TEAM PORTFOLIO

Dutch CanSat Competition 2024-2025

The Netherlands esero

Template Final Design

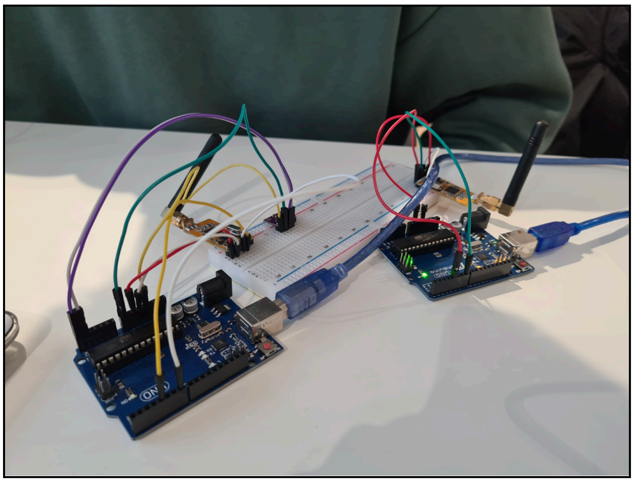
General

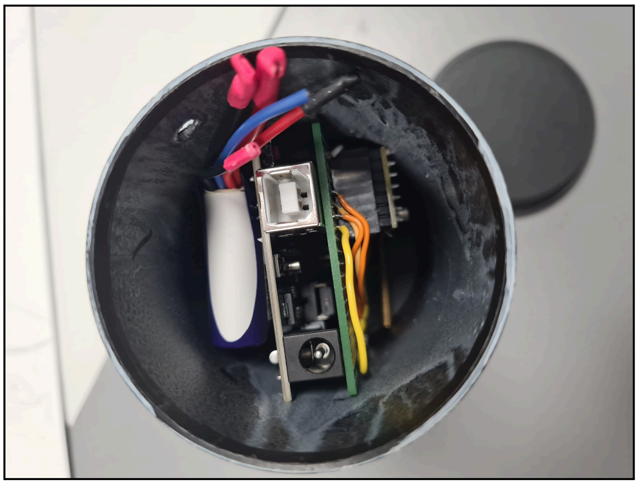
Team: SCAMSAT
Team Number: 2
School: Amsterdam International Community School
City: Amsterdam
Word Count: 9121

1 Mission Overview

1.1 Primary Mission

Species **Cam**era **Sat**ellite, or Team SCAMSAT for short, is a dedicated team of passionate and skilled individuals. We work together to design and build a high-performing CanSat, combining innovation, precision, and careful planning to take on every challenge with confidence. Team SCAMSAT is committed to collecting essential environmental data, specifically air temperature and pressure, during deployment and descent. To accomplish this, the team utilizes APC-220 transmitters for real-time data transmission. The core mission, meeting standard CanSat requirements, has been successfully completed. This includes full integration and thorough testing of the APC-220 transmitters with the BMP-280 sensor, ensuring accurate and efficient data transmission up to around 450 meters within our tested trials. With this milestone reached, the team is now focused on enhancing long-range communication uptill a minimum of 1000 meters. Using a PCB Shield, the Arduino UNO, has been connected to the APC, along with the BMP and is working well. As shown in the photo below. This upgrade is a key step in improving SCAMSAT's mission, allowing it to stay connected and send environmental data from higher altitudes and longer distances, opening doors for future applications. Below is a photo of two modules communicating. One will stay on the ground as the base station, while the other, inside the CanSat, will send live altitude data back. During the final launch, the APC-220 will transmit this data to the Yagi antenna. Nevertheless along with all of these primary communication components, our secondary mission requires electronics as well.

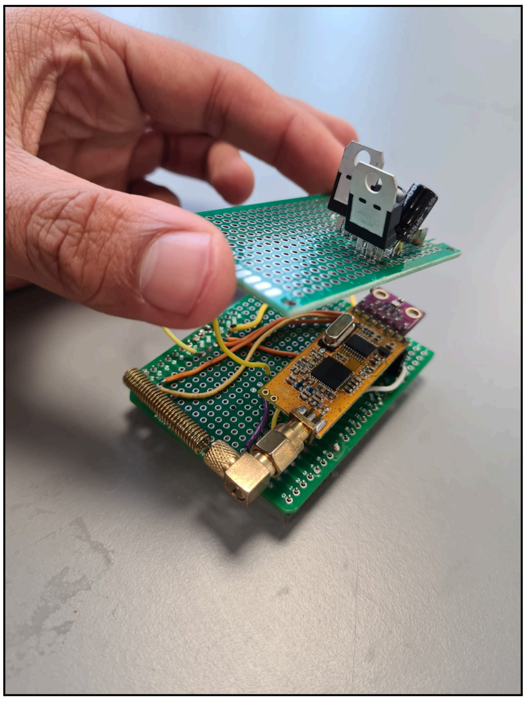




1.2 Secondary Mission

For this year's secondary mission, we wanted to step beyond the typical Earth-based applications of most CanSats and instead model a mission that pushes the boundaries of exploration. While many CanSat missions

focus on studying environmental conditions on Earth, we chose to simulate a concept that could one day help search for extraterrestrial life. Our goal is to develop a small satellite system capable of detecting life by identifying heat signatures and observing movement, which could eventually be launched into orbit for deep-space exploration. To achieve this, our CanSat is equipped with an infrared (IR) LED emitter and receiver to detect motion signatures, alongside a live transmission camera system to capture and analyze movement. For this competition's testing phase, we are experimenting with insects as our test subjects, recording their movement patterns and heat emissions as they respond to our setup. This will help us refine our detection techniques for potential future applications beyond Earth. Additionally, we have incorporated a reflective sheet on the bottom of the CanSat. This sheet is designed to reflect light, making the CanSat more visually noticeable and further attracting life forms, improving our chances of capturing meaningful data. These combined elements will allow us to study how organisms interact with our CanSat, mirroring how we might detect life in an extraterrestrial setting. Since submitting our proposal, we have successfully acquired and tested the camera, which now only requires soldering for final integration. We are optimizing live data transmission to ensure clear and real-time imaging. The infrared detection system is also being fine-tuned to accurately sense heat variations. Our camera is powered through a voltage divider, providing 5 volts from our LiPo battery. A common power system connects the LiPo to the Arduino Uno, infrared sensing system, and camera, ensuring stable operation throughout the mission. The LiPo provides enough power to support all onboard systems, allowing continuous data collection and transmission. By taking this approach, we hope to demonstrate the feasibility of using small, cost-effective satellites to detect life beyond Earth.



1.3 Scientific and/or technical objectives

The main goal of our CanSat project is to explore the possibility of detecting microscopic life, potentially on other planets. To make this happen, we're keeping our design compact by using small, multifunctional components like the BMP-280 sensor, which measures both temperature and pressure. For our secondary mission, we're making the most of the available space by minimizing electronics and mounting them along the interior sides. Most of our components are soldered directly onto the shell, ensuring durability and efficient use of space. A key part of our mission is making sure the CanSat descends safely and remains visible after landing. One of the most exciting innovations in our design is the use of live video transmission for data collection. Instead of storing images on an SD card, our camera, now fully operational, will send live footage in real time, allowing us to instantly analyze movement and heat signatures. This real-time capability makes the system more efficient and helps us detect life forms more effectively.

1.4 Data measurements and analyses

The data gathered will consist of temperature, pressure, and visual recordings, captured using a BMP-280 sensor and a camera. The temperature and pressure data will help evaluate environmental conditions, while the visual

recordings will be processed through computer vision to identify microscopic life forms and light patterns.

Component (Use Case)	Data Sender from CanSat	Data Receiver to Ground
BMP-280 (Temperature)	APC-220	Yagi Antenna (2.5 GHz 12 dBi)
BMP-280 (Pressure)	APC-220	Yagi Antenna (2.5 GHz 12 dBi)
IR Blaster (Signal Out)	Arduino UNO	n/a
IR Receiver (Live Data)	APC-220	Yagi Antenna (2.5 GHz 12 dBi)
FPV camera 5v 170' (Live Video)	APC-220	Yagi Antenna (2.5 GHz 12 dBi)

1.5 Design

1.5.1 Base Body (PVC)

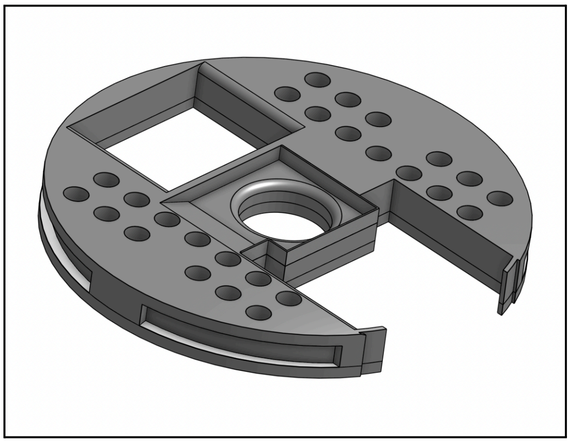
This year our CanSat will be using a variety of materials for its body design.

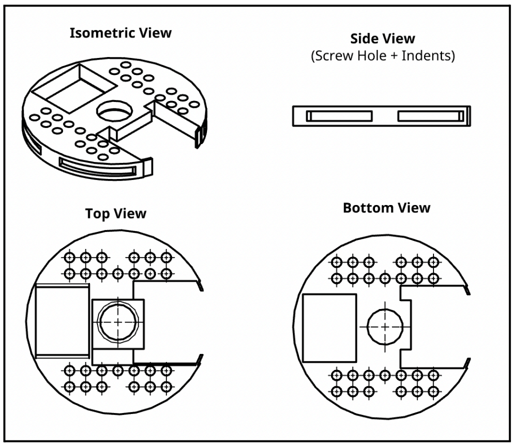
The Main body will be constructed using a ⌀60mm grey PVC pipe that will be 110mm Tall. We will then coat this entire PVC in black paint with white outlines. Such as shown on the side. We will create 8 holes using a drill, (2x4 on each isometric side) for the parachute cords to attach. Image on the side is the initial creation of this. (Development seen further on in the report).

1.5.2 Caps (PLA 3D Printed)

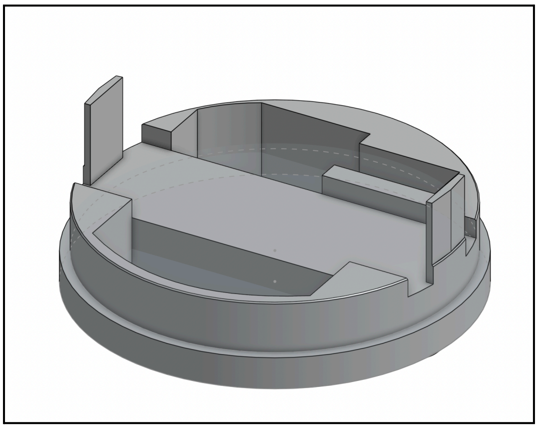
This year we will be 3D modeling 2 pieces:

- **Middle cap**
    - Sits 20 mm from ground
    - Screwed in from sides
    - 6mm thick
    - Holds Camera
    - Holds IR emitter + Receiver
    - Indents near screws for easy fit + alignment
    - 13 Holes x 2 for antenna signal to pass through of ⌀3mm
    - Fillit added for easy slide in of components



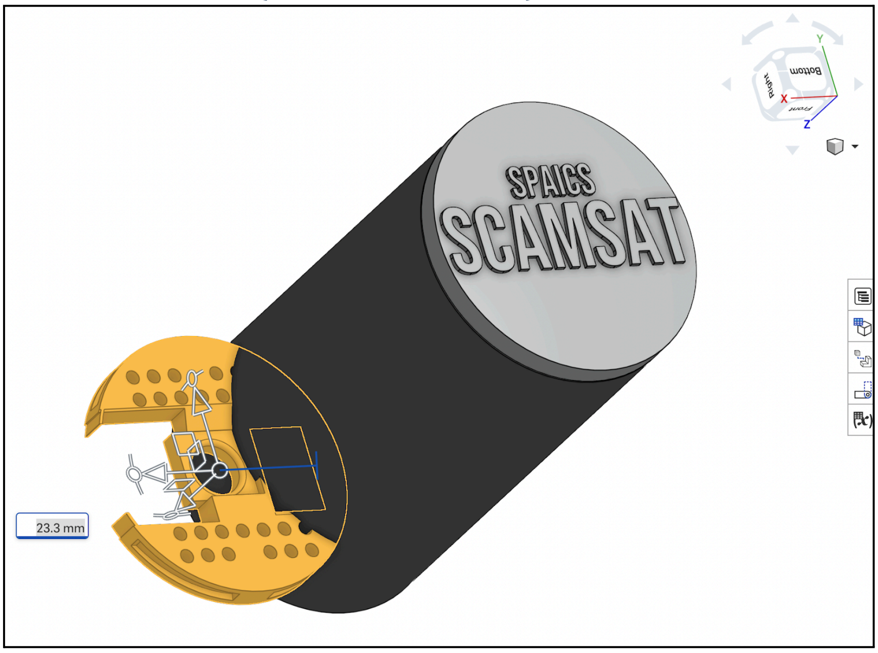


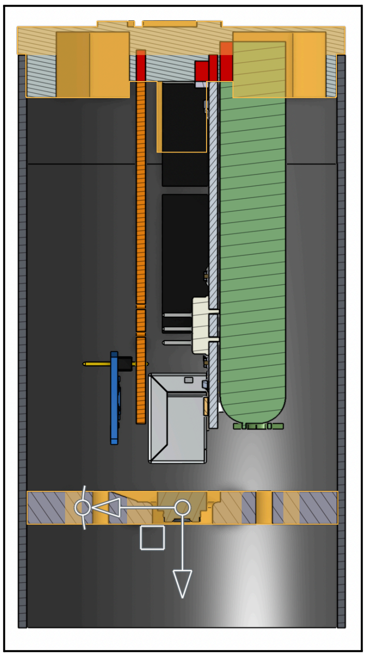
- **Top Cap**
    - 10mm Thick
    - 5mm Outwards that lays on top of the can
    - 5mm on the inside with placeholder for electronics
    - SCAMSAT written on top, later painted on with gold (Seen below)
    - LIPO fits inside the placement
    - APC-220 antenna fits inside curve
    - small piece of foam between APC and Shield to hold it in place.
    - Taller holders in middle to slide in UNO/Shield to hold in place (Shown further down)
    - High outerwall thickness for high tension cap
    - Perfect inside fit creates closure in can
    - Pieces that hold up Arduino UNO fit between parachute cords for more safety.



These two disks are used later on and placed within the CanSat. The middle disk is screwed in from outside with a washel and screw using a high power drill. The top cap stays firm during descent as tested due to the perfect fit pressure, and the lock from the parachute. This cap allows easy access to the inside as well.

1.5.3 Combination (Disks + Electronics)





The two images above show the combination of disks, image on the left shows the way that these two disks will be placed together onto the PVC. The PVC in the above image does not show any holes for parachute or screws for easy representation. The image on the right shows a cross/sectional view of the can with primary electronics inside. Once the disks are attached. The electronics can be placed inside the can:

No.	Electronics	Mission
1	APC-220 (Data Sender to Ground)	Primary + Secondary
2	BMP-280 (Temperature + Pressure)	Primary
3	LiPo Battery 7.4 2S 1800mAh(Power Source)	Primary + Secondary
4	Arduino UNO + Shell (The Brain)	Primary + Secondary
5	FPV camera 5v 170' (Live Camera Transmission)	Secondary
6	IR emitter (Send Waves)	Secondary
7	IR Receiver (Gather Heat Signature)	Secondary
8	Switch	Primary + Secondary

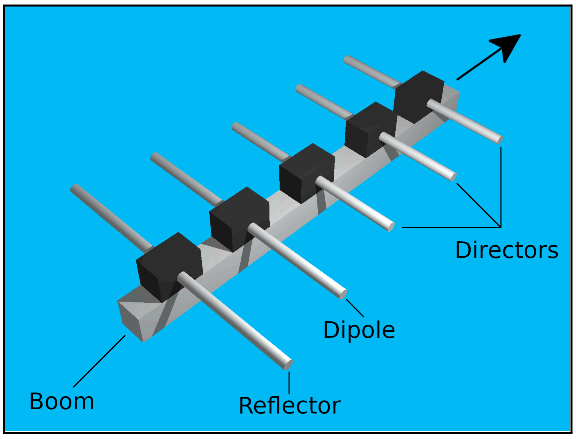
All above electronics are needed to complete the primary and secondary mission. These have been tested and are working together; they fit well together perfectly within the CanSat.

1.5.4 Parachute Attachment

The parachute is attached to the CanSat by 6 evenly spaced holes in which strong and durable ropes are inserted. A total of 3 ropes are threaded through two adjacent holes in the CanSat each to loop back up to connect to a swivel with an overabundance of zipties. This swivel then connects to the parachute on its other end through 6 strings of similar strength. This attachment is very strong and can easily withstand forces over 100N, surpassing the minimum requirement of 50N.

1.5.5 Ground Station + Yagi (Antenna)

Our Yagi antenna will be directly connected to the APC-220 module on the ground station. We will appoint one person to direct the Yagi towards the CanSat as it descends, ensuring optimal signal reception. The APC-220 is a long-range RF transceiver module that will be responsible for receiving telemetry data from the CanSat. This module operates at a frequency of 433 MHz, providing reliable communication over long distances. By using a directional Yagi antenna, we can enhance the reception of signals from the CanSat, allowing us to maintain a strong link throughout its descent. The ground station operator will continuously track the CanSat's position and adjust the antenna accordingly. As shown on the side.



1.6 Test Results

During our Test Day, we encountered an issue with our communication range, which was limited to about 150 meters, much shorter than we had anticipated. Upon investigating the cause of this problem, we realized that the signal was being obstructed by a Faraday cage effect, likely due to the positioning of the antenna inside the CanSat. To address this, we repositioned the antenna to the outside of the CanSat, which significantly improved our range and allowed for much better transmission. This adjustment was tested with the APC-to-APC communication setup, and we were able to achieve much longer distances. Moving forward, we plan to test with the APC-to-Yagi setup paired with the ground station, as we previously achieved a range of 800 meters in a trial test, although we haven't been able to test it further since then.

In terms of the CanSat's construction, there were no major issues with the build itself, but after conducting additional research and reviewing the data, we decided to make a change regarding the method for attracting insects. Initially, we planned to use UV lights, but further testing revealed that UV lights would not be as effective in the long run for attracting insects as we had hoped. As a result, we have opted to switch to the peanut butter method, which has proven to be more reliable for this task.

Regarding the parachute, we are satisfied with its design, but we've identified a small issue with the swivel: it's a bit too weak for our needs. To resolve this, we will be replacing the current swivel with a stronger one to ensure that the parachute deploys correctly without any issues during descent. Furthermore, initially with the expert from delft, upon viewing the parachute and the additional videoclips, the repeated side landings were recognized. We were told to incorporate a spill hole, which is located at the roof of the parachute, and is aimed at preventing the parachute from over inflating. It maintains stability, and would allow the Cansat to land more straight. However, it seemed as a problem, but was soon abolished as some crucial components were placed at the ends of the Cansat, meaning that side landing would actually preserve these components. Yet, this serves as important feedback for future projects, as in other cases this could definitely seem like an issue. Aside from these minor changes, there have been no further adjustments needed to the ground station or other components of the CanSat. We are confident that these improvements will address the issues we encountered and help us move forward with more effective testing and preparation for the final launch.

1.7 Adjustments original design plan

Several important updates and improvements have been made to the design and functionality of our CanSat. In terms of structural modifications, we are introducing a new middle cap and an updated bottom acrylic disk (Given from CanSat Starter Kit), positioned 10 mm above the base, to enhance stability and optimize internal component arrangement. Additionally, we will be reprinting the top cap using a resin printer to improve durability and precision.

On the hardware and software side, we are refining our power distribution system by incorporating voltage dividers, one supplying 5V to the camera and another providing 3.3V to the IR system. To accommodate these adjustments, an extra PCB will be added to integrate the voltage dividers efficiently. Furthermore, we are implementing a new transmitter for the camera to improve live data transmission reliability. As part of our mission refinement, we have also decided to remove all UV components, allowing us to focus on other detection methods, such as infrared-based heat signature tracking.

Regarding the parachute system, no modifications are required, as it has already been tested and meets all necessary performance criteria. These updates collectively contribute to enhancing the CanSat's overall efficiency, ensuring smoother operation, better power management, and more effective data collection, all while maintaining a structurally sound and optimized design.

1.8 Testing

Overall, most of the components actually went by extremely seamlessly, with minor issues in soldering, however it was swiftly solved. The BMP, Accelerometer and APC responded successfully without any real problems. Our only real issue was with the parachute.

While testing prototype issues, we encountered issues with the durability and rotation of the cansat. First, we attempted with a parachute that utilized metal locks/rings, in order to hold the Cansat. The problem didn't lie in the metal not being strong enough, but instead it was the concept that it made the lid of the Cansat a significant stress point. With the material further also being plastic, it couldn't withstand the force exerted by the 350 gram cansat, and it had easily broken. Furthermore, the Cansat would also spin, creating harder impacts with the ground, possibly damaging the components, eg. sensors. The primary reason behind this had to do with initial tension at the lock. From the results, the tension at the strings were not perfectly uniform at the attachment point. If one side experiences slightly more tension (even by extremely little), it can cause the lock to shift/twist. Because the lock was exerting a high force, this led to a rotational force that made the Cansat spin. We then adjusted the prototype, and instead of one lock holding the Cansat, we distributed strings into the Cansat through drilling holes. This did remove the problem of only having one key stress point, as it was distributed throughout six holes. This did improve the durability, however we were at the time still unaware of the other issue. The process of getting the strings into the holes wasn't so accurate, and the lengths were probably not so accurate. This would lead to an unequal distribution of forces between the strings. This imbalance causes the CanSat to experience rotational forces, as one side may pull harder than the other, initiating spinning.

- Video 1 of test: https://youtu.be/t90XIXu7qNo
- Video 2 of test (Lid Breaks): https://youtube.com/shorts/1107BeyuZ70

Only after these tests did we understand how to improvise on this rotational force. This was through a swivel point. A swivel point would allow the parachute to rotate freely around the access, without causing the entire cansat to spin uncontrollably. Without a swivel, any small imbalance or twist in the parachute could lead to the Cansat spinning as the strings twist. However, a swivel allows the strings to independently move, abolishing the rotating force. Even if the strings are of unequal lengths, a swivel allows the attachment point to adjust itself, resulting in a more stable descent. We will still incorporate a chain, so therefore we will select a stronger material as the lid of the Cansat, eg. Steel plate. This will improve durability, and some force will already be removed from the lid due to the swivel. The swivel point turned out to be extremely successful, with the attachment finally being able to withstand the force, due to the equal distribution of stress. This would not only decrease the chances of potential damage, but also ensure that the parachute is reusable and will remain intact.

Therefore, with every component functioning as of now, with minor adjustments we can create a very successful product that thoroughly addresses our mission.

2 CanSat Technical Requirements

Requirement 1 Dimensions

The Cansat requirement is Ø66mm, and 110mm tall (Excl. Parachute). Our Cansat has two separate compartments:

- 10mm (Top Cap Thickness)
    - 5mm Protrude outwards (Sit on top of Can's circumference)
    - 5mm shelled inwards (Incision for UNO | **NOT** added to total)
- 85mm (Top Part)
    - 6mm (Cap inside Can | **NOT** added to total)
- 20mm (Bottom Part | Open from the bottom)

Total Height of can = 110mm. For the Cansat Body, we will be using a Ø60mm PVC Pipe to ensure a strong body. There will be many small holes in the middle cap for the APC to transmit data well hence it will not protrude outwards the given dimensions. The parachute will be made of soft material and will fold within the given extra 4.5cm. Hence all CanSat dimension requirements will be met.

Requirement 2 Extensions

Nothing will be extending outside the Cansat except an extremely small piece of antenna. The body of our Cansat has a diameter of 60mm, ensuring that the components stay within the constraints of maximum diameter 66mm. With 6mm of extra buffer outside the body, this space has been allocated for the antenna, without exceeding the overall maximum diameter. No elements, including antennas, transducers or any other components can extend beyond the diameter until it has exited the launch vehicle. Therefore, this consideration of 6mm space ensures that it can properly fit without possibly experiencing damage, whilst following the regulations of the maximum dimensions.

Requirement 3 Weight

After measuring, the Cansat weighs 308 grams including the parachute, which falls under the within range of 300-350g that is set by the organization. To achieve this feasible weight, we carefully designed the Cansat by utilizing efficient components, beneficial parachute material, and conducted precise soldering to minimize excess weight. Furthermore, we selected lightweight materials alongside compact and durable hardware while still optimizing the software to its maximum potential. This is the reason that the weight falls under the requirements, without requiring any additional ballast. The weight of 308 grams is extremely effective, as the Cansat remains light and functional while remaining inside the constraints. This ultimately ensures optimal performance without any compliance with the regulations/requirements.

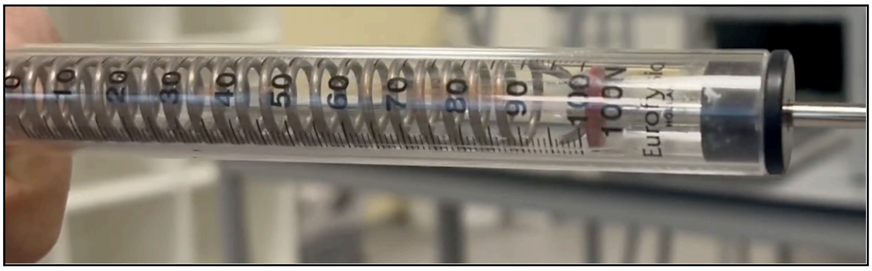
Requirement 4 Dangerous materials

Our Cansat avoids the use of any dangerous materials such explosives, detonators, flammable substances, etc. The only potential slight concern is the battery *(High Discharge LiPo Battery Nano-Tech 1.0 100mAh 25-50C Discharge)*, but it is assured that it meets the safety standards as it is carefully selected and incorporated. The battery is enclosed in the Cansat, which will definitely prevent any risks for incidents such as short circuits. Additionally, the Cansat does contain minimal sharp components (Arduino Uno), however it is securely covered with foam to prevent any injury to anyone or damage to other components. Externally, we use standard components, and through sticking to this regular equipment, we can ensure that the Cansat is very safe and

functional, whilst meeting the competition's regulations.

Requirement 5 Parachute strength

The parachute connection is one of the most important elements in ensuring safety of the entire system. We incorporated zip ties on the top of the parachute, and then made an attachment to a newton meter, where it was later exposed to a force of 100 N, the maximum capacity of our newton meter. This far exceeded the 50 N requirement. The results were highly satisfactory, as the connection between the Cansat and the parachute was able to handle the force in a very effortless manner. This demonstrates its ability to effectively withstand much higher forces than are required. Despite going over the required force by 2x, the connection showed no signs of tension or stress, depicting that the system is built well. Although the recommended force to withstand would be 200 N, the parachute still handled the force feasible for us easily, demonstrating that the system is designed to provide reliable safety. The material that was employed for the rope further played a significant role in the connection's ability to easily withstand the 100 N test. It was made from synthetic material (see below), and is designed to be enduring, durable, and resistant to any potential damage. This ensures that it will stay connected, even if conditions during the launch are extreme. Furthermore, the attachment points that integrate the rope with the parachute were very precisely measured and executed. They were equally split throughout the design, ensuring balanced stress distribution of force, as there are multiple stress points. Through evenly spreading the weight, the possibility of failure under stress will be greatly limited. In conclusion, the parachute connection did extremely well during the test, as it easily dealt with forces of 100 N. With the recommended force of 200 N easily possible, the parachute could further deal with even greater stresses, ultimately indicating the system's strength and ability to withstand the launch.



Link: https://youtu.be/f9q_qDRTa7Q

Requirement 6 Vibrations

In order to determine whether or not the Cansat is able to withstand vibrations resulting from an acceleration of up to 20 G, we will attach it to a bicycle wheel of radius 1m. The following formula will allow us to determine the required speed to simulate 20 G.

$$F_{cp} = \frac{mv^2}{r}$$

$$\omega = \frac{v}{r}, \therefore\ v = r\omega$$

$$F_{cp} = \frac{m(r\omega)^2}{r}$$

$$F_{cp} = mr\omega^2$$

$$20g = F_{cp} = 0.35 \cdot 1 \cdot \omega^2, \quad g = 9.81$$

$$\sqrt{\frac{20 \cdot 9.81}{0.35}} = \omega = 23.68 rad/s$$

$$\frac{23.68 rad/s}{2\pi} = 3.77\ rotations/s$$

The Cansat successfully experienced 20 G and underwent up to 4 rotations per second, and remained intact during the test with no external, visible damage. All internal components were checked, and remained operational. Our system in the Cansat recorded accelerometer readings during the test, and it was confirmed that it experienced a G force of 20.

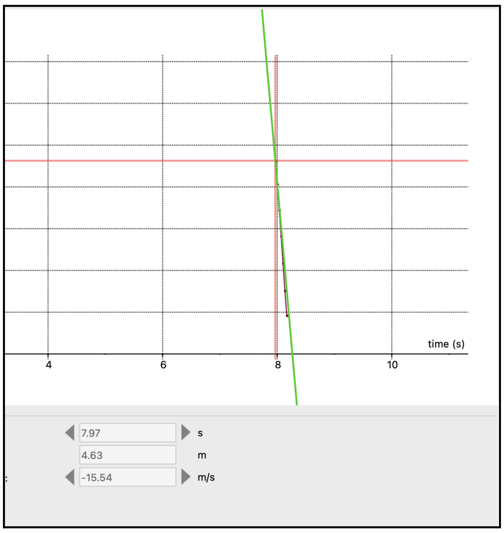
Requirement 7 Flight time

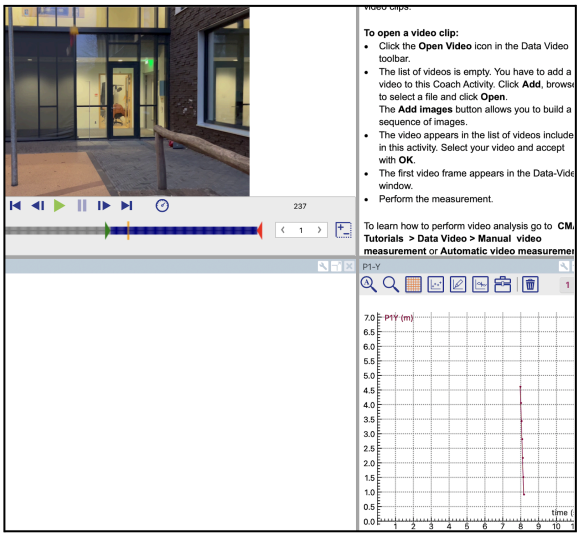
In order to determine whether or not the can has achieved terminal velocity, and at what speed it is travelling we have utilised a data analysis software called tracker. We have recorded 5 tests, where we were able to then measure the ratio of distance travelled:time, we can also determine whether or not the cansat will be able to descend 1 km in under the standard 77s. Finder is a Java scripted app, where we were able to gather our data points.

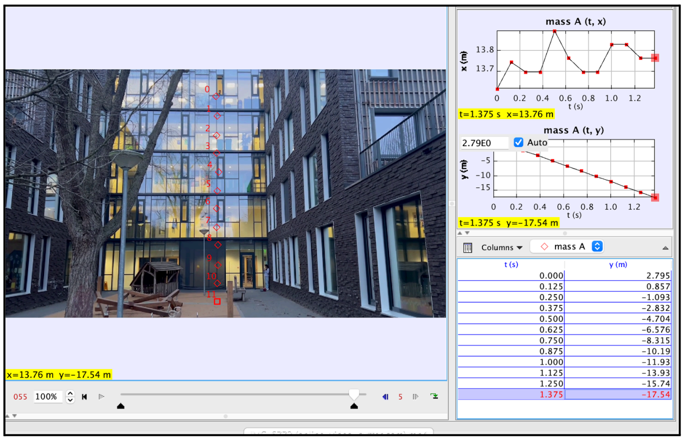
Testing Videos:

- https://youtu.be/ngDk7Pn9o04
- https://youtu.be/q4bpcIdUGNc
- https://youtu.be/O2kHXJnwahc
- https://youtu.be/b8Fvqsm1ND0
- https://youtu.be/UJzOJne4Aj8

After initial tests where we just analyzed a specific section of around 3m, results turned out to be promising with them lying in the range of around 15-15.5m/s. Through carefully tracking the Cansat, accurately adjusting the frames, incorporating calibration and grids, we were able to carry out accurate analysis. Below is one of the five tests that shows a velocity of 15.54, which was found through analyzing the slope. Calculations can be conducted that with 15.54m/s, the Cansat can descend just under 1200m in 77 seconds, which is well above the 1000m height.







The calculation was for the ratio of 2:15.4m of the height of the drop. After speaking to the DARE professionals, we did discover that the ratio of acceleration: terminal velocity would be different and more inconsistent for a shorter distance, so while this data is sufficient, there could be underlying causes that disrupt the reliability. Later on, we conducted a test for the entire 15.4m building. Even with this change, results remained consistent, with the images below depicting an average 15.3m/s. This was calculated through y2-y1/x2-x1, with these variables representing distance and time. With all results illustrating that the Cansat will descend at a sufficient speed, we will ultimately incorporate a similar area and material for the final, as it has been proved to have been extremely effective and successful. This will preserve the crucial components, and enhance the chances of an achieved mission. With an approximate velocity of 15.4m/s, and the Cansat being able to descend around 1.2km in 77 seconds, by using the ratio it is found that it will be able to complete the descent in approximately 64.16 seconds, which is in compliance with the requirement.

$$1.2km\ in\ 77\ seconds$$

$$1.2:77,\ \ 1:x$$

$$1km\ calculation\ =\ 1x77/1.2$$

$$1km\ =\ 64.16s$$

Requirement 8 Parachute security

The area of the parachute has been calculated in a manner that during the entire descent it will travel at over 13m/s, ensuring a feasible recovery. Therefore, our Cansat doesn't utilize a parachute of larger size that will deploy later on, indicating that it wouldn't require an active deployment mechanism during the flight. A larger parachute will be used for slower descent rates at particular altitudes, and in contrast would require a deployment mechanism to ensure it is controlled. However, as seen above with our Cansat already in the designated range, incorporating such a mechanism would add various unnecessary issues without providing many benefits. By maintaining a steady descent of over 13 m/s with our primary parachute alone, our Cansat achieves a feasible recovery without any risk or complexity that could potentially occur with a larger parachute and active deployment system. Thus, this design ensures reliance on the system and will therefore be employed.

Requirement 9 Power supply

Our Cansat contains a battery that provides an extremely reliable source of power to every onboard system. The battery we are using has an approximate 7.4 volts, which is certainly sufficient power for all the critical components such as the BMP, ACP, Accelerometer, Camera and IR. The battery is able to continuously operate for around 4-6 hours, which would meet the requirement of it having to be activated for four hours non-stop without running low. This ensures that our Cansat can remain powered during the length of the mission (including waiting time), and it can constantly provide data. Further, the battery is designed to be very accessible, which would allow quick replacement/recharge if rarely required. This means that if maintenance is required, it can swiftly be conducted without any disruptions. Therefore, by using this 7.4 volt battery we are able to meet the requirement of power supply.

Requirement 10 Power switch

Our CanSat's master power switch has been securely soldered onto the shield. The top cap, while firmly in place to ensure stability during descent, remains easily removable for accessibility. This design allows the entire electronics system to be taken out when necessary, enabling quick activation of the switch without compromising the CanSat's integrity.

Requirement 11 Recovery system

Our recovery system is created to be extremely durable, reliable, and resistant to any possible damage. The parachute is made from a bright yellow synthetic material, which will enhance visibility during and after landing, which would make it more efficient to locate based on the circumstances. The parachute connection has precisely been integrated to withstand the forces that will be experienced through deployment and descent. This has further been tested (Newton test), where the connection's ability to withstand greater force than required was demonstrated without any signs of damage or stress. Further, are durable and reliable (synthetic), and with multiple tests that resulted in the parachute staying compact, we can state that it can be reused after the launch. The stress being evenly distributed across 6 points further depicts the system's reliability. Overall, our system meets the standards in terms of both safety and performance, providing a safe, effective, and reusable recovery system for the Cansat's descent.

Requirement 12 Retrieval system

While we have not incorporated a beeper, radio, gps, etc, to meet the requirement of the retrieval system we do have a neon, bright yellow parachute. This would still easily be spotted for retrieval after landing. Along with this we are adding a buzzer onto the shield that will activate near a low altitude for easy recovery, which will emit high frequency sounds. Through this sound signal, it would be more efficient to locate the Cansat during the stage of descent. Overall, with this combination of a bright parachute and a buzzer, we will ultimately be able to ensure that the retrieval process will be quite swift and simple. Therefore, this approach provides us with cues to facilitate locating the Cansat, which further meets the final requirement.

3 Outreach

3.1 Outreach Plan

Our outreach strategy has remained consistent from the beginning, with this year's focus on two key objectives:

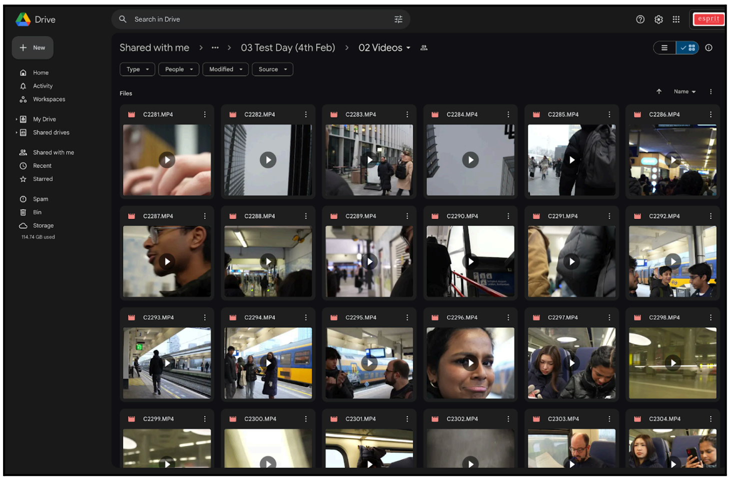
1. Increasing public visibility
2. Securing sponsorships

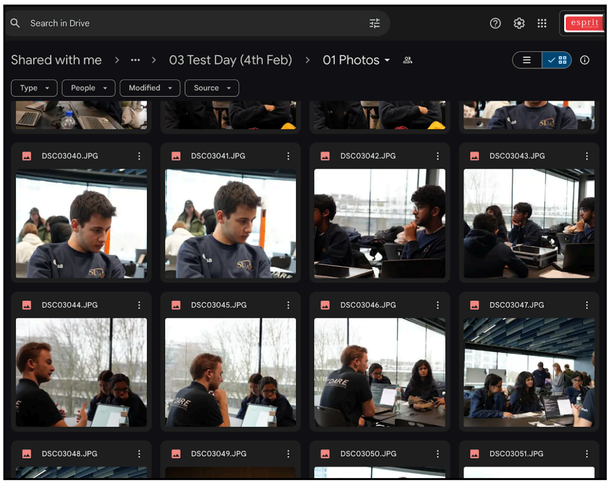
Since our secondary mission explores the search for extraterrestrial life, we have tailored our outreach efforts to reflect this intriguing and ambitious theme, aiming to spark curiosity and engage our audience in a meaningful way. By aligning our communication with the core concept of our mission, we hope to inspire more people to take an interest in space exploration and the role that small-scale satellites like CanSats can play in future discoveries. To make information more accessible, we have introduced a Linktree that provides direct access to all of our sponsors, making it easier for our audience to learn about the organizations supporting us. This initiative strengthens our relationships with sponsors while also allowing our community to see the broader impact of our project. Additionally, we have partnered with the newly established AICS bulletin board club, which serves as a central platform for sharing updates, ideas, and progress with our school. The club is currently preparing the SPAICS article, which will further expand our outreach, bringing greater visibility to our work and allowing us to connect with a larger audience. Instagram continues to be one of our most effective tools for engagement. By consistently sharing updates, sponsor highlights, and behind-the-scenes content, we are able to keep our school community, the ESERO network, and the wider public informed about our progress. Its broad reach and accessibility make it an essential part of our strategy, ensuring that our mission remains visible and exciting for those following our journey. Through these combined efforts, we are confident in our ability to build stronger connections, enhance public awareness, and successfully achieve our outreach goals for this year. By continuously improving our communication and expanding our reach, we aim to inspire more people to support and engage with innovative projects like SCAMSAT, demonstrating the potential of student-led space exploration initiatives.

3.2 Progress

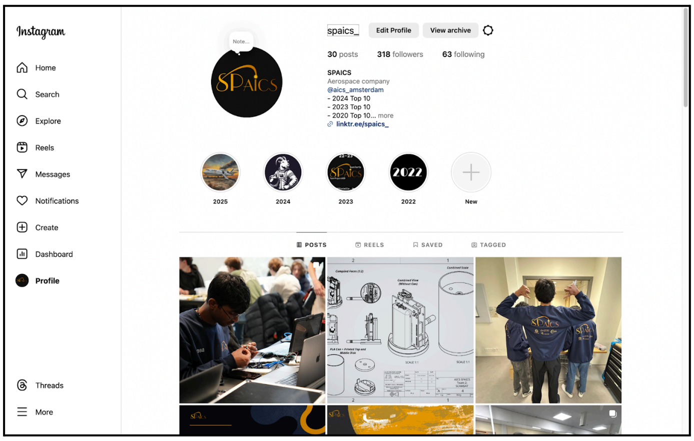
Our SPAICS team has been actively growing our presence both online and within the school community. Through consistent social media engagement and collaborations, we have strengthened our reach and visibility. On Instagram, we have been posting regularly and gaining more traction, now making us the most followed club in our school. During the initial round, we secured two sponsorships and featured them in posts on our page. As we gained more sponsors, we created another social media post to highlight them. Before that, we uploaded photos of our team working, which received the most views and likes. Our SPAICS page also has dedicated highlights showcasing new YouTube videos along with major events, such as the upcoming launch day. Additionally, our SPAICS group, the school's Media Team, and the Student Council have collaborated on a short, fun, and informal interview round to help us reach this year's goals. This video has been edited and will soon be uploaded to the Student Council's page. We also shared photos from our TU Delft visit, 3D designs of our CanSat, and pictures of our newly arrived hoodies, which we have been actively promoting through Instagram Stories. On Delft Day, we took photos for the Yearbook team, further promoting our club for future years. These included candid shots as well as descriptions and names for the yearbook, helping solidify our presence in the school community and inviting new students to join. Having a large public following allows for growth, and the goal of SPAICS is to inspire bright minds by offering them an incredible opportunity to work in a team, develop a product, and see it succeed all while maintaining high academic standards. If we reach the final competition, we must showcase our success on these platforms. A video documenting our TU Delft trip is currently being created and will be

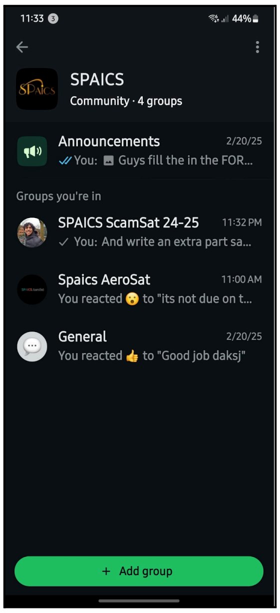
uploaded to our YouTube channel soon. We filmed a large portion of the trip, and all files are stored in our shared drive. With all these initiatives, our goal is to continue expanding SPAICS impact and engagement. By leveraging social media, partnerships, and creative content, we are ensuring that our club not only thrives this year but leaves a lasting legacy for years to come.

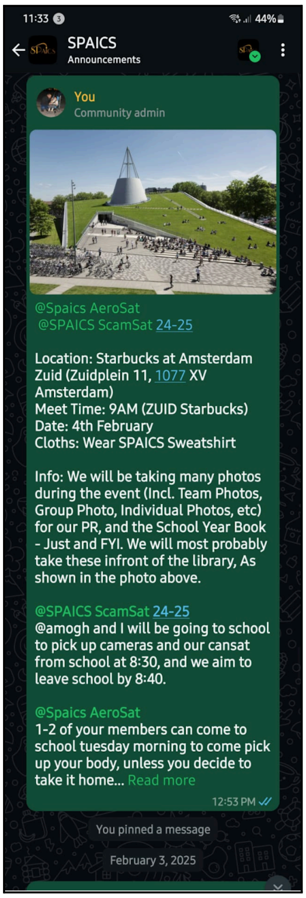


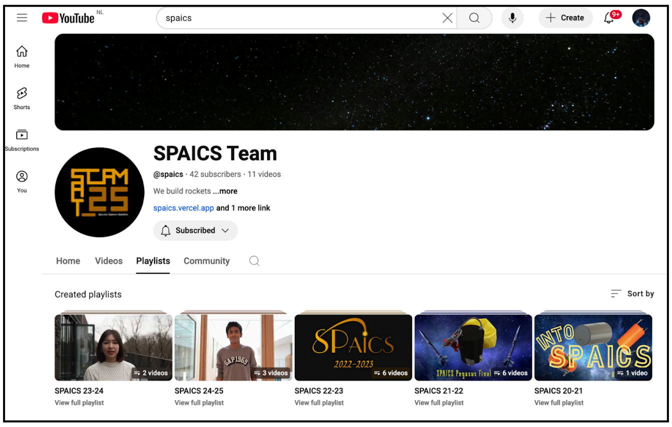


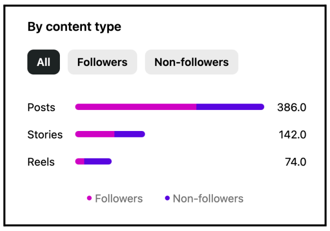
Above is our Shared google drive with all photos and videos, this being for test launch day and individual photos.











Above are all forms of evidence for our consistent progress in outreach programs. (As our school has two teams we work with them to maximize and efficiently produce our CanSat) (Whatsapp Community with main communication | Instagram | Youtube | Trello Shown further down)

4 Project management

4.1 Process Summary

Our aspiration of simulating a concept that could eventually help detect extraterrestrial life forms has been a gradual process revolving around dedication and determination. From the start, our team worked collaboratively to refine and solidify our mission objectives, ensuring that both the primary and secondary missions were clearly defined. Once the core idea was established, we transitioned into the design phase, where we carefully planned the structure, hardware, and software components necessary to achieve our goals. Weekly meetings provided a consistent framework for brainstorming, refining our approach, and keeping the project on track.

As with any complex project, we encountered challenges along the way. Some of the biggest hurdles included optimizing the CanSat's compact design to accommodate all components, refining long-range communication for live data transmission, and ensuring that our heat signature detection system functioned effectively. Instead of allowing these obstacles to slow us down, we adapted by troubleshooting, testing alternative solutions, and leveraging our collective expertise to find the best possible outcomes. The hands-on approach of testing, iterating, and improving has been key to our progress.

Despite these challenges, our team has remained highly motivated and efficient. Strong communication and organization have ensured that no major setbacks derailed our progress. With a well-structured workflow, continuous problem-solving, and a shared commitment to our mission, we have steadily advanced toward our final launch. Looking ahead, we are excited to see our efforts come to fruition and push the boundaries of what our small-scale CanSat can achieve.

4.2 Team

Our team consists of 6 members and an additional intern, structured based on experiences, skills and interests in order to ensure maximum contribution towards the final project.

- Hardware/Software (Kavin & Varun): Responsible for programming, soldering, wiring, hardware integration, and PCB design. They ensure that all electronic components are functioning and correctly incorporated. Kavin is a dedicated member, who has been in Spaics for 2 years, leading in soldering and mission development, while Varun adds expertise in both hardware and software, with one year in SPAICS.
- Body Design (Amogh & Milo): Focused on designing a strong, durable, and accessible CanSat body that is able to integrate all systems, including hardware and recovery. Amogh contributes significantly, with over two years of advanced 3D design skills, while Milo leverages extensive experience in design and drawings to ensure precise, practical solutions.
- Recovery (Can): Designs and tests a lightweight, reliable parachute system to ensure the CanSat lands safely and within the given time frame. Can is responsible for creating a precise design that is able to seamlessly integrate the recovery system with the body.
- Public Relations (Daksh): Controls outreach, communication, and sponsorship efforts to raise awareness about the project. Daksh effectively handles social media, interacts with local companies, and ensures the project reaches the potential sponsors and supporters to assist our team.

- Intern (Laksh): Supports all team members to gain significant experience in various aspects of the project. Laksh primarily focuses on recovery this year, while further also assisting in public relations, working on advertisements and gaining skills for future control.

While the team is separated into distinct roles, everyone always strives to contribute not only in their designated role, but also the ones of others. This fosters greater brainstorming which always ultimately provides us with more structured and greater ideas/outcomes. This strengthened teamwork increases innovation and efficiency, allowing us to maximize our potential, ultimately enhancing the final product. Our team requires us to collaborate and build one each-others ideas. We have noticed that when not communicated well as in previous year's, our goals do not end up aligning as we have not structured well. Our roles need each other to work well as we build on one by one. e.g. The body team needs the hardware/software team's dimensions, they must work together to see if all will fit or not etc. Our team is highly motivated to complete this project!

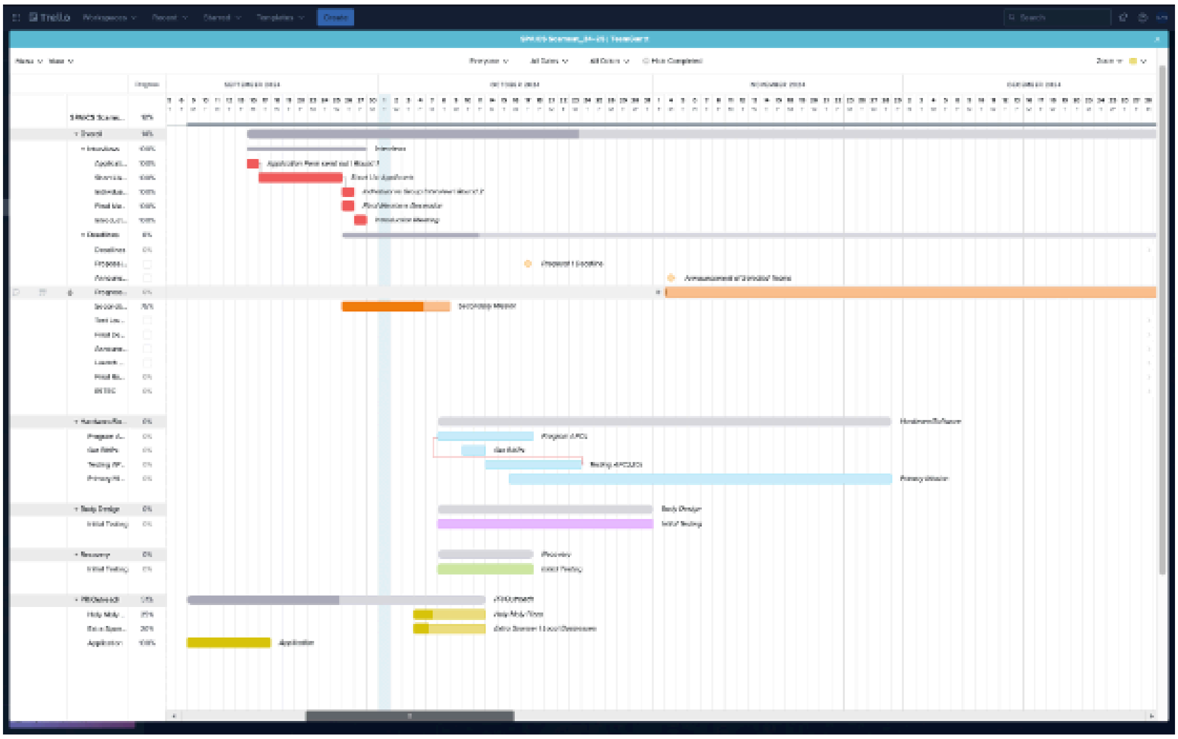
4.3 Cansat Status

Our CanSat is in its final stages, with most components fully functional and assembled. The primary and secondary missions are both working as expected, with successful testing of the BMP-280 sensor for temperature and pressure, as well as the camera and IR system for heat signature detection. The primary mission has already been soldered, but the camera and IR components still need to be soldered onto the CanSat to finalize the setup.

On the structural side, the parachute is complete and ready for deployment, while the body team has finished the main design work. However, we still need to 3D print a new model of the top cap in better quality. Once printed, the final assembly will involve placing the new acrylic disk into its holder, securing it with screws, and attaching the reprinted cap to ensure everything is securely enclosed. These last steps will bring the CanSat to completion, making it fully prepared for testing and, ultimately, launch.

4.4 Planning

We have developed a well-organized system for managing our time and responsibilities throughout the CanSat project. Every Friday from 4:30 to 5:30, we hold weekly meetings to assess our progress, review completed tasks, outline what still needs to be done, and strategize solutions for any challenges we encounter. These meetings serve as a crucial touchpoint, keeping everyone aligned and ensuring that work across different disciplines moves forward efficiently. We keep our team organized by tracking meeting invites on Google Calendar and using our SPAICS WhatsApp community for clear and direct communication from team leaders. For task management and deadlines, we rely on Trello, ensuring that every milestone is met on time. The CanSat project follows a structured 26-week timeline, including holidays, making careful planning essential. To streamline workflow and keep everyone updated, we use a WhatsApp group for quick updates and integrate Trello with a power app that connects directly to our Gantt Chart. This setup allows us to visualize our timeline, allocate resources efficiently, and balance our workload with school commitments. By using these tools, we have been able to stay accountable, maintain steady progress, and ensure that no deadlines are missed.



Beyond our scheduled Friday meetings, we have designated additional time slots for team members to focus on their individual roles. Whether it’s coding, soldering, or assembling components, this extra time has allowed us to make continuous progress between meetings and address tasks that require deeper attention. This flexibility has been invaluable, helping us stay ahead of schedule while ensuring that each aspect of the CanSat is completed with accuracy and attention to detail. Every team member has shown a high level of dedication, consistently attending meetings and actively contributing to the project. In addition to our internal efforts, we also hold regular discussions with our mentor to seek guidance and feedback. These conversations have provided us with valuable insights, helping us refine our ideas and make well-informed technical decisions.

Aside from our technical work, we have also focused on building a strong team identity. One of the ways we've done this is by designing and ordering team hoodies, which we were eagerly anticipating in our previous updates. Now that they have arrived, we are incredibly proud to wear them and represent our team as a unified group. We all wore them to the TU Delft Test Launch (As shown above.), and the final design made possible with the support of our sponsors has exceeded our expectations.

By combining structured meetings, effective task management tools, flexible working hours, ongoing mentorship, and efforts to strengthen our team spirit, we have created an environment where the CanSat project can thrive. This level of organization and commitment has allowed us to stay on track, work cohesively, and approach each challenge with a clear strategy. As we move forward, we are confident that this approach will continue to drive our success and bring us closer to achieving our ultimate mission.

4.5 Finance

Finance plays a crucial role in this year's SPAICS AICS project, and we have successfully secured funding from four local sponsors. Our school has two participating teams:

- Team 1: AeroSat
- **Team 2: SCAMSAT**

Each team initially receives €500 in funding from the school, and any additional sponsorships acquired by AICS are evenly distributed between the two teams. This year, our PR team reached out to four different companies, securing valuable sponsorships to support our project.

eduBridge: EduBridge is an organization specializing in IB Mathematics for all ages and English tutoring for primary students in the Netherlands. Located near our school, they contributed €50 in exchange for increased public exposure. Since this sponsorship benefits both teams, the total €100 donation was split equally, adding €50 to our budget.

Sol el Luna: Sol el Luna, a restaurant in Amsterdam's De Pijp, is known for its warm atmosphere and diverse menu featuring lunch, dinner, and tapas. Having opened just three months ago, they are rapidly growing, and we

secured a €200 sponsorship from them in exchange for promotional exposure. We have already visited their establishment and plan to celebrate there after our competition. This sponsorship added €100 to our team's budget.

Better Life Acupuncture: A small local business in Amsterdam, Better Life Acupuncture offers traditional Chinese medicine treatments, including acupuncture and cupping, aimed at pain relief and mental well-being. They contributed €50 to our project, which was divided between both teams, adding €25 to Scamsat's budget.

SuperDNA 3D Lab: SuperDNA 3D Lab is a 3D solutions provider specializing in CGI product rendering, AR shopping experiences, product animations, and functional videos. We previously collaborated with them and reconnected this year for another small sponsorship. They contributed €50, with €25 allocated to our team.

Through these sponsorships, we raised an additional €400 for this year's CanSat competition, with Team Scamsat receiving €200 of this amount. However, after collectively deciding to design and order team hoodies, which cost around €400 in total, we used this sponsorship money to fund them. The final price for our team's hoodies came to €194.60.

The following data sheets compare only Team Scamsat's total €700 budget.

This year, our new body design recruit, Milo, has played a crucial role by providing access to his personal 3D printer, resin printer, and various essential materials such as nuts, bolts, screws, and different types of PLA filament. Most of the materials required for the project are either already in the possession of team members or available from previous years. We have full access to the SPAICS room and its inventory, which includes electronics from the CanSat kit and components from past missions, such as APCs, breadboards, LEDs, and more. The same applies to recovery materials, as we have a supply of fabric from previous years that can be repurposed. The only additional materials we may need are reflective elements from safety vests for the parachute or reflective coating for the interior.

To maximize our budget efficiency, we prioritize reusing materials whenever possible. By repurposing preserved components, we significantly reduce unnecessary expenses and ensure that funds are allocated to critical needs, such as testing, unexpected adjustments, and improvements. Additionally, having access to spare materials in the SPAICS room, including screws, bolts, and various PLA filaments, further minimizes costs. This sustainable approach not only keeps our project cost-effective but also ensures that we maintain flexibility in our budget for last-minute modifications. By efficiently managing resources and avoiding waste, we are able to focus on refining and enhancing our CanSat without financial strain.

With these resources and sponsorships, we are well-equipped to advance our project and ensure a successful CanSat mission.

Funding:

Company		Budget (Euro)
Initial	School Budget	500

Sponsors	eduBridge	50
	Sol el Luna	100
	Better Life Acupuncture	25
	SuperDNA Lab 360	25
Total		**700**

Budget:

Expense details	Qty.	Category	Cost	Status
Hoodie L	5	PR	€27.80	ORDERED
Hoodie M	1	PR	€27.80	ORDERED
Hoodie S	1	PR	€27.80	ORDERED
FPV camera 5v 170'	1	Electrical	€19.80	ORDERED
Cansat Kit	1	Electrical	€100	ORDERED
Safety Vests	1	Recovery	€3.74	ORDERED
Transport Minivan	1	PR	€130.00	TBD

Allocation:

Category	Groups	Price
PR	Transport	€130.00
	Hoodies	€194.60
Electrical	Camera	€19.80
	Cansat Kit	€100
Recovery	Safety Vest	€3.74
	Total Spent	€448.14
	Total Left	€251.86

From our total budget of €700, we have set aside an additional €250 specifically for food and any unforeseen expenses that may arise throughout the project. This careful allocation allows us to handle unexpected costs without putting pressure on our main budget. By managing our funds responsibly and efficiently, we maximize our resources while maintaining a financial cushion. This strategic planning ensures that all essential needs are covered while leaving us with ample funds. As a result, we will have more than enough for a well-deserved celebration at the end of the competition, making it a fitting reward for our hard work.

5 Evaluation

Our team has grown tremendously throughout this year's CanSat project, demonstrating a strong balance of experience, organization, and adaptability. We are a diverse group, with some of us having been involved in

SPAICS since it first began, while others joined more recently. Despite our different levels of experience, we have built an environment where knowledge flows freely across disciplines, ensuring that no one is left behind. Open communication and teamwork have been key in keeping the project moving forward, allowing us to overcome technical challenges and make continuous improvements. Unlike previous years, where separate aspects of the project sometimes held each other back due to incomplete work or miscommunication, we have developed a structured and efficient way of working that ensures steady progress without unnecessary delays.

One of the biggest improvements we have made this year is our ability to anticipate and solve challenges before they become major obstacles. In past years, teams struggled with last-minute deadlines, often rushing to complete final reports and critical technical tasks just days before submission. We recognized this as an issue early on and made a conscious effort to change our approach. By focusing on structured planning, distributing workloads effectively, and ensuring that every aspect of the project technical development, documentation, and testing gets the attention it deserves, we have significantly reduced stress while increasing the quality of our work. This mindset has allowed us to maintain productivity without feeling overwhelmed, ensuring that each component of the CanSat is built and tested thoroughly before launch.

Testing has played a crucial role in refining our CanSat's performance. During Test Day, we encountered a major issue with our transmission range, which was significantly shorter than expected, only reaching about 150 meters. After thorough investigation, we discovered that the metal structure of the CanSat was unintentionally acting as a Faraday cage, blocking the transmission signal. Recognizing the problem, we quickly adapted by repositioning the antenna outside the CanSat, which drastically improved communication range. In follow-up tests, we confirmed that this change allowed the CanSat to transmit data over much longer distances. Initial tests between APC-to-APC showed promising results, and when we conducted our first test with APC-to-Yagi and the ground station, we successfully reached 800 meters. However, we recognize that a single test is not enough to fully validate our solution, and we plan to conduct further trials to ensure the CanSat performs consistently under different conditions.

Beyond communication issues, we have also made key refinements to our secondary mission. Initially, we planned to use UV lights to attract insects, but after further research, we realized that UV lights would not be effective for most species in the long run. Instead, we decided to implement our peanut butter method, which has proven to be more reliable. This change was made after careful consideration of the mission's goals, and we believe it will yield more consistent results. Additionally, while our parachute design is generally well-executed, we identified a minor issue with the swivel, which is slightly weaker than expected. To prevent any risks during descent, we plan to replace it with a more durable component. These proactive adjustments ensure that our CanSat will function as intended without last-minute failures.

Budgeting has been another major focus for our team, as we wanted to make sure that we could allocate funds efficiently while avoiding unnecessary expenses. One of our biggest financial strategies has been to reuse materials from previous years whenever possible. Components such as electronics, APCs, breadboards, LEDs, recovery fabrics, and structural elements from past missions have been carefully preserved and repurposed, allowing us to cut costs significantly. Additionally, we have full access to the SPAICS room, which contains a variety of spare materials, including screws, bolts, and various PLA filaments. These resources have allowed us to minimize expenses while still maintaining the quality of our CanSat. Thanks to these budget-conscious decisions, we have been able to dedicate funds to more critical aspects of the project, such as testing, unexpected

adjustments, and future improvements. This careful financial management not only helps us optimize our current CanSat but also ensures that we have a financial buffer for any unforeseen issues.

One of the things that sets this year's team apart is our shared motivation and commitment to excellence. For some of us, this is our final year in the SPAICS program, making this project even more significant as we strive to leave a lasting impact. We are not just building a CanSat we are building an experience that reflects all the skills we have developed throughout our time in the program. Unlike previous years, where uncertainty and procrastination often led to rushed solutions, we have maintained steady progress, using our time effectively and taking full ownership of our work. This passion extends beyond scheduled meetings; many of us have dedicated extra time outside of official sessions to brainstorm ideas, troubleshoot issues, and refine our designs.

Beyond the technical aspects, this project has been an incredible learning experience for all of us. Every discipline within our team has faced unique challenges, requiring patience, creativity, and problem-solving skills to overcome them. The hardware and software team, for example, faced difficulties with camera integration, requiring extensive testing and troubleshooting before reaching a stable solution. The body design team had to navigate space constraints, ensuring that all necessary components fit within the limited dimensions of the CanSat without compromising functionality. Meanwhile, the recovery team worked to resolve issues with the parachute swivel, a critical component in ensuring a safe descent. Each challenge we faced gave us an opportunity to improve our problem-solving abilities and technical skills, preparing us for more complex engineering and scientific endeavors in the future.

Looking back, we are incredibly proud of what we have accomplished. This project has been more than just assembling a CanSat; it has been a journey of learning, problem-solving, and teamwork. The effort we have put in, the obstacles we have overcome, and the skills we have gained make this experience truly meaningful. Unlike previous years, where teams often struggled with organization and efficiency, we have developed a structured approach that has allowed us to maximize our productivity and push our capabilities further. By staying organized, working efficiently, and supporting each other, we have built something we can all be proud of, leaving a strong foundation for future teams to build upon.

To this regard, the project has met our expectations, maybe even far exceeded them. The difficulties each discipline faced, such as issues with camera for HW/SW, issues with space in the Body Design, and issues with the parachute swivel for recovery, have all been resolved with a great amount of learning benefitted from each. Our team is incredibly satisfied with our progress, and are looking forward to the final launch, hoping for good weather!