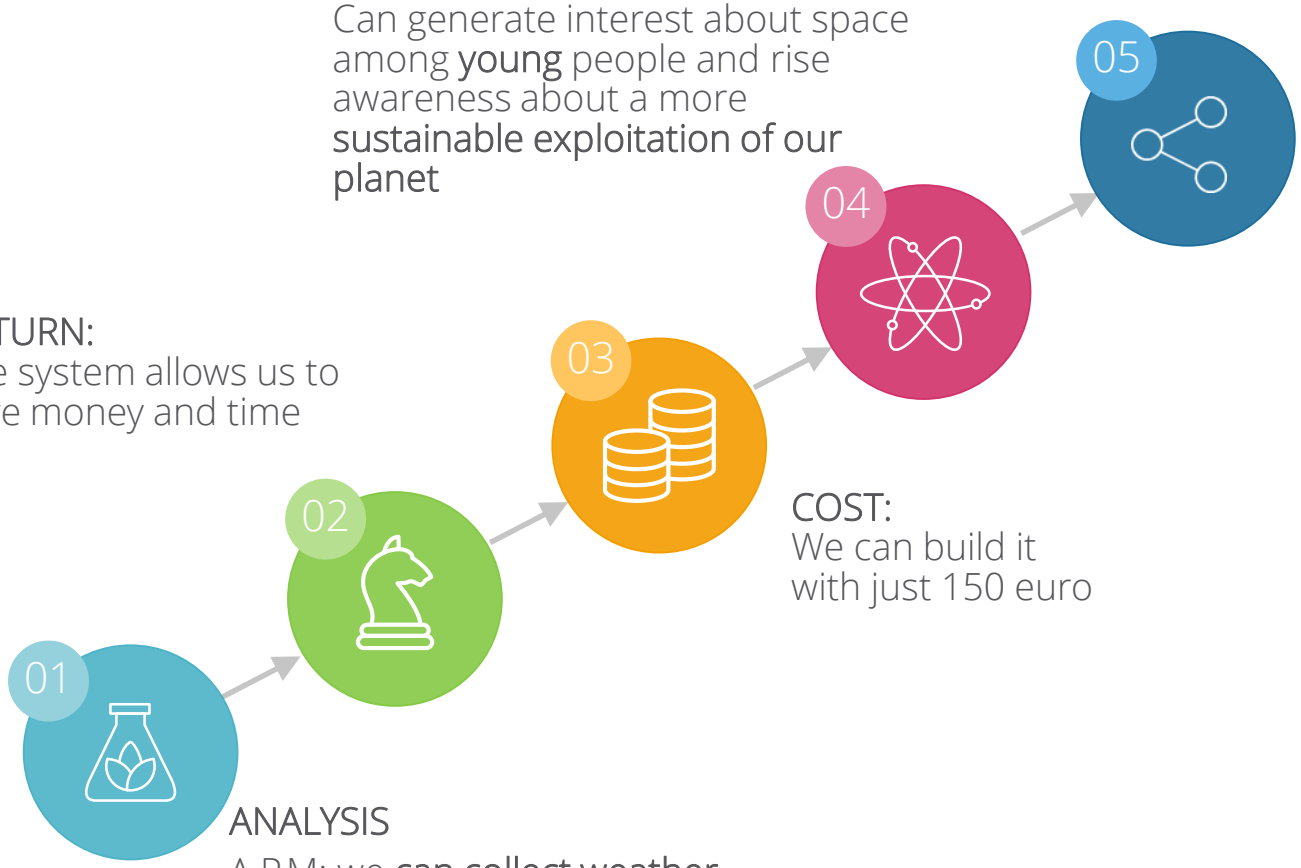
Project's results:

IMAGES:
Can generate interest about space among **young** people and rise awareness about a more **sustainable exploitation of our planet**

SHARING:
Every student of the world can have its own balloon and get inspired through it.

RETURN:
The system allows us to save money and time

COST:
We can build it with just 150 euro



ANALYSIS
A.P.M: we **can collect weather data** and, thanks to the additional sensors available on the A.P.M., other parameters useful to measure **the quality of air**.

THANK YOU for your attention

...Now have your say!