Report n°1 - Skyfall Mission

1. Introduction

We are one of three teams proudly representing Decroly School, located in Uccle, Brussels. Our decision to participate in this contest stems from our shared passion for collaborating on meaningful, hands-on projects in the fields of science and robotics. As science enthusiasts, we often watch scientific videos online, and it was during one of these moments that we came across a video about the challenges faced by a Japanese probe SLIM during its landing (it fell on its side) (see sources 11, 12 and 13). This incident inspired us to design an innovative system capable of automatically righting itself. While our primary goal is to succeed in this competition, we are also driven by the opportunity to explore broader objectives that align with our vision and values.

We joined CanSat to learn more about electronics, physics and coding, but also in order to develop our leadership, teamwork, and collaboration skills. Our goal is to be creative and design a truly innovative technological object. The CanSat experience will also help us assess and confirm whether we are interested in pursuing a career in science.

Primary mission

Our primary mission is mandatory and consists of recording atmospheric data such as temperature, pressure, etc. Then, we will send this data in real time to a ground station, so that we can recover the data even if our CanSat is lost.

Secondary mission

Our secondary mission will be as follows: we will invent a system that enables the CanSat to upright itself after it has landed, regardless of the position in which it lands.

Upon reaching the ground, our CanSat will use sensors to determine its position relative to the surface and calculate how it should position its legs to stand vertically. It will then deploy its legs at the angles that were calculated previously.

This project stands out for its unique structure equipped with deployable legs that allow the CanSat to reposition itself vertically after landing. The integrated algorithm analyzes the CanSat's precise position and calculates the exact angles needed for each leg's deployment, ensuring optimal upright positioning.

Our secondary mission aims to provide a solution for rovers that are unable to right themselves after a failed landing on a planet or asteroid.

Our secondary mission aims to solve the issue encountered by the Japanese probe SLIM. Although SLIM successfully landed just 10 meters from its target, the landing ended in failure, with the rover tipping onto its nose, rendering its solar panels unusable. We found this unfortunate, especially given that SLIM managed to land very close to its target. We then thought it would be innovative to create a system capable of autonomously righting itself after landing, thus preventing such avoidable problems.

After landing, our CanSat will analyze its inclination data to verify whether it successfully repositioned itself upright. The algorithm used for self-righting will also log the angles and adjustments made during the process. This data will be analyzed to assess the effectiveness and reliability of the self-righting mechanism.

We believe that it is an interesting idea which is realistic and capable of being implemented, and that it has scientific value, namely addressing the issues faced by the Japanese probe.

2. Project description

2.1 Primary Mission

We are going to measure temperature, humidity, altitude, pressure, GPS position, horizontal speed, and time.

BPM 280	The BPM280 is a component that allows us to know in real-time the temperature and pressure of the environment in which the CanSat is located, as well as its altitude in real-time.
DHT11	The DHT11 is a component similar to the BPM280, which also allows us to monitor the temperature in real-time, as well as the humidity of the environment where the CanSat is located. We chose to use two chips performing the same function to obtain the most accurate data possible by averaging the readings from both.
GPS Neo-6M	This component will provide us with the GPS coordinates of the CanSat after its landing, allowing us to locate it. Additionally, this chip enables us to determine altitude (like the BPM280), speed, and all of this as a function of time

Powerboost 1000c	This is a module that allows us to use our battery by transforming the voltage from 3.7V to 5V and also to recharge it.
Module SD	This component allows us to use an SD card to locally store all the data collected by the CanSat, in case our radio or receiver malfunctions.
Batterie	This is the battery of our CanSat. It supplies electricity to all our components, enabling them to function.
RFM69	This component will allow the CanSat to transmit the data it collects in real-time to our ground station. We will receive this data using our Yagi antenna.

2.2 Secondary Mission

Objective of the Secondary Mission:

The goal of the secondary mission is to design a CanSat that will be capable of accurately calculating its tilt relative to the ground (on all three axes: X, Y, and Z) after it has landed. It will then deploy four movable legs, each set at a different angle, enabling the CanSat to right itself in alignment with the gravitational force (i.e., standing upright and oriented towards the center of the planet). The deployment will be controlled by servomotors, which will be managed by a gyroscope. Our code will calculate the deployment angle based on the CanSat's tilt relative to the ground. In conclusion, our primary objective is to measure the CanSat's tilt and then adjust its position accordingly.

How the Secondary Mission Will Be Triggered:

We will integrate an altimeter that will transmit information to the Raspberry Pi when it detects an altitude of 700 meters. This, combined with verification from the accelerometer that the CanSat is moving at a speed equal to or in excess of 20m/s, this will allow the CanSat to determine whether it is still inside the rocket or not. Then, the CanSat will begin analyzing its tilt to calculate the precise angle for the deployment of 3 legs, thereby enabling the CanSat to right itself. Once the CanSat reaches the ground and for a period of 30 seconds (i) the CanSat remains stationary as detected by the gyroscope, and (ii) the CanSat remains at a constant speed of 0m/s as detected by the accelerometer, then the Raspberry Pi will calculate the necessary angles for optimal leg deployment and perfect self-righting. Thus, the righting phase will only be activated when the correct altitude is reached and the accelerometer confirms the absence of movement.

6-axis Gyroscope (MPU 6050)	The MPU 6050 is a sensor which measures the inclination (gyroscope) of the CanSat. This allows us to determine if the CanSat has landed (if it remains motionless for 30 seconds, then it has landed). After landing, this chip will give us the precise inclination of the CanSat and will thus

	allow precise calculations of the deployment angle of each leg. Moreover, this component is interesting for our secondary mission because it also features an accelerometer function.
BPM 280	To measure the altitude at which the CanSat should start the angle analysis.
3 Motors	To deploy the legs and thus straighten the CanSat.
Battery	It's the battery of our CanSat, it allows us to power all our components with electricity and thus enable their operation.
Module SD	This component allows us to use an SD card to locally store all the data collected by the CanSat, in case our radio or receiver malfunctions.
Passive buzzer	A passive buzzer produces sound when driven by an electrical signal generated by a microcontroller. In our CanSat, it will serve as an audible alert to indicate the CanSat's location, making it easier to retrieve.

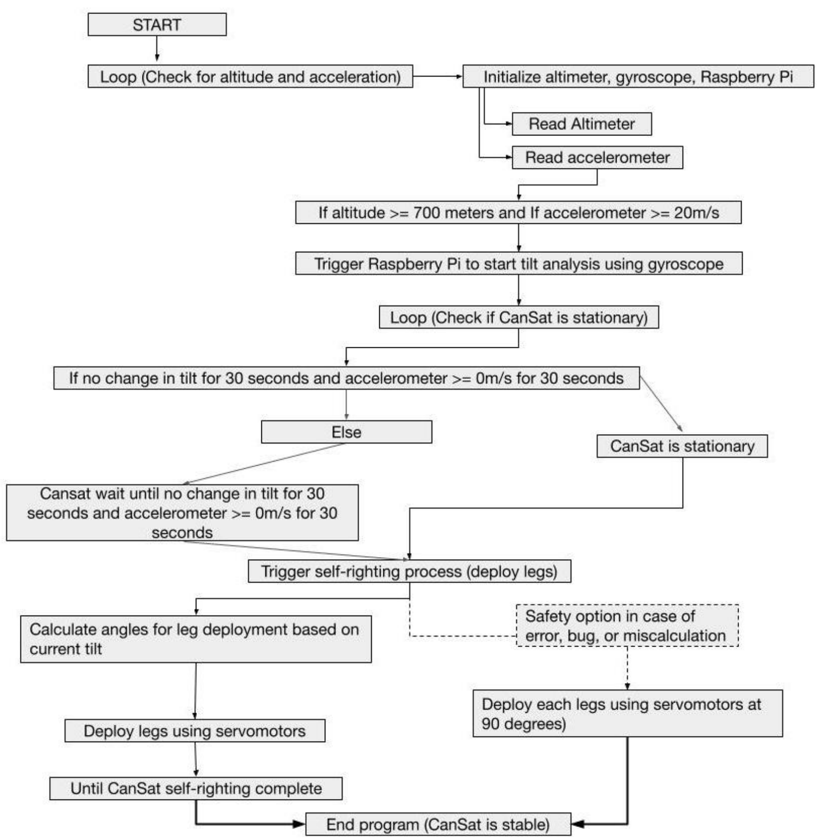


Figure 1. Secondary mission control diagram

2.3. Mechanical design

2.3.1 Parachute Design

We started with a parachute that looks like a disc with a hole in the centre when it is flat. We wanted to make it look like a half-donut, so we attached lines of hooks to the outer and inner edges of the circle.

The circle's diameter was 1m with a hole in the middle with a diameter of 0.2m.

After several attempts we realised that our parachute did not work, so we decided to remove the fasteners from the inner edges to form a half-sphere instead of a half-donut. This worked straight away.

Figure 2. Our parachute

For our calculations we used the formula : $m\,g = \frac{1}{2}Cd\,\rho <, a\,v^2$.

Data :

m = mass = 0,3 kg → as light as possible to gain some margin

g = gravity = 9,81 m/s^2

Cd = Drag coefficient = ? → It depends on the form of the parachute

ρ = air density = 1,1 kg/m^3 → approximately

a = surface = $\frac{\pi}{4}\ m^2$

v = speed = 9 m/s → objective

Calculations :

$$m\,g = \frac{1}{2}Cd\,\rho\,a_1 v_1^2$$

$$m\,g = \frac{1}{2}Cd\,\rho\,a_2 v_2^2$$

$$\frac{1}{2}Cd\,\rho\,a_1\,v_1^2 = \frac{1}{2}Cd\,\rho\,a_2\,v_2^2$$

$$a_1 v_1^2 = a_2 v_2^2$$

$$\pi\frac{d_1^2}{4}v_1^2 = \pi\frac{d_2^2}{4}v_2^2$$

$$d_1^2\,v_1^2 = d_2^2\,v_2^2$$

$d_1 = 1\,m$

$v_1 = ?$

$d_2 = ?$

$v_2 = 9\ m/s$

We have 2 unknowns, so we need to calculate one of them.

We calculate the speed of our existing parachute (v_1) by launching it several times from a certain height and then averaging its speed.

This gives 3 m/s

We isolate

$$d_1^2\,\frac{v_1^2}{v_2^2} = d_2^2$$

We remplace

$$1^2\,\frac{3^2}{9^2} = d_2^2$$

$$d_2^2 = \frac{1}{9}$$

$$d_2 = \frac{1}{3}\,m \approx 0,33\,m$$

Our parachute should therefore have a diameter of 0,33 m and a hole in the centre 5 times smaller, i.e. 0,07 m.

2.3.2 Can Design

During the hardware design phase of the primary mission, we first realized that using electrical wires to connect components was fragile and consumed a lot of space. To address this, we decided to create custom PCBs to enhance robustness, safety, aesthetics, and compactness. This approach not only saves space but also provides better clarity and organization.

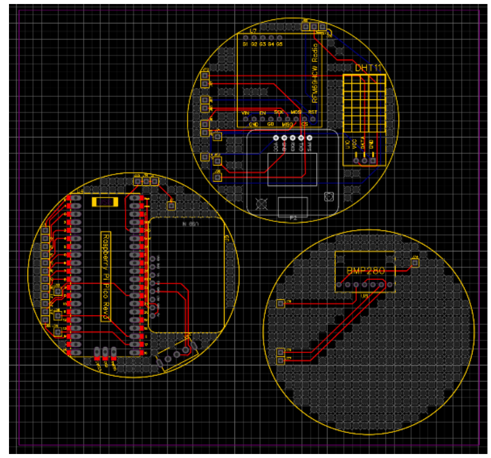


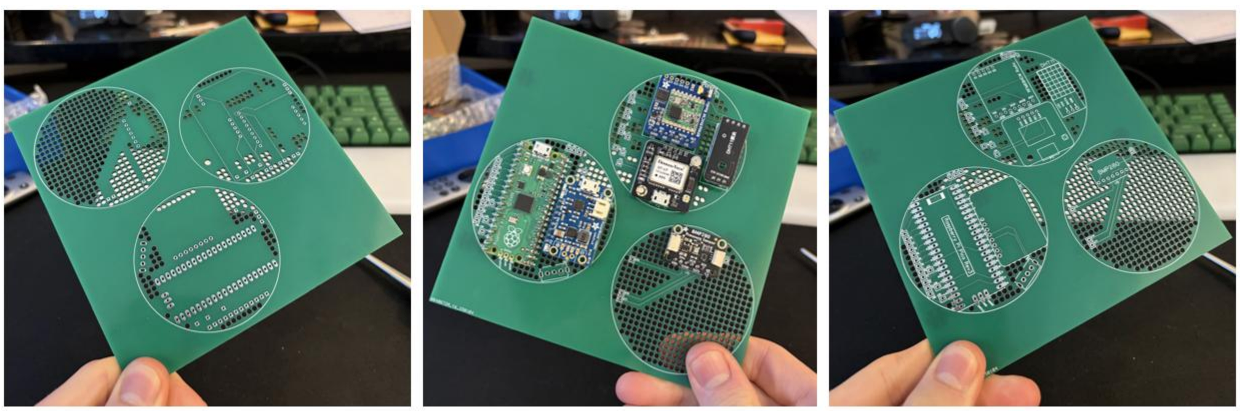
Figure 3. Plan of our PCBs

Our PCBs are round and stacked on top of each other, connected with solid AWG22 wires.

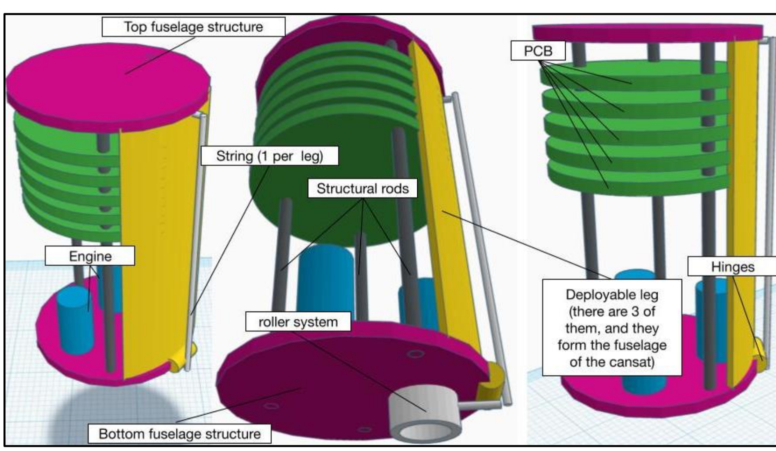
For the self-righting mechanism, we decided to use the CanSat's fuselage itself as deployable legs. Beneath the CanSat, four servomotors will be installed, each attached to an individual wire (one wire per motor) connected to the legs. These wires will wind up via the servomotors, allowing each leg to deploy effectively.

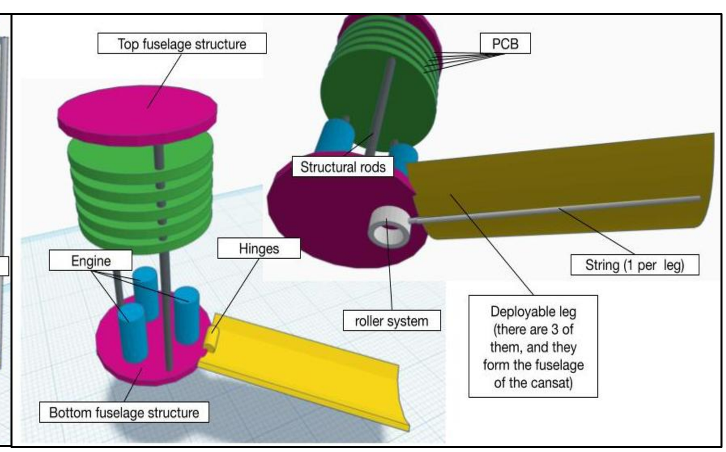
Above all, for practicality and safety, the primary and secondary missions will be handled by two separate circuits, each powered by its own Raspberry Pi. This setup allows us to test our PCBs as soon as the primary mission is complete, and ensures greater safety—if one Raspberry Pi fails, only one of the two missions will be compromised.

Version 1 of our PCBs for primary mission:



Before deployment **After deployment**





After deployment:

To enable the deployment of each leg, a cable will be attached to its upper end. This cable will be wound around a roller system fixed to a motor on the bottom fuselage plate. When the motor operates, it will rotate the roller system, causing the cable to wind around it. The traction exerted on the cable will allow the leg to deploy.

After deployment:
Once the leg is fully deployed, the motor can stop to maintain the position. The cable will remain tensioned to keep the leg stable in its deployed state. Additional locking mechanisms may be implemented to ensure the leg remains securely in position, reducing reliance on continuous motor operation.

Method used:

- A cable is attached to the upper end of the leg.
- This cable passes through a roller system connected to a motor.
- The motor, by activating the rollers, winds the cable around them.
- The winding of the cable exerts a pulling force on the leg, causing it to deploy.
- After deployment, the position is stabilized by tension in the cable or through locking mechanisms.

The operation is therefore based on a simple motorized traction mechanism via a cable wound on rollers. This appears to be an effective technical solution for controlled deployment and stabilization.

2.4. Electronic design

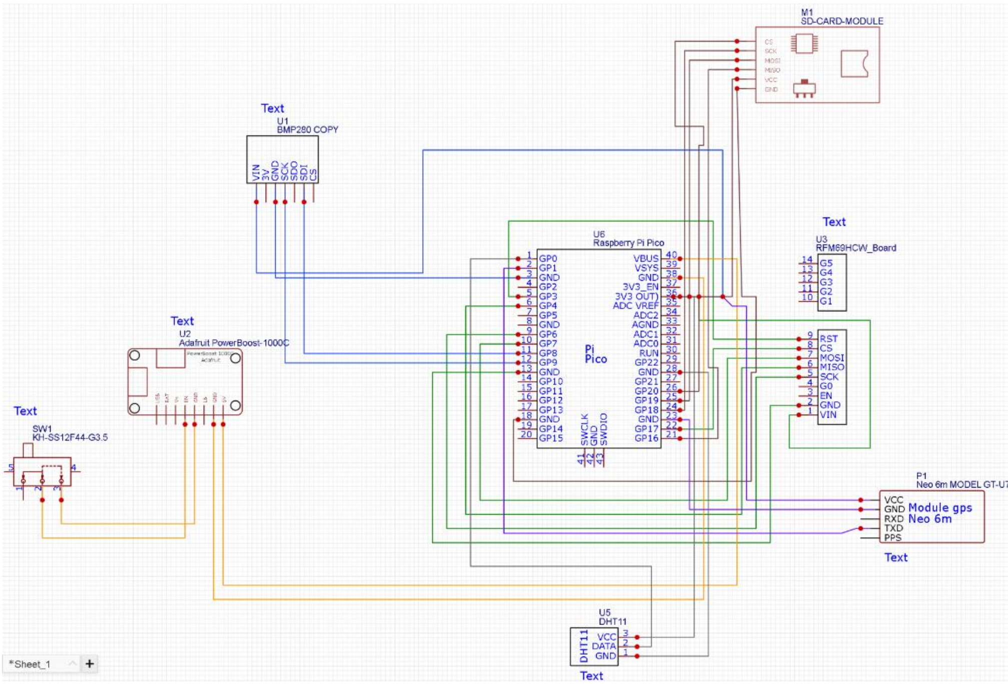
2.4.1 System overview

Here are the details of the connections for our CanSat's primary mission, along with the components we are using: Raspberry Pi Pico, BMP280, RFM69, DHT11, GPS Neo-6M, Switch KH-SS12F44-G3.5, Powerboost Adafruit 1000C, Micro SD module, and a LiPo battery.

We selected most of our components, such as the Raspberry Pi Pico and BMP280, based on guidance from Innoviris, which we believe ensures compatibility and reliability. However, the GPS Neo-6M, DHT11, and Micro SD module were chosen independently, based on specific project requirements.

- GPS Neo-6M: Selected for its small size, high accuracy, and affordability, making it ideal for a compact system like our CanSat.
- DHT11: This thermometer and humidity sensor was chosen for its ease of use, accuracy for our mission's needs, and straightforward integration into the codebase.
- Micro SD Module: Selected to facilitate efficient data storage and retrieval for mission logs and sensor readings.

For the roles and functions of other components, such as the power management via the Powerboost Adafruit 1000C and the BMP280 for atmospheric pressure measurements, please refer to the detailed sections above. This carefully curated selection of components ensures a balanced mix of performance, size, and cost-effectiveness for the CanSat's mission.



2.4.2 Power consumption

Table 2: Expected power draw for all the electronics

Module	Expected power draw (mA)
RPi Pico	93
BPM 280	3
DHT 11	2.5
GPS Neo-6M	65
RFM69	100
Total	**263.5**

Battery and operational duration:

- *Battery capacity: 1300 mAh.*
- *Estimated operational duration:*

$$Duration = \frac{Battery\ capacity}{Battery\ consumption} = \frac{1300}{263.5} = 4.93\ H \quad \text{or 4h55}$$

2.5 Software design

Our code is designed to manage a CanSat system, collecting and transmitting environmental and positional data through various sensors and modules. After importing the necessary libraries, the program configures the hardware components, including the RFM69 radio module, BMP280 and DHT11 sensors, the Neo-6M GPS module via UART, and an SD module for data storage. The BMP280 measures pressure and temperature, while the DHT11 provides temperature and humidity data. The GPS collects positional, altitude, and speed information.

A specific function we created calculates altitude from pressure using a standard formula. The program also initializes a file system on an SD card, where data is recorded to ensure its safety, even in the event of radio transmission interruptions.

In the main loop, GPS data is read and formatted to include latitude, longitude, altitude, speed, and the number of satellites in use. The DHT11 and BMP280 sensors provide environmental measurements. The collected data is combined into structured messages and saved to the SD card to create a reliable log.

These messages are also transmitted via the RFM69 radio module to a base station, with a LED indicator lighting up to signal each transmission. The program integrates error-handling mechanisms to ensure continuous execution, even if some sensors or modules encounter issues. This approach enables the system to collect, store, and transmit critical data reliably and securely.

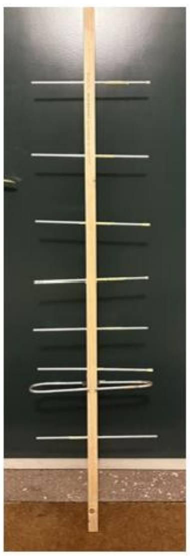
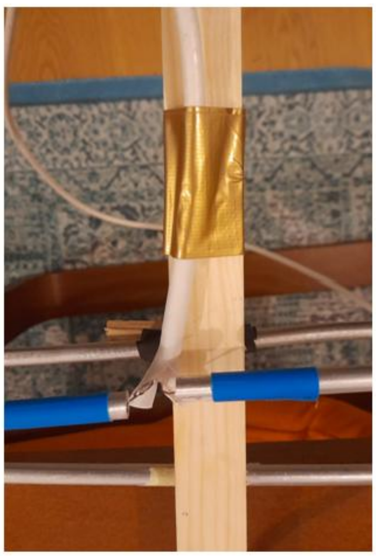
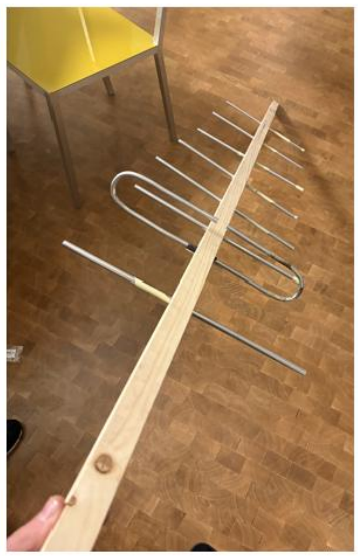
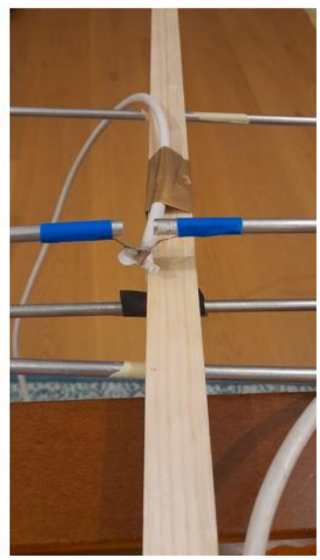
```
Program Start

|

|--> Initialize modules and sensors (RFM69, GPS, BMP280, DHT11, SD)

|--> Create "data_log.txt" file

|--> Main Loop (while True)

|        |

|        |--> Read GPS data

|        |--> Read DHT11 data (temperature, humidity)

|        |--> Read BMP280 data (temperature, pressure, altitude)

|        |--> Format and display data

|        |--> Log data into "data_log.txt"

|        |--> Send data via RFM69

|        |--> Wait for 1 second

|

End Program
```

2.6 Ground station design & Data processing

2.6.1 Antenna & Data Capturing

We will use a Yagi antenna to improve the reception of data transmitted by the CanSat to our computer. We will collect all the data sent by the CanSat during the entire flight as well as during the ground phase. Afterwards, we will transfer all the recorded data to an Excel spreadsheet to convert it into graphs and analyze the flight. However, in case of poor radio connection, which affects the transmission of information via radio waves, we have a backup solution where the data is also recorded on an SD card integrated into the CanSat. We used a Yagi antenna calculator to determine the antenna's dimensions.

	Metric (mm)	Imperial (inches)
Wavelength	692.36	27.258
Boom **BL***	1066.24 mm	41.978 inch
Gain	10.5 dB *(approx.)*	10.5 dB *(approx.)*
Reflector	Position **P** 0 mm	Position **P** 0 inch
	Length 333.72 mm	Length 13.139 inch
Dipole**	Position **P** 166.17 mm	Position **P** 6.542 inch
	Length 333.72 mm	Length 13.139 inch
Director 1	Position 218.09 mm (**P** +51.93 mm)	Position 8.586 inch (**P** +2.044 inch)
	Length 314.86 mm	Length 12.396 inch
Director 2	Position 342.72 mm (**P** +124.63 mm)	Position 13.493 inch (**P** +4.906 inch)
	Length 311.87 mm	Length 12.278 inch
Director 3	Position 491.58 mm (**P** +148.86 mm)	Position 19.353 inch (**P** +5.861 inch)
	Length 309.13 mm	Length 12.17 inch
Director 4	Position 664.67 mm (**P** +173.09 mm)	Position 26.168 inch (**P** +6.815 inch)
	Length 306.62 mm	Length 12.072 inch
Director 5	Position 858.53 mm (**P** +193.86 mm)	Position 33.8 inch (**P** +7.632 inch)
	Length 304.35 mm	Length 11.982 inch
Director 6	Position 1066.24 mm (**P** +207.71 mm)	Position 41.978 inch (**P** +8.177 inch)
	Length 302.29 mm	Length 11.901 inch

2.6.2 Data Processing

We will create Excel spreadsheets to later make diagrams that will help us analyze the data collected during the flight.

2.7 Recovery system

To retrieve our CanSat, we will use a GPS and a passive buzzer. The buzzer will emit a sound after the upright phase to indicate its location. Additionally, we are also going to paint our parachute in a way that makes it as visible as possible.

3. Testing

To date, we have already tested our primary mission, and it is functioning properly, with all components displaying their data correctly. Additionally, the Yagi antenna works well over a distance of at least 300 meters, although we haven't had the chance to test it at greater distances yet. As mentioned earlier, we have already built a test parachute to calculate the measurements for the final parachute.

	Statut	
Parachute	IN PROGRESS	Make the final version with all the data calculated previously.
Primary mission	IN PROGRESS	Everything has been tested and is functional except for the SD card reader.
Antenna	IN PROGRESS	Tested at a distance of 300m, awaiting long-distance testing (1km).
PCBs primary mission	IN PROGRESS	Awaiting version 2.
Code primary mission	IN PROGRESS	Everything has been tested except for the SD card reader.
Secondary mission	ON HOLD	Awaiting the components.
PCB secondary mission	ON HOLD	Awaiting the components.
Code secondary mission	ON HOLD	Awaiting the components.
Deployment system	ON HOLD	Awaiting the components.
Design 3D	ON HOLD	Awaiting the components to create the precise 3D model.

Overview of our failures and how we addressed those failures:

	Failures	Solution
Parachute	The parachute did not deploy	We changed the arrangement of our tie wires.

Primary mission	Issues with strength and space, and problems with the GPS code.	We created custom PCBs and eventually found our mistake.
PCB primary mission	PCB was too wide	We did 2 versions.
Code primary mission	The GPS didn't work in the final code because a pin was named twice.	We reviewed the code several times and eventually found the error.
Secondary mission	N/A	N/A
PCB secondary mission	N/A	N/A
Code secondary mission	N/A	N/A
Hardware	Linking components with electrical wire was too voluminous, too fragile and insufficiently reliable	We created custom PCBs.

4. Requirements

No.	Requirement	Status
1	**Size of a standard soda can (115 mm height and 66 mm diameter)**	OK
2	**Antenna and parachute (folded) respect the CanSat diameter (66 mm)**	OK
3	**Weight between 300 g and 350 g**	OK
4	No explosive or flammable material	OK
5	4 hours of power from battery	to be verified
6	The battery can be changed on field	OK

No.	Requirement	Status
7	**Have a master switch**	OK
8	Have a reusable recovery system, such as a parachute (bright coloured fabric recommended)	OK
9	Parachute attachment should accept 100 N	not yet
10	**Flight time limited to 120 s**	not yet
11	A descent rate between 8 and 11 m/s	not yet
12	**Acceleration 20 g**	to be verified
13	**A positioning system can help retrieval (beeper, GPS, radio signal...)**	OK
14	Total value under €500	OK
15	Include real market cost of sponsored material	OK
16	**Respect assigned radio frequency**	OK

5. Overall progress

5.1 Human resources

Here is our team: From left to right, Oscar Beck, Yann Lamperti, Yosha Schor, Gypsie Verbrugge, Kian Jongen, Sam Bruffaerts

All team members are in their final year at Decroly School in Brussels.

Yosha: I selected the mathematics and science track at school, so that I have 7 hours of science and 6 hours of mathematics per week. In addition, I attend a 4-hour mathematics course at ULB every Saturday morning. I am passionate about engineering, and I have built my own computer, a Formula 1 simulator using PVC tubes that perfectly replicates a driver's position, and an aircraft simulator mimicking the posture of F-16 pilots. This summer, I attended a summer programme at the Faculty of Engineering at the University of Toronto.

As part of this CanSat competition, I focus on the hardware side, particularly on the electronics design and 3D modeling of the CanSat, while also contributing to the software and mechanical aspects. I have always enjoyed teamwork and am skilled at managing a team, communicating effectively, and adapting to others. I am passionate about this project, my team, and I am confident that our CanSat will be a success!

Gypsie : I selected art, history of art and infographics as main options at school. Last summer, I went to Oxford on a language course organised by EF. The course allowed me to improve my English, and I now have a C1 level. During the programme I stayed with a host family. As part of the CanSat project, I particularly enjoy working in a team and learning new skills.

In the team I focus on social media and communication but I also contribute to the hardware and the electronics design. I also brought my artistic skills to the team by designing the logo of our team, and by contributing to the 3d design aspects. I'm very happy to be a part of this exciting project, and I very much enjoy working with the other members of the team.

Yann : I also selected the mathematics and science track at school, and this choice reflects my interest in these subjects. Alongside my studies, I engage in several activities that I am passionate about, such as playing the piano, athletics, and theater. These activities help me develop my creativity, discipline, and teamwork skills. I also regularly participate in additional activities in the mathematical sphere such as Imath, held on Saturday mornings and Wednesday afternoons, which allow me to deepen my knowledge and tackle stimulating challenges.

I chose to take part in the CanSat project because it brings together my areas of interest within a dynamic and practical framework. This project represents a unique opportunity to explore scientific and technical concepts while working as part of a team, and I find it both incredibly enriching and captivating.

Sam : I also selected the mathematics and science track at school, and I very much enjoy the science and mathematics courses. In addition, I also attend a theater course at school which I take pleasure in. In addition to school, I currently attend prep courses for medical school, every Saturday morning. These courses allow me to prepare for the entrance exam for medical school which takes place at the end of the year.

With a very busy schedule between soccer, school, CanSat, and all my other projects, I have excellent organizational skills. This is also one of the skills I bring to the group, along with my knowledge, good mood, and competitive spirit.

Oscar : I also selected the mathematics and science track at school, mainly because I have always been interested in maths and science. For several years I took part in robotics classes at the Scientothèque, at the ULB, where I first heard about the Cansat project. I did a few programming classes during those years. I'm also passionate about drawing and music.

I became interested in the Cansat project because I wanted to develop my programming skills and learn new skills while having fun with our wonderful team.

Kian : I also selected the mathematics and science track at school, along with additional options in sports and Greek.

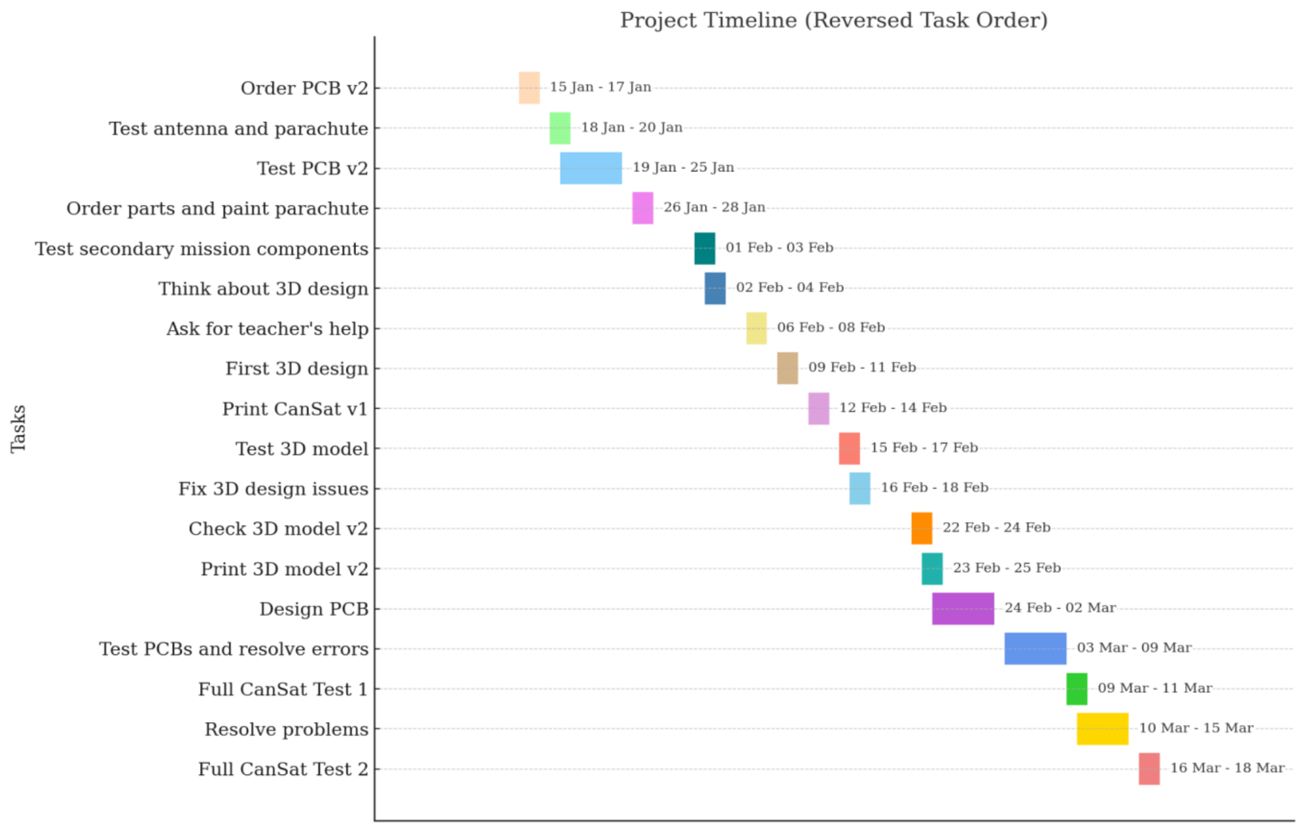
I have a passion for sports in general, but I primarily practice fencing at a high level (I participated in the European and World Championships last year). Having to balance fencing, school, the Cansat project, and my work as a waiter has allowed me to develop my organizational and planning skills.

I decided to join the Cansat program because I wanted to learn new skills, particularly in all the technological and organizational aspects it entails. Within the project itself, I am responsible for designing the parachute. I also contribute to the creation of the Yagi antenna as well as the videos needed to communicate about our project.

	Gypsie	Oscar	Kian	Yann	Yosha	Sam
Communication	⭐	⭐				⭐
Hardware	⭐		⭐	⭐	⭐	
Software		⭐		⭐	⭐	
Administration & treasury	⭐				⭐	⭐
3D		⭐		⭐		
Parachute			⭐			
Drafting	⭐	⭐	⭐	⭐	⭐	⭐
Engineering		⭐	⭐	⭐	⭐	⭐
Planification	⭐			⭐	⭐	⭐

5.2 Planning

Timetable and planning:



Progress report:

Item	Status (in %)	Comment
Calendar	IN PROGRESS (80)	We improve it over time
Logo	DONE (100)	
Primary mission (P.M.)	IN PROGRESS (90)	Awaiting the final version of the PCBs + Awaiting the SD card reader.
Code P.M.	IN PROGRESS (99)	The SD card reader code needs to be tested.
PCB P.M.	IN PROGRESS (85)	Design in progress

Secondary mission (S.M.)	IN PROGRESS (20)	Waiting for the components
PCB S.M.	IN PROGRESS (0)	Awaiting data
Modelling	DELAYED	Waiting for the precise dimensions of the PCBs and components for the secondary mission.
Parachute	IN PROGRESS (65)	Finish the final version.
Antenna	IN PROGRESS (70)	Awaiting long-distance testing.
Social Media	IN PROGRESS (/)	

5.3 Budget

Part	Price (€)	Shop	Order Date
CanSat Starter kit	-100	The Hergée Museum	4/11/2024
Fabric (parachute)	-3	Chien Vert	20/11/2024
GPS + DHT11	-26,98	Amazon	22/11/2024
Wooden stick and metal tube	-11,47	Brico	24/11/2024
Custom PCB	-44,39	JLC	06/01/2025
TOTAL	**185,84**	/	/

6. Outreach

We are active on social media, and we have selected several platforms on which we post regular updates and progress videos:

- Our instagram account: https://www.instagram.com/skyfall_mission/
- Our TikTok account: https://www.tiktok.com/@skyfall_mission

We also want to create posters to put in our school and we regularly talk about our project to people we know.

We seek to ensure that our social media posts are fun, because we believe that humour and fun are the best way to attract the attention of our target audience, namely students.

We also monitor social media and identify what is trending and then seek to incorporate these trending topics in our posts.

7. Discussion

The first stages of the project went very well. We assigned separate roles to each team member, and each team member performed research in the domains relevant for his or her tasks. We have all learned a lot !

Aside from the GPS (which didn't work in the final code because a pin was named twice), everything worked on the first try (the Yagi antenna, the temperature, pressure, and altitude sensors, etc.). As of now, we have tested all our primary mission except for the SD card reader which we don't have yet (we will receive it on Tuesday, 14 January), but we already have the necessary code for its operation.

We have also done all the necessary calculations for our parachute and have bought the fabric. We will be manufacturing the parachute next week.

We will seek to complete our primary mission next week as well. By doing so, we will be able to start our secondary mission within 2 weeks, together with the first 3D model.

Regarding the hardware, we realized that connecting the components with wires took up too much space in the can and was very fragile. So we decided to create our own custom PCBs. We also decided not to solder anything for now and to do it only in the last stages of construction. This should allow the solder joints and connections to be stable and clean at launch. We are confident that we will be able to identify equipment small enough to fit in our tiny box. Overall, we are confident that we will be able to successfully complete this project and have full confidence in our highly motivated team.

We look forward to seeing our canister fall slowly thanks to its parachute, and to see it rise again with full confidence.

8. Conclusion

We are delighted to participate in the CanSat project, and the project has been very enriching for all of us. We have gained a considerable amount of technical knowledge and developed many important skills. But this is only the beginning, and we are excited to discover the next stages of the project and see our CanSat for real.

One of the aspects which we found particularly interesting so far was the fact that we had to work in a group, and indeed cooperate with each other and rely on each other. Although we have performed numerous group assignments at school, this project was different because of the volume and complexity of the project. The project cannot be handled solely or mainly by one or two members of the group (as sometimes happens in group assignments at school) and we had to equally divide the work amongst ourselves, and rely on group members to perform their tasks in a timely manner. This required careful planning and organisation, but also commitment from all members of the group. We are very proud that the atmosphere within our group has remained excellent, and that all members of the group remain highly motivated and committed.

Since we started the CanSat project, we have managed to comply with the timetable we have developed for ourselves. Several components have worked at first try (such as the antenna, the temperature sensors and the altitude sensors), and our code has very quickly achieved the desired results. This is a testimony to the efficiency of the group.

We very much hope that our CanSat will indeed be built and that our CanSat will meet the requirements imposed by the project.

The journey so far has been fascinating, and this is only the beginning!

References

1. https://jlcpcb.com/?from=VGS&utm_source=google&utm_medium=cpc&utm_campaign=14177189905&gad_source=1&gclid=CjwKCAiAp4O8BhAkEiwAqv2UqAqXonYUEgGIab8hbSn3jmupn8KnK5727UvnXlXKYRxQ6VfWUN_oXBoClGcQAvD_BwE
2. https://www.youtube.com/watch?v=35YuILUlfGs&list=PLr5hOpbuTRXXZjHFPKTKG3aaFlTc-gc1y
3. https://www.youtube.com/watch?v=MsdJgEinb34&t=300s&pp=ygULcGNiIGRlc2lnbiA%3D
4. https://www.youtube.com/watch?v=UKNnxAajH9s&pp=ygULcGNiIGRlc2lnbiA%3D
5. https://www.youtube.com/watch?v=RfGuJ5nTeVw&t=321s&pp=ygULcGNiIGRlc2lnbiA%3D
6. https://www.reddit.com/r/beneater/comments/ry7b57/which_pcb_manufacturer/
7. https://www.viasion.com/blog/top-15-pcb-manufacturers-and-suppliers/
8. https://www.youtube.com/watch?v=utBQqcuOt9U&pp=ygULcGNiIGRlc2lnbiA%3D
9. https://www.youtube.com/watch?v=aICfPYkbBus&t=710s&pp=ygULcGNiIGRlc2lnbiA%3D
10. https://easyeda.com/fr
11. https://www.generation-nt.com/actualites/slim-atterrisseur-japon-lune-fin-mission-2049968?utm_source=chatgpt.com
12. https://www.cite-espace.com/actualites-spatiales/slim-se-reveille-sur-la-lune/?utm_source=chatgpt.com
13. https://www.generation-nt.com/actualites/slim-atterrisseur-japon-lune-fin-mission-2049968?utm_source=chatgpt.com
14. https://www.youtube.com/watch?v=bTuQasdQ6cA&pp=ygUTc29saWRlIHdpcmVkIGF3ZyAyMg%3D%3D
15. Raspberry Pi-Pico-W-pinout.png (1374×867)
16. GitHub - inmcm/micropyGPS: A Full Featured GPS NMEA-0183 sentence parser for use with Micropython and the PyBoard embedded platform
17. https://www.youtube.com/watch?v=yf52Erawyfg&pp=ygUMYW50ZW5uZSB5YWdp
18. https://www.changpuak.ch/electronics/yagi_uda_antenna_DL6WU.php
19. https://www.youtube.com/watch?v=NiDCgM2f5ww&pp=ygUMYW50ZW5uZSB5YWdp
20. Yagi Antenna Calculator
21. https://www.youtube.com/watch?v=3EAj2gPka54&pp=ugMICgJmchABGAHKBQZjYW5zYXQ%3D

22. https://www.youtube.com/watch?v=uuItz61DIxk&pp=ygUGY2Fuc2F0
23. http://www.innoviris.brussels/fr/program/cansat-belgium
24. https://recherche.wallonie.be/Cansat-Belgium
25. https://www.esa.int/Education/CanSat
26. https://www.planete-sciences.org/espace/CanSat/Presentation
27. https://www.facebook.com/CanSat.Belgium/?locale=fr_FR
28. https://www.tinkercad.com/things/dwrsjJ87iZC-fantastic-crift-fulffy/edit?returnTo=https%3A%2F%2Fwww.tinkercad.com%2Fdashboard&sharecode=JpDYc539c2Z4ae3eZ4sZQkhs3bztlNvo4dSrAwJ3hA4
29. https://youtu.be/lEOqrg5gM9Q?si=LWWxeJr8T79-ULG1
30. https://youtu.be/3AIA1HBsTVI?si=-q11SxLKiDpRzkSi
31. https://www.youtube.com/watch?v=1LjLq1CoB1E&feature=emb_logo
32. https://learn.adafruit.com/adafruit-feather-m0-express-designed-for-circuit-python-circuitpython/using-with-arduino-ide
33. https://www.generationrobots.com/fr/401727-mini-cam%C3%A9ra-jpeg-1386.html
34. https://www.editions-eni.fr/open/mediabook.aspx?idR=8457f073dc836b48a324c65a97bdc71b
35. https://openclassrooms.com/fr/courses/4076871-sinitier-a-la-robotique/4083254-fabriquez-votre-propre-robot-arduino
36. https://forum.arduino.cc/index.php?topic=32533.0
37. https://www.robotshop.com/community/blog/show/comment-fabriquer-un-robot-lecon-7-utiliser-des-capteurs-2
38. https://web.maths.unsw.edu.au/~lafaye/CCM/transmission/transanalog.htm
39. https://fr.wikipedia.org/wiki/Robot#Composition_d'un_robot
40. https://robodk.com/doc/fr/Robot-Drivers.html
41. https://www.youtube.com/watch?v=d_F1DjB5SjA
42. https://www.youtube.com/watch?v=qHRp2G1ANpI
43. https://www.youtube.com/watch?v=kwsJOlc_RbI
44. https://www.youtube.com/watch?v=wBoU6Dp5Gs8&t=333s
45. https://www.youtube.com/watch?v=3YbL2Rj-62Q&t=1436s
46. https://youtu.be/vMT-97kW9nQ?si=x20YHB8GqboeirSn
47. https://youtu.be/9_srWebChyo?si=GEhyT8_aerlYuG0C