CanSat Final Report
LC Sat Team

Team Name: LC sat

Country: France

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1 INTRODUCTION

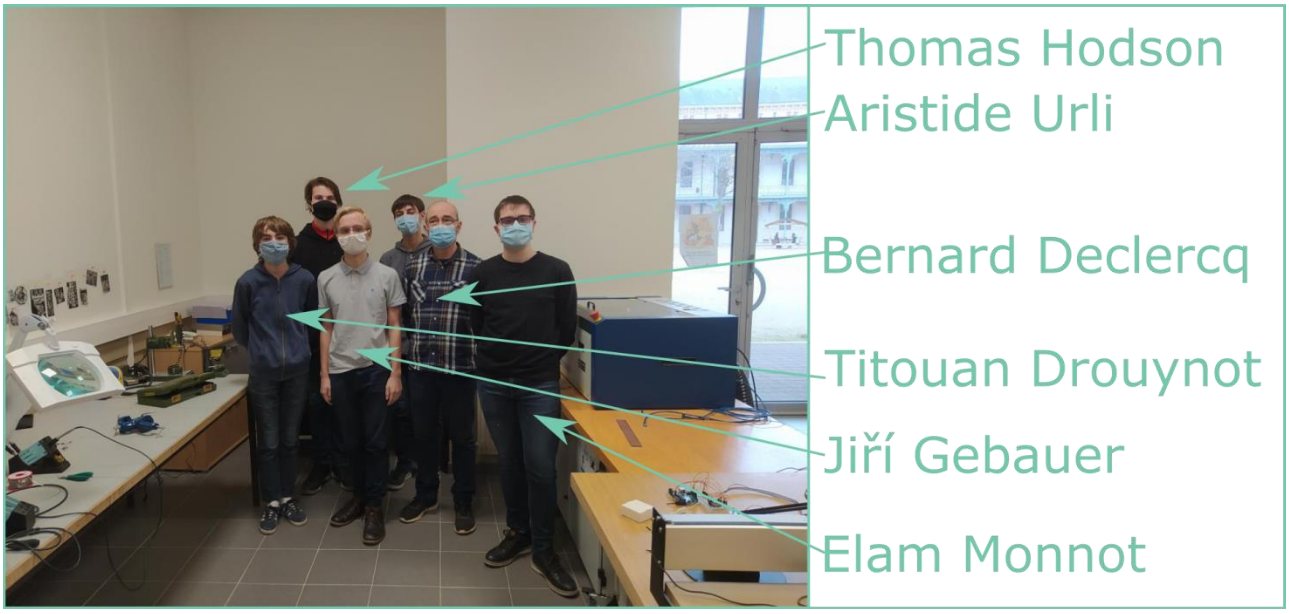
1.1 Team organisation and roles

We are the “LC sat” team, “LC sat” standing for “Lycée Carnot satellite”, “Lycée Carnot” being our high school. We decided to join this competition because we think that it is a great opportunity to put into practice our skills and to turn theoretical ideas into reality. Our team is composed of four members, plus our representative teacher (see the next picture):

- Bernard Declercq is the Team’s representative teacher. He teaches Engineering Sciences at Carnot high school. He didn’t contribute to the practical realisation of the CanSat competition itself; however he was of great help with the administrative tasks.
- Jiří Gebauer, in 1^{0th} grade, is Czech, and arrived in France this year to study. He wants to focus on sciences from next year onwards i.e. maths, physics, chemistry and computer sciences. He is the team leader and has already participated several times in the CANSAT competition. He worked on the hardware, the search of sponsorship and the communication (contacted sponsors and media, welded components …).
- Titouan Drouynot, in 10th grade, has chosen maths, physics, chemistry and biology as his main core studies for the next two years. He mainly worked on the hardware and 3d modelling (designed the blue-prints, the 3d models and printed them, welded the components …).
- Aristide Urli, in 12^{th} grade, had maths and physics as his core studies with the advanced maths option. He will join Carnot-CPGE (special class which prepares students for high level exams to join premium engineering schools), in MP2I precisely (Maths, Physics, Engineering and Computer Sciences). He worked as a software engineer (created the internal software).
- Thomas Hodson, in 12^{th} grade, also opted for maths and physics, coupled with the advanced maths option and European section for his core studies. He will go to university to attend a double degree in maths and computer sciences. He worked as a software engineer and as a graphic designer (designed the logos, created the data treatment application …).
- *Elam Monnot was the 5^{th} member of the team during the national phase of the competition, but because of personal issues, he decided to leave the team. He designed the parachute.*

Because of the Covid-19 situation and the fact that we weren’t in the same classes, we didn’t work at school. We opted for remote working through the “discord” medium. We organised weekly meetings each Sunday 3 p.m. for week review, decision making and to plan the following weeks. Because each member has fairly specific skills and knowledge, workload sharing and decision taking were easier. During Sunday's meeting we met to discuss the "what" questions, and the "how" questions that were answered by the member in charge. Time dedication wasn't regular (especially due to delivery delays), we first dedicated a couple hours a week but we ended with more than 20 hours a week per member.

Figure 1 – The Team's members



1.2 Mission objectives

We choose a scientific secondary mission. We installed several sensors to record and store data during the ascent, drop and descent. The purpose is to cross these data, with the provided application, to find scientific correlations between different parameters. Moreover, we wanted to take into account in our project current world issues, especially data protection by implementing an encryption option and sustainable development by using bio-plastic.

During the dropping, the sensors recorded and stored data. We developed an application which allowed us to cross and plot data into linear charts. Based on the shape of the curves, it might be possible to find some correlations between different parameters (relation between atmospheric pressure and air temperature for instance).

We also wanted to convey the message that it is possible to create tiny scientific satellites, which can be sent into space along with bigger satellites, for students to allow them to undertake scientific research. Thomas in 11th grade started a research project for the physics Olympiads. He needed space "data" and the CanSat is the perfect opportunity to get them.

2 CanSat Description

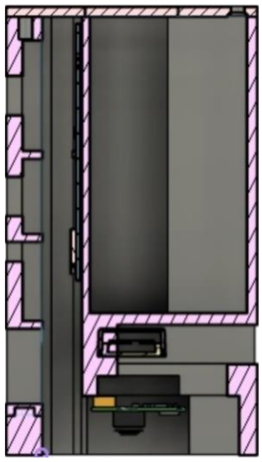
2.1 Mission outline

We decided to record multiple sources of data during the ascent, the drop and the descent. This data was processed with a dedicated application to find scientific relations between different physical dimensions (pressure and temperature relation for instance), highlight physical events (such as the fall slowed down by air friction) …. Our project was motivated by observing in experimental conditions the theoretical knowledge we have of physics. We also wanted to take into account the issues of our time, mainly the environmental impact by using bio-plastic for our CanSat's structure and data protection by implementing an encryption option and authentification securities to prevent all data corruption problems.

This mission required several sensors and two cameras (detail in the appendix 1) to record the different data. Plus, we need a powerful onboard computer to gather this data, encrypt them (if the encryption option has been activated), compress and send them to the ground station. Because of all these components, our CanSat must have powerful batteries and an important storage capacity to provide enough energy and memory. The ground station only needs a computer with enough power to run a web server in charge of rendering the provided application and communicating with the CanSat's onboard computer.

To protect the fragile components, from the accelerations and decelerations, we created a structure which holds the components and absorbs the shocks. Components also heat, so we designed an air-cooling structure (see figure 2).

Figure 2



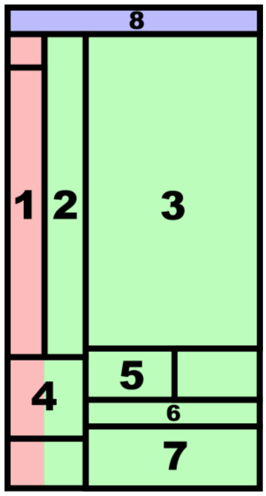
Technical design of the CanSat's interior

2.2 Mechanical/structural design

We used the Autodesk Fusion 360 to model the CanSat (see more here). The main structure of the CanSat is printed out of PLA (polylactic acid), a vegetal bio-plastic (see the video). The components are fixed on the plastic structure with double-sided tape. The electrical components are linked together with electrical cable. The Cansat is composed of three parts (figure 3):

- The first part (in red) on which sensors and batteries are fixed. The second part (in green) contains and protects the onboard computer. A few sensors are fixed on this part.
-
- The third part (in blue) holds the batteries in place, consolidates the entire structure and the parachute attached to it.

Figure 3



Schematic of the Cansat's interior

We splitted the middle part to print it out faster. You can find our 3D models on our website (here). You can find the location of the components with the appendix 2.

Some drawbacks come with this model, especially with the SD card which is hardly accessible and the wiring making it difficult to assemble the CanSat.

2.3 Electrical design

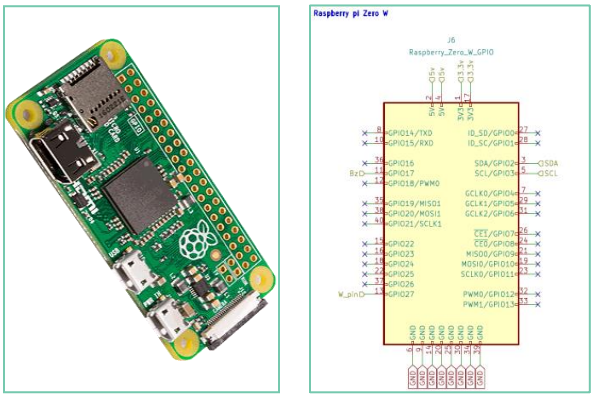
We used the KiCad software for the electrical design (more here). All components, including the onboard computer (Raspberry Pi Zero W), communicate using the I²C protocol, which allows to link each component to dedicated computer PINs. The CanSat and the ground station communicate using wifi 2.4 GHz and 5 GHz without the need for an external antenna.

Components description:

Onboard computer:

The onboard computer is the Raspberry Pi Zero W, which is simple to use and comes with integrated wifi. The Raspberry Pi has a 2 GB RAM which is enough to read, store and potentially encrypt data. The raspberry Pi Zero W also has a camera input and an integrated SD card port to store the programs and record data.

Figure 4 - Raspberry PI Zero W

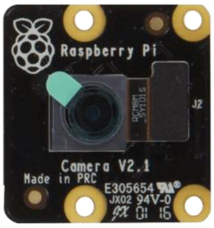


Raspberry Pi Zero W

Infrared camera:

We selected the Pi NoIR V2 camera because the Raspberry Pi Zero W has a dedicated input for this camera. This camera can record infrared signals, which are not visible to the human eye. Because the camera has been designed for Raspberry Pies, it comes with pre-built libraries to control the camera which speeds up the programming process.

Figure 5 – Infrared camera

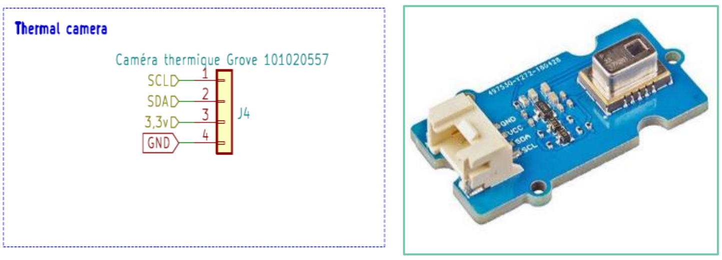


Camera Pi NoIR V2

Thermal camera:

We opted for the Thermique Grove 101020557, a thermal camera, which records an 8x8 pixels array between 0°C to 80°C.

Figure 6 – Thermal camera

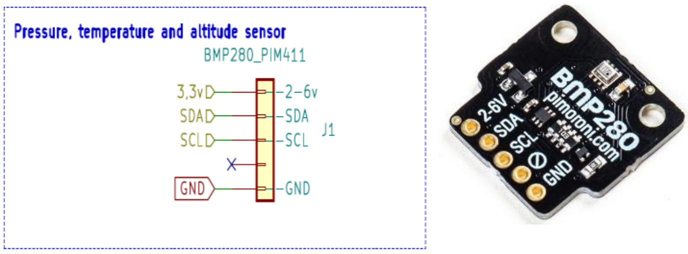


Thermique Grove 101020557

Pressure and temperature sensors:

This component measures the ambient temperature (from -40°C to 85°C) and the atmospheric pressure (from 300 to 1100 hPa). It also estimates the altitude based on pressure data.

Figure 7 – Temperature and pressure sensor

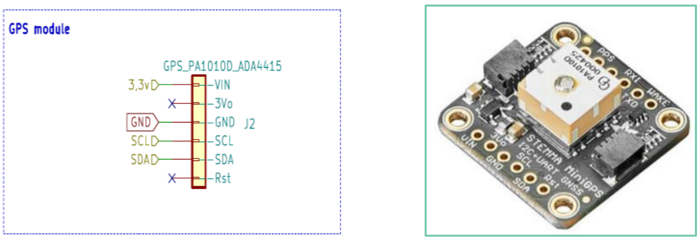


BMP280 PIM411 module

GPS:

We selected this GPS because it records the CanSat's coordinates, velocity plus the quality and number of GPS satellites signals.

Figure 8 - GPS



GPS PA1010D ADA4415

Accelerometer:

This module records the acceleration on each on the three space axes.

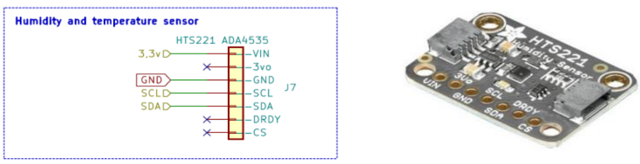
Figure 9 - Accelerometer

Accelerometer 3 axes MMA8452Q module

Humidity and temperature sensors:

This component measures the air humidity and the ambient temperature.

Figure 10 - Accelerometer



HTS221 ADA4535 module

Buzzer:

We use the buzzer to help find the CanSat once it has landed.

Figure 11 - Buzzer

Figure 12 – Wifi switch

Wifi switch:

This component is linked to a DEL which shows if wifi is on or off.

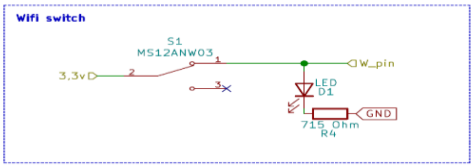
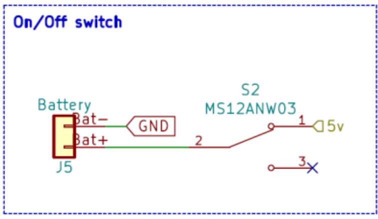


Figure 13 – On / Off switch

On/off switch:

We use this switch to indicate if the Raspberry Pi is activated. This component is directly linked to the CanSat's onboard computer power input.



Battery capacity:

Our battery has a capacity of 2600 mAh with a 14.8 V tension, which means 38 480 mWh of available energy. With the estimated energy consumption of the components (detailed in table 1), our CanSat has a 20 hours and 45 minutes autonomy.

<table>
<tr><th colspan="4">TABLE 1 - Energy consumption in 1 hour:</th></tr>
<tr><th>Component</th><th>Tension (V)</th><th>Intensity (mA)</th><th>Power (mW)</th></tr>
<tr><td>Raspberry Pi Zero W</td><td>5</td><td>170</td><td>850</td></tr>
<tr><td>BMP280 module</td><td rowspan="9">3,3</td><td>> 0,1</td><td>> 0,1</td></tr>
<tr><td>GPS module</td><td>28</td><td>92,4</td></tr>
<tr><td>Accelerometer module</td><td>> 0,1</td><td>0,3</td></tr>
<tr><td>HTS221 module</td><td>> 0,1</td><td>> 0,1</td></tr>
<tr><td>Thermal camera</td><td>4,5</td><td>14,9</td></tr>
<tr><td>Camera Pi NoIR V2</td><td>250</td><td>825</td></tr>
<tr><td>Buzzer</td><td>16</td><td>52,8</td></tr>
<tr><td>DEL Indicator</td><td rowspan="2">2</td><td rowspan="2">6,6</td></tr>
<tr><td>DEL Indicator</td></tr>
<tr><th colspan="3">Total power</th><th>1850</th></tr>
</table>

Although our CanSat is fully functional, we've already thought of new improvements, especially using a more powerful Raspberry Pi for faster data encryption, and replace the thermal camera with a higher resolution one which was initially unavailable. If there was a next step in the competition, we definitely would change those points.

2.4 Software design

We decided to use two Raspberry Pies for the onboard computer and the ground station. Both these computers run on the Pi OS, which handles pre-built functionalities. We agreed to use the Python programming language because it has a huge quantity of libraries and can be used in almost every programming field. On the top of that, Aristide and Thomas had already used Python in other projects.

Our project uses two separate softwares: an onboard one to control the CanSat itself and another for the ground station to store and process the data. The software allows users to download the recorded data through wifi without having to retrieve the SD card (detail in the appendix ②). Previously, during the national phase of the competition, users had to download the raw data through the CanSat's wifi onto their computer. They also had to install a client app on their computer to process the data. We decided to step up our project and link both software into a web-app which allows any kind of connected device to control the CanSat. With this new feature, all users now only need a web browser (detailed in the table 2) and the ground station caters for everything except deciphering (assuming encryption was turned on) which still requires users to install a computer app.

<table>
<tr><th colspan="3">TABLE 2 - Amount of data recorded on each sensor</th></tr>
<tr><th>Sensor</th><th>Recording frequency</th><th>Amount recorded per minute</th></tr>
<tr><td>Primary camera</td><td>720p 30fps, h264 format</td><td>444 MB</td></tr>
<tr><td>Thermal camera</td><td>8x8 pixels 10fps, uncompressed 16bits/pixel</td><td>75 MB</td></tr>
<tr><td>Temperature, pressure and altitude sensors</td><td rowspan="3">10 records per seconds (3x16 bits).</td><td rowspan="3">3,51 KB</td></tr>
<tr><td>Accelerometer</td></tr>
<tr><td>GPS</td></tr>
<tr><th colspan="2">Total amount of data recorded</th><th>519 MB / minute</th></tr>
</table>

We use a 32 GB storage SD card (the 16 GB one is a replacement card) in the CanSat which allows for a 33 minutes fall, more than enough storage for the ascent, the dropping and the fall.

<u>Onboard software:</u>

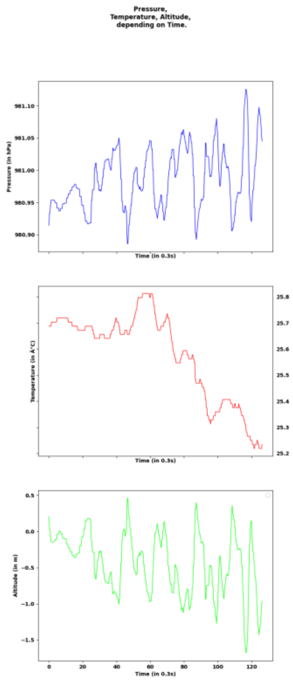
The onboard software can run in two modes: an automatic one and a semi-automatic one. Both modes are identical except for the start and stop recording functionalities. In automatic mode, the software starts recording when the vertical accelerometer detects a significant acceleration (start of the fall) and stops when the vertical accelerometer doesn't detect any acceleration during a period of 60 seconds. In semi-automatic mode the user will command the CanSat when to start and stop the recording.

In both modes, the onboard software first initializes libraries and waits until every component returns a ready message. The software will start a web server and connect itself to the ground station's wifi, which will be used to transfer data to the ground station and receive commands from the ground station. During the recording process, the onboard computer gathers the sensors' data and stores them on the SD card. At the end of the recording, the onboard computer encrypts (if the encrypt mode has been activated) and compresses the data before sending them over to the ground station.

<u>Ground station software:</u>

We created dedicated software to process the data received from the CanSat. The purpose is to cross different types of data into charts in order to find and establish scientific relationships between those data. If the encryption option isn't activated, the user can link any connected device to the ground station's wifi and access the application without downloading anything. However, if the data is encrypted, the user can only download the compressed encrypted raw data file. In that case, users will have to use the computer client application we had initially developed for the national phase of the competition in order to decipher, uncompress and process the data. As you can see on figure 14, the chart illustrates the decrease of pressure and the temperature when the altitude is higher.

Figure 14 - Temperature, Pressure and Altitude during time



Both applications (the web-application and the computer application) offer approximately the same features: charts drawing, custom maps creation and even video processing (motion filtering for instance).

This software is highly configurable but only in the program itself. A future improvement might be a configuration interface which would save having to stop and restart the CanSat.

Due to Covid-19 pandemic, the ground station and the CanSat won't be use. We decided to update the original software into a "website" to let people use the "process data".

The full detailed diagrams are in the appendices 5. You can have free access to the program on our github (here). The designs are available on our website (here).

2.5 Recovery system

The easiest way to slow down the cansat during the fall is a parachute. We agreed on a circular parachute rather than a wing parachute because of development complexity. However, the CanSat isn't steerable with this type of parachute.

We opted for an 8 $m.s^{-1}$ dropping velocity which offers a safety margin within the restrictions (the dropping velocity must be higher than 5 $m.s^{-1}$ and lower than 12 $m.s^{-1}$) even with strong winds. We estimated a 120 to 130 second descent.

We asked GJN Aerospace for the mathematical formula to calculate the required diameter of the parachute. Thanks to their advice, we used the 2 following formulas:

$D = 1{,}1892 \times \sqrt{S}$ We used it to calculate the parachute Diameter.

$F = \frac{1}{2} \times C_D \times \rho \times S \times v^2$ We used it to calculate the parachute's surface area.

We used the following web site (here) and created a 3 cm hole on the top of the parachute. We decided to use some ripstop because of its low density (40g/m²). The parachute is fixed on the CanSat with dedicated holes on the top.

Induced drag formula:

$$F = \frac{1}{2} \times C_D \times \rho \times S \times v^2$$

$$S = \frac{2 \times m \times g}{C_D \times \rho \times v^2}$$

$$S = \frac{2 \times 0{,}340 \times 9{,}823}{0{,}9 \times 1{,}217 \times 8^2}$$

$$S = 0{,}095\ m^2$$

F: Induced drag (N).
C_D : Coefficient of induced drag.
ρ: Volumic mass (Kg/L).
S: area of the parachute (m²).
V: velocity (m/s).

Formula provided by GJN Aerospace:

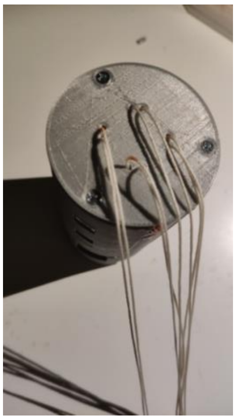
$$d = 1{,}1892 \times \sqrt{S}$$

$$d = 1{,}1892 \times \sqrt{0{,}095}$$

$$d = 0{,}37\ m = 37\ cm$$

D: the diameter of the parachute (cm).
S: the area of the parachute (cm²)

Figure 15 and 16 – Parachute and the holding points



2.6 Ground support equipment (if applicable)

During the national phase, our CanSat didn't have any ground support equipment. We created a computer application to process the data: the user had to connect his device to the CanSat's wifi to download the data from the CanSat. We also created a web application catered for the control panel of the CanSat. The problem was the local application because the users had to download it on a computer.

For the international phase of the competition, we wanted to step up our external application. We decided to combine the local computer application with the web control panel. The purpose is to allow any connected device to access the application without having to download anything.

We decided to recycle the previous onboard computer (Raspberry Pi CM4) as a web server. The users will access a control panel to start and stop the recording or to switch the encrypt option on or off.

It is important to notice that our Cansat can be fully autonomous. The ground station acts more as an ergonomic function for users rather than an essential option.

Figure 17 and 18 – Screenshots of the web-application

3 Project Planning

3.1 Resource estimation

3.1.1 Budget

Our CanSat cost about 250€, we didn't report small elements such as screws. You can find the detail prices in table 4. The entire project, including the CanSat, the prototypes, the spare components and pieces bought cost around 400€. Our website and our applications are hosted on other Raspberry Pies, included in the 400€ total price

TABLE 4 - Budget

Component	Unit price (€)	Quantity	CanSat price (€)
Buzzer	0,59	1	0,59
16 GB micro SD card	16,95	1	16,95
Thermal camera	45,60	1	45,60
Accu Li-Ion MGL99015	13,90	4	55,60
BMP280 module	9,50	1	9,50
GPS PA1010D module	37,90	1	37,90
Infrared Camera	29,90	1	29,90
Accelerometer module	3,99	1	3,99
Humidity sensor	8,50	1	8,50
5 Vcc regulator	3,95	1	3,95
Slide switch	3,17	2	6,34
DEL indicator	0,43	1	0,43
Raspberry Pi Zero W	10,00	1	10,00
DESON M3 insert	0,18	5	0,90
JST standard inputs	0,86	4	3,44
Plastic			About 1€
Parachute			About 6€
CanSat's total price			**≈250 €**

→ THE EUROPEAN SPACE AGENCY

3.1.2 External support

We made several attempts at finding support, some of them succeeded but others failed. However we didn't ask for software support. All the successful attempts are summarized in table 5. You can also find the unsuccessful ones in the appendix 4.

TABLE 5 - External support

Name	Phase	Reason
Carnot High school	1 and 2	Economic support (500€) and outreach program.
AMCCO: a local Aero modelling club	1	Drop tests.
GJN Aerospace (previous team of Jiří Gebauer)	1	Helped with the Recovery system.
Burgundy University, especially Mr Matthieu Rossé (a teacher researcher in electronics).	1	Helped to solve a major problem with his experience and the university's high-tech equipment.

3.2 Testing

We organized four different testing phases:

- A parachute testing phase. Thanks to AMCCO, we tested the dropping velocity of our CanSat. We used a water bottle (figure 19) with the same weight as our Cansat. We also tested the parachute fastening and the parachute ropes strength. We also verified our estimated descent rate, which was correct.

Figure 19 – Parachute test prototype

- A unit test. We individually tested every component and program functionality. Thanks to these tests we found that the camera was deficient. We also found out some incompatibilities between component libraries.

- A full software and hardware test (figure 20). We linked up all components and ran the program to spot and fix any errors. Thanks to this test, we identified the Raspberry Pi CM4 issue. We had to repeat 3 times this testing phase, with changes between each, until the CanSat was fully functional.

- An external software test, to verify if the encryption option was functional and if the data was stored correctly. We found that we had to calibrate some sensors to record useful data.

We repeated the same process for the international phase (except for the parachute test) because we had made a few changes.

Figure 20 – Unit test setup

3.3 Time schedule of the CanSat preparation

The CanSat development is a high demanding process which involves a detailed work plan. We encountered several problems which required strong adaptability. We had to change our schedule a number of times but we stuck to a weekly Sunday 3 p.m. meeting. During these meetings, we usually planned the following weeks (detail in table 3). The covid19 situation and our different school schedules decreased meeting possibilities. However, thanks to the Discord medium, we were able to communicate easily and to react quickly when we faced issues.

TABLE 3 - Latest project plan

Date	Task
Middle of November 2020	Jiří Gebauer and Titouan Drouynot founded the team.
End of November 2020	We were looking for the other members and sent our application.
Beginning of December 2020	We contacted the French jury for the first time.
Middle of December 2020	Development of two concepts started (Teensy and Raspberry Pi).
End of December 2020	We decided to use the Raspberry Pies computers.
Middle of January 2021	First attempts to gain sponsors.
End of January 2021	Our school provided us with a 500€ budget.
Middle of February 2021	Basis of our new concept are known.
Beginning of March 2021	We ordered everything needed for our CM4 concept.
10.03.2021	Successful tests of the parachute with ballast CanSat.
12.03.2021	Thanks to our Critical Design Review we were qualified for the national finals.
End of March 2021	French jury decide that the French Final wasn't possible in the common form.
Beginning of April 2021	Huge problems with Raspberry Pi CM4 rose.
End of April 2021	We decided to replace Raspberry Pi CM4 with the Raspberry Pi Zero W.
Beginning of May 2021	We started the final preparations for the national Finals.
09.05.2021	Successful final tests for the software.
21.05.2021	We were selected to represent France for the international phase of the competition.
17.07.2021	Official drop phase of the national competition.

3.4 Lessons learnt from the National Competition

During the national phase of the competition, we encountered several problems, especially administrative and technical issues:

- We first had to select shopping platforms which respect our high school purchasing policy. This process was tedious because we couldn't use mainstream shopping platforms such as Amazon, and we had to order our components from several suppliers. This caused delivery problems which delayed our CanSat's assembly and software testing process. To anticipate future setbacks, we decided to order parts in packs to provide for replacements in case of technical issues.

- We also encountered a major technical issue with our first onboard computer. We could only boot the cansat when the onboard computer was in debug mode. We tried to figure out what the problem was by testing components ourselves and were even assisted by a university teacher but we couldn't find the origin of the problem. We finally decided to buy a new onboard computer, not as powerful but still sufficient for the job.

- We finally faced an unexpected problem during the national finals. Our CanSat wouldn't start. After an intense testing session we identified the problem. The SD card, which stores the program, was corrupted (probably went through magnetic gates during transport). We were able to correct the issue. We decided to send 2 SD cards for the final phase of the competition to prevent the same issue.

All these issues were time consuming (especially the first one). We tried to react as fast as possible. We learned that we must split our problem solving technique into a "pure problem solving" and "find a replacement solution".

We also got some remarks on our presentation and our report during the national finals. They noticed that our tables were sometimes split over two pages and the pictures weren't numbered. Also, we spent too much time on the technical aspect instead of the mission's purpose. Last but not least, the jury though that the encryption of data wasn't in the spirit of the competition, but we still kept it as an option in our project because cyber security is an important issue. Note that the purpose isn't to privatise data but to protect them from all king of corruption during the recording and transferring process. The online application can store different data set (with backups) to create an open data platform.

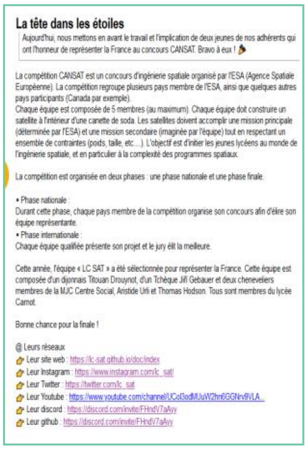
4 Outreach Program

We tried to publicise our project on different media to reach as many people as possible and different publics. We contacted multiple organisations but only a few of them helped. Moreover, because of the Covid19 situation and our different class schedules, school presentations were impossible. We thank all the people who helped us. The table 6 contains all of our successful attempts. All unsuccessful attempts wan be found in appendix 4.

TABLE 6 - Outreach program

Name	Type	Actions	Public
Discord	Social media	Create and communicate with a community.	Young public
Twitter	Social media	Create and communicate with a community.	Young public
Instagram	Social media	Create and communicate with a community.	Young public
YouTube	Video media	Upload video to present our project.	Young public
Our website	Website	We created articles to promote our project and explain how it works.	Old public
MJC CS Chenôve	Website	A Cultural centre which post an article (here) on Facebook and its website. (①)	Old public
Github	Professional sharing platform	Upload our programs	Professional public
Carnot high school	Website	Posted an article (here) on the high school's website. (②)	Our schoolmates

Figure 21 – Article on the website of Chenôve MJC


La tête dans les étoiles

Aujourd'hui, nous mettons en avant le travail et l'implication de deux jeunes de nos adhérents qui ont l'honneur de représenter la France au concours CANSAT. Bravo à eux !

La compétition CANSAT est un concours d'ingénierie spatiale organisé par l'ESA (Agence Spatiale Européenne). La compétition regroupe plusieurs pays membre de l'ESA, ainsi que quelques autres pays participants (Canada par exemple).
Chaque équipe est composée de 5 membres (au maximum). Chaque équipe doit construire un satellite à l'intérieur d'une canette de soda. Les satellites doivent accomplir une mission principale (déterminée par l'ESA) et une mission secondaire (imaginée par l'équipe) tout en respectant un ensemble de contraintes (poids, taille, etc....). L'objectif est d'initier les jeunes lycéens au monde de l'ingénierie spatiale, et en particulier à la complexité des programmes spatiaux.

La compétition est organisée en deux phases : une phase nationale et une phase finale.

- Phase nationale :
Durant cette phase, chaque pays membre de la compétition organise son concours afin d'élire son équipe représentante.
- Phase internationale :
Chaque équipe qualifiée présente son projet et le jury élit la meilleure.

Cette année, l'équipe « LC SAT » a été sélectionnée pour représenter la France. Cette équipe est composée d'un dijonnais Titouan Drouynot, d'un Tchèque Jiří Gebauer et deux chenevelier membres de la MJC Centre Social, Aristide Urli et Thomas Hodson. Tous sont membres du lycée Carnot.

Bonne chance pour la finale !

@ Leurs réseaux
Leur site web : https://lc-sat.github.io/doc/index
Leur Instagram : https://www.instagram.com/lc_sat/
Leur Twitter : https://twitter.com/lc_sat
Leur Youtube : https://www.youtube.com/channel/UCoI3odMJuW2hn6GGNrv9VLA...
Leur discord : https://discord.com/invite/FHndV7aAyy
Leur github : https://discord.com/invite/FHndV7aAyy

Figure 22 – Article on the facebook of Chenôve MJC


MJC de Chenôve
Hier, à 04:17

La tête dans les étoiles

Aujourd'hui, nous mettons en avant le travail et l'implication de deux jeunes de nos adhérents qui ont l'honneur de représenter la France au concours CANSAT. Bravo à eux !

La compétition CANSAT est un concours d'ingénierie spatiale organisé par l'ESA (Agence Spatiale Européenne). La compétition regroupe plusieurs pays membre de l'ESA, ainsi que quelques autres pays participants (Canada par exemple). .... Afficher la suite

9 · 2 commentaires 4 partages
J'aime · Commenter · Partager
Voir tout

Figure 23 – Article on our high school website


LYCÉE CARNOT

Accueil > Projets et Vie de l'élève

Concours CanSat : Le lycée Carnot champion de France !

Le lycée Carnot champion de France
Compte-rendu proposé par Thomas

Cette année, nous participons au CanSat, un concours d'ingénierie spatial organisé par L'ESA (Agence spatiale européenne). L'objectif est de concevoir un satellite à l'intérieur d'une canette de soda, tout en respectant un ensemble de contraintes prédéfinies. Nous sommes l'équipe **LC sat**, une des 12 équipes qui ont concouru pour la phase de qualification nationale, organisée par le CNES (Centre national d'études spatiales) et Planète sciences.

1. Titouan Drouynot (Seconde) - HARDWARE
2. Jiri Gebauer (Seconde) - SPONSOR et HARDWARE
3. Eliam Monnot (Terminale) - PARACHUTE
4. Aristide Urli (Terminale) - PROGRAMMEUR
5. Thomas Hodson (Terminale) - PROGRAMMEUR
6. Bernard Declercq (Terminale) - PROFESSEUR REFERENT

Notre satellite a pour mission secondaire de collecter des données, de manière sécurisée, au cours de sa chute afin d'établir des relations scientifiques. Le projet se divise en 3 secteurs :

- Le satellite
- Les programmes
- Les sponsors et les réseaux

Récemment, le vendredi 21 mai, nous avons été sélectionnés pour représenter la France à la finale internationale qui aura lieu le 27 juillet. Celle-ci promet d'être riche en expériences en rencontres et en découvertes.

Bravo aux 5 élèves qui se sont investis dans ce concours et à leur enseignant Monsieur De Clercq, professeur de sciences de l'ingénieur au lycée Carnot, qui les a accompagnés tout au long de leur projet.

5 Requirements

Our CanSat respects all of the requirements established by the organisers. Here are all the details combined in table 7:

TABLE 7 - Requirements

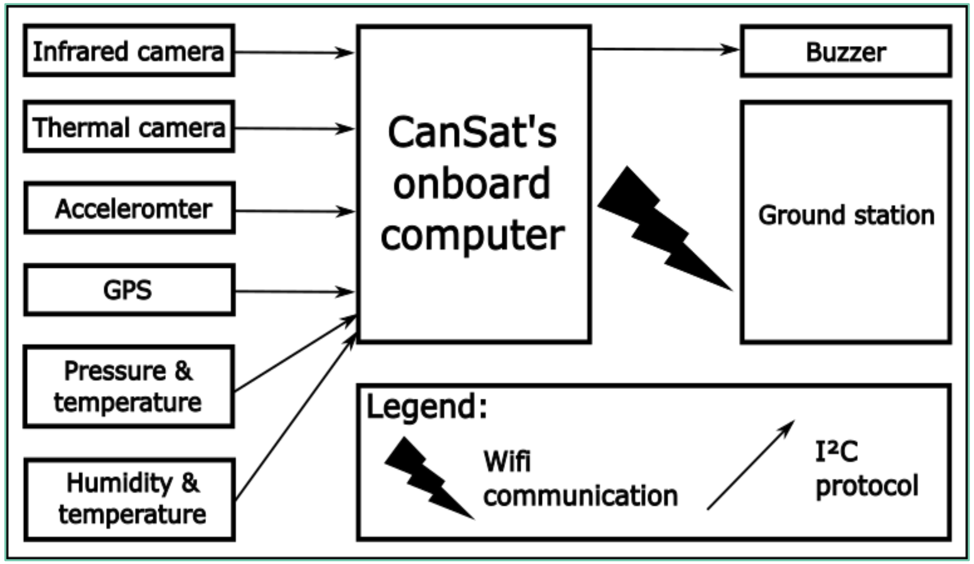
Characteristic	Requirement	Value	Eligibility
Height	≤ 115 mm	114mm	Yes
Diameter	≤ 66 mm	64 mm	
Mass	300 – 350 g	≈ 340 g	
Flight time scheduled	≤ 170 s	120 – 130 s	
Additional length of external elements (along axial dimension)	None		
Calculated descent rate	5 – 12 m/s	8 m/s	
Autonomy	≥ 4 h	20 h 45 min	
Total cost	≤ 500 €	≈ 250 €	

According to the rules, our CanSat must record the pressure and the temperature for more than 2h. Note that our CanSat can record both these measures every 10 ms for more than 84 hours provided the infrared and thermal cameras are switched off. With both cameras on, we must need a 256 Go SD card. Also according to the rules, our CanSat must be quickly ready for a second drop. Our CanSat can immediately take off but without the possibility to start a new recording. For a fresh recording, you must wait a maximum of 20 minutes of data transfer (less if the encryption option wasn't selected) if the previous recording lasted a maximum 17 min with all sensors turned on.

On behalf of the team, I confirm that our CanSat complies with all the requirements established for the 2020 European CanSat competition in the official Guidelines,

Signature, place and date:

Appendix:



APPENDIX 1:

Internal communications diagram.

APPENDIX 2:

Components location in the CanSat

TABLE 8 - Component locations

Component	Location in the Cansat
Pressure, temperature sensors (and altitude estimation)	1
GPS	
Humidity and temperature sensors.	
Raspberry Pi Zero W	2
Batteries	3
Switches	4
DEL indicators	
Buzzer	5
3 axes accelerometer	6
Primary camera (records infrared signals)	7
Thermal camera	
Parachute fixations	8

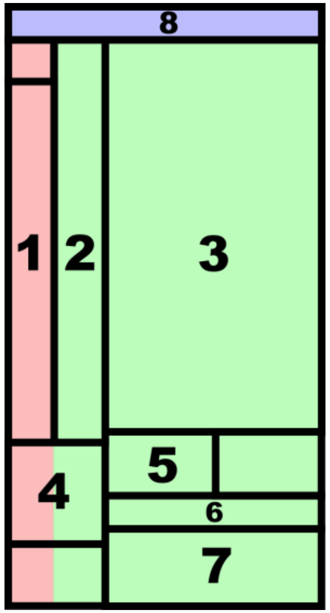


Figure 3-bis

Schematic of the Cansat's interior

APPENDIX 4:

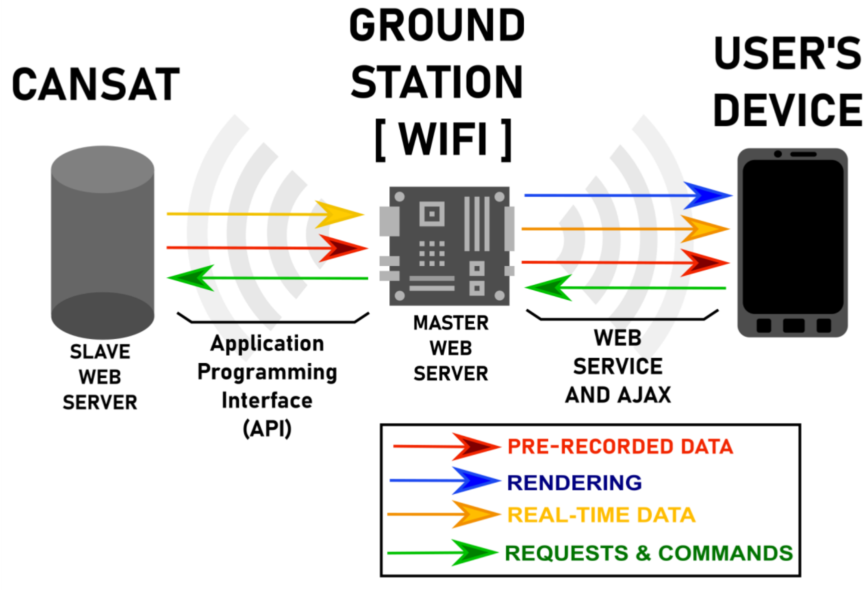
Unsuccessful requests for outreach program and external support.

TABLE 9 - Outreach program and external support unsuccessful attempts

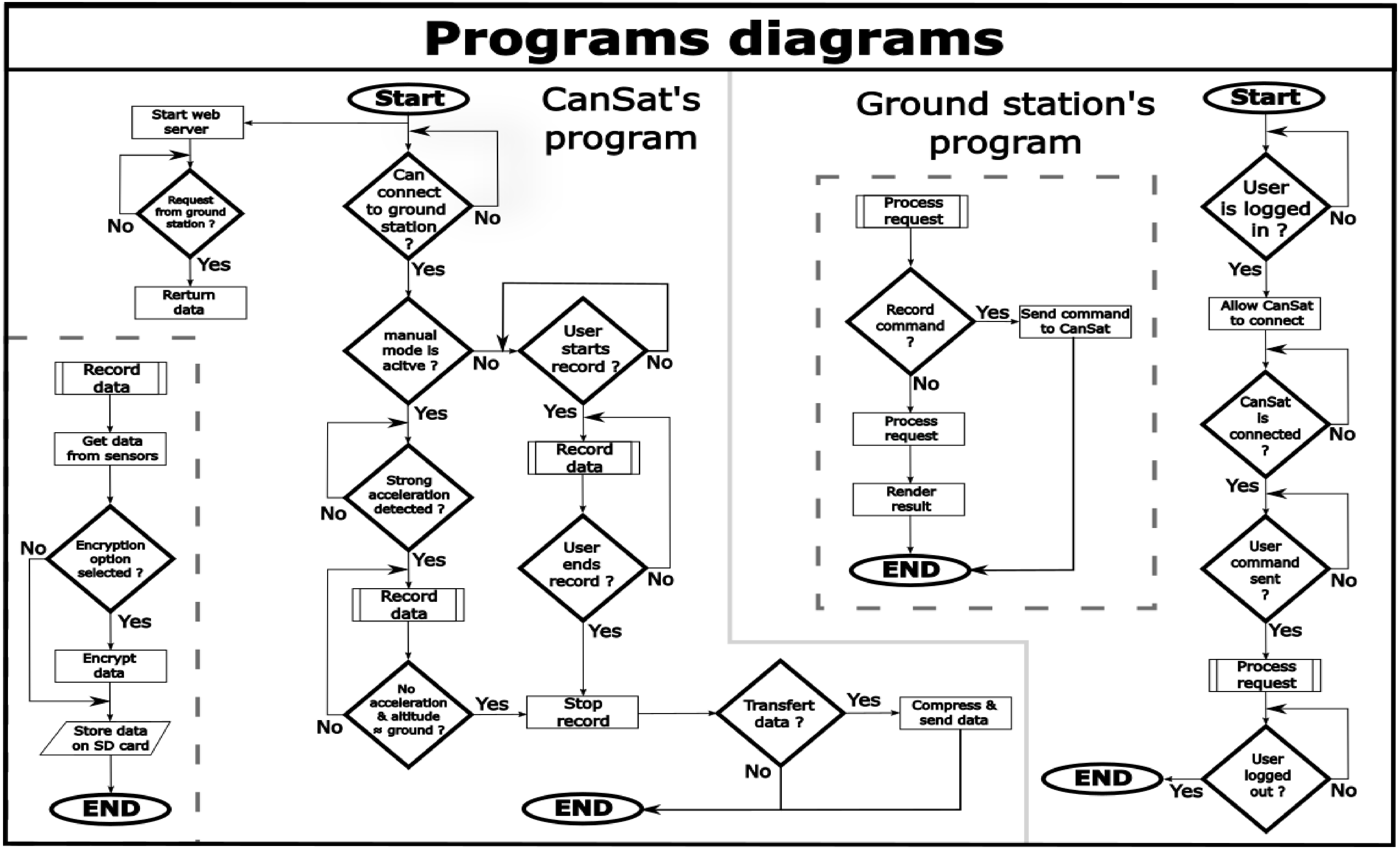
Name	Type	Actions	Public
Outreach program			
Okapi	Newspaper	No response	Young public
Le petit quotidien		No response	
Le monde des ados		In process	
Le bien public		No response	Old public
Radio Uno	Radio	No response	
Radio campus		No response	
External support			
Bobby Duke Arts (An Art Youtuber).	No response	We wanted to decorate our CanSat. No response.	
Hacksmith Industries (A YouTube engineering Team).	No response	They usually undertake similar projects. We asked for advice. No response.	

APPENDIX 3:

Schematic of communications between the different devices.



APPENDIX 5 :



Programs diagrams
CanSat's program
Start
Start web server
Request from ground station ?
No
Yes
Rerturn data
Can connect to ground station ?
No
Yes
manual mode is acitve ?
No
Yes
User starts record ?
No
Yes
Record data
User ends record ?
No
Yes
Strong acceleration detected ?
No
Yes
Record data
No acceleration & altitude ≈ ground ?
No
Yes
Stop record
Transfert data ?
Yes
No
Compress & send data
END
Record data
Get data from sensors
Encryption option selected ?
No
Yes
Encrypt data
Store data on SD card
END
Ground station's program
Process request
Record command ?
Yes
No
Send command to CanSat
Process request
Render result
END
Start
User is logged in ?
No
Yes
Allow CanSat to connect
CanSat is connected ?
No
Yes
User command sent ?
No
Yes
Process request
User logged out ?
Yes
No
END