



## Space Banan

### 1. Introduction

Meet our team "Space Banan", consisting of five students from the Lycée des Arts et Métiers.

Our primary goal is to accomplish the primary mission successfully and to ensure that our Satellite will be able to land safely and track the necessary data. Once all the components have been successfully integrated, our technical department will start working on the secondary mission.

At the start the goal was to calculate the exact location of the satellite but later got changed to just measuring the magnetic field in order to keep track of which way the satellite is rotated.

We chose this secondary mission because we find it is important to always know the satellites' position since it makes some of the data like the magnetic field strength or even temperature more relevant.

### 2. Project description

#### 2.1 Mission Overview

Our goal is to create a compact case for the Raspberry Pico and to create a working minisatellite. The primary mission consists of a pressure and temperature sensor and a GPS tracker. We aim to make them work fine and especially the GPS tracker, so that we find back our satellite after the launch.

What is more, we want to create an antenna that is working so that we can get the data of the Raspberry Pico in real-time.

Secondary mission:

Our goal for the secondary mission is to measure the electromagnetic field which will tell us in which direction the CanSat is rotated. This will be done by using an accelerometer. We also measure the longitude, latitude and altitude with a GPS Tracker to draw the position on a 3D diagram. Our mission was to draw the 3D diagram live with the values we got from the satellite. But since couldn't get it to work live, we created it manually after the launch with the data saved on the pico combined with real-time data.

#### 2.2 Mechanical design



**Parachute:** Our parachute is made of a similar material to plastic that's used to make a parachute. We chose to do a cross formed like parachute to minimize the movement (without taking the wind into consideration) around itself. Its width would be 9,1cm wide and the length 34,4cm.

**Chassis:** Our chassis is 3D printed from our school in the form of a can that has a height of 10cm.

## 2.3 Electronic design

### CanSat

The electronic design includes components such as a Raspberry Pico, sensors (temperature, pressure, and accelerometer), a GPS module, and a radio module to communicate with the ground station as well as a batterie.

### Ground Station

The ground station is made up of a rasperrri pico that is connected to a computer. A radio module with an antenna is connected to the rasperrri pico. The antenna captures the data sent in real-time by the CanSat and saves them in a CSV.

## 2.4 Ground station design

**Computer:** we take our school laptop and all our programs are running on it. For the moment we are taking 3 laptops but later we will transfer everything to one and do some tests.

**Antenna:** Two people on our team went to the YAGI antenna workshop and constructed one.

**Data Storage:** We will use another laptop to get all the data we get from our CanSat.

## 2.5 Software design

Our main code that is written in Circuit Python and stored in the Satellite saves the data on the pico internal storage in one big CSV file. As we wanted to secure the rescue of our CanSat, we sent all the data to our ground station. On the grounstation also written in Circuit Python, we saved the GPS data in a CSV file. With the data sent we could recover some of the information sent that wasn't saved. The Satellite had also a feature that it sends data even when the internal storage is full which saved us as we saved the data 1x per second and so we could still get information after the pico was filled up completely.



## 2.6 Recovery system

Our recovery system consists of a GPS tracker to find the exact location of our CanSat. This worked fine and so it was possible to easily recover our CanSat. What is more, our parachute is calculated to reach a speed of 11 m/s so that we can delimit the radius of where the satellite landed.

## 2.7 Testing

*Testing Procedure:*

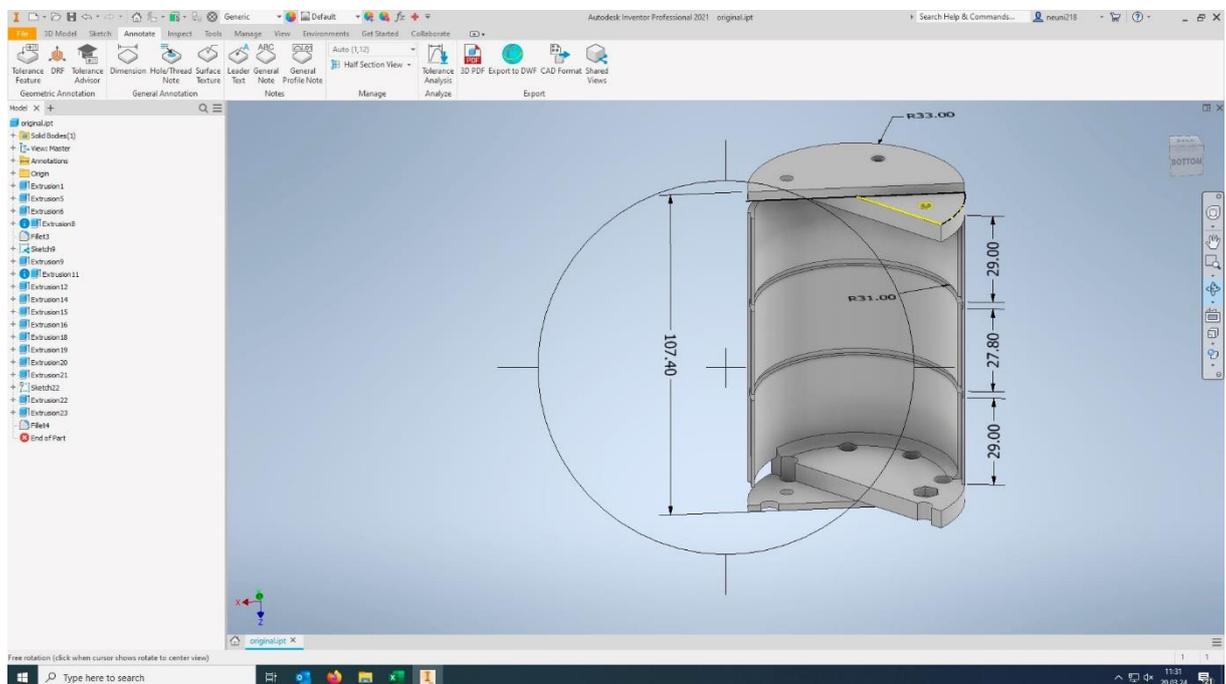
Up to this point we've tested our parachute for both the primary and secondary missions. The parachute we tested in school worked fine, falling with a speed of about 9.6m/s. This speed is a bit under the 11m/s target, but we figured it's better to be a little slower than being too fast. So, we decided to leave it as it is. We started coding in MicroPython but had to switch to CircuitPython later on as we came across some compatibility issues in our code.

Hence we decided to ask a friend who knows the programming language better than we do, and he helped us. Now the code is working, but after doing some further testing, we discovered that there was a problem with the cables connected to the sensors. Currently we are addressing this problem.

Since our group consists of 5 people, 2 people dedicated themselves to work on the secondary mission, which was completed without any facing any considerable problems.

The antenna will be tested the 22.03.2024.

## 3. Requirements



## 4. Overall progress

### 4.1 Human resources



Iana: Designing, calculating and sewing the parachute, construction of the YAGI satellite

Fynn: Designing the parachute, calculating the ideal size, and coding (mainly secondary mission as well as ground station).

Yannik: Coding, responsible for configuring the Raspberry Pico and its components, and scripting for the primary mission.

Tim: Coding for the secondary mission.

Luca: Handling electronics, soldering the Raspberry Pico and its components.

## 4.2 Planning

We have nearly completed the primary mission. We have already made a script that calculates the height using the temperature and pressure and a script that reads the temperature and pressure sensors. However we have encountered a problem: Our GPS sensor is not compatible with micro python. That's why we switched to circuit python.

We already started the secondary mission and are programming the accelerometer. Our parachute is also nearly done, and we now need to assemble all the pieces and finish the code.

## 4.3 Budget

Starter kit: 500€

The following Budget is for the 3 groups: Space Race, Space X and Space Banann:

Reference	Product	Tax Rate	Unit Price (Tax excl.)	Qty	Total (Tax excl.)
ADF-GPS-MINI-PA1010D	PA1010D Mini GPS - UART, I2C interface	17 %	€32.00	3	€96.00
ADF-MICROSD-BRK	[T] - Micro SD adapter - Extra version	17 %	€8.22	3	€24.66
FILS-BB-FFASSOR-v2	Prototyping wire for Breadboard (Assortment + Extra)	17 %	€8.06	1	€8.06
GYRO-9DOF-LSM9DS1	LSM9DS1 - 9 DOF - Gyro/Accel/Mag + Temp breakout	17 %	€41.77	1	€41.77
PIEZO-BUZZER	Piezo buzzer	17 %	€1.47	3	€4.41
SD-MICROSD-32GO	microSD card - 32Go CLASS 10, UHS 1	17 %	€11.98	3	€35.94

Tax Detail	Tax Rate	Base price	Total Tax
Products	17.000 %	€210.84	€35.84
Shipping	17.000 %	€10.00	€1.70

Total Products	€210.84
Shipping Costs	€10.00
<b>Total (Tax excl.)</b>	<b>€220.84</b>
<b>Total Tax</b>	<b>€37.54</b>
<b>Total</b>	<b>€258.38</b>

Payment Method		
	VISA payment	€258.38

Carrier	
	BPost World Business

Artikel-Nr.	Artikel	Menge	Einheit	inkl.MwSt.	Einzelpreis (€)	Gesamtpreis (€)
72244	Nähmaschinennadeln mit Flachkolben/Microtex 5x100	2	Packungen)	17%	3,83	7,66
70009	Alterfil S 80, Nähgarn, Polyester, 1000m schwarz	5	Rolle	17%	5,60	28,00
70656	Schlauchband, Polyester, einfarbig, 50mm schwarz	5	m	17%	2,06	10,30
71078	Dyneema-Kordel, ohne Mantel, 4mm grau	30	m	17%	1,87	56,10
70446	Kanteneinfaßband, Ripsband, Polyester, 12mm schwarz	15	m	17%	0,54	8,10
70773	Ripstop-Nylon Zeltstoff, silikonbesch., 40den, 55g/qm orange	6	m	17%	7,77	46,62
Nettosumme:		146,20 €		Warenwert:		156,78
zzgl. MwSt. 17%:		24,85 €		Frachtkosten:		14,27
				Gesamtsumme:		171,05



Barre filetée en fer M2,5 longueur : 3 pce  
1000 mm  
Réf. 6178919

Livraison sous  
env. 2-3 jours  
ouvrables

18,60 €

Matériau: Métal

6,20 € / pce

Questions sur la boutique en ligne.



+352 288007-00  
lu.-sa. 08h00 - 18h00

Sous-total  
frais d'expédition

18,60 €  
0,00 €

**TOTAL**  
TVA incluse

**18,60 €**  
2,70 €

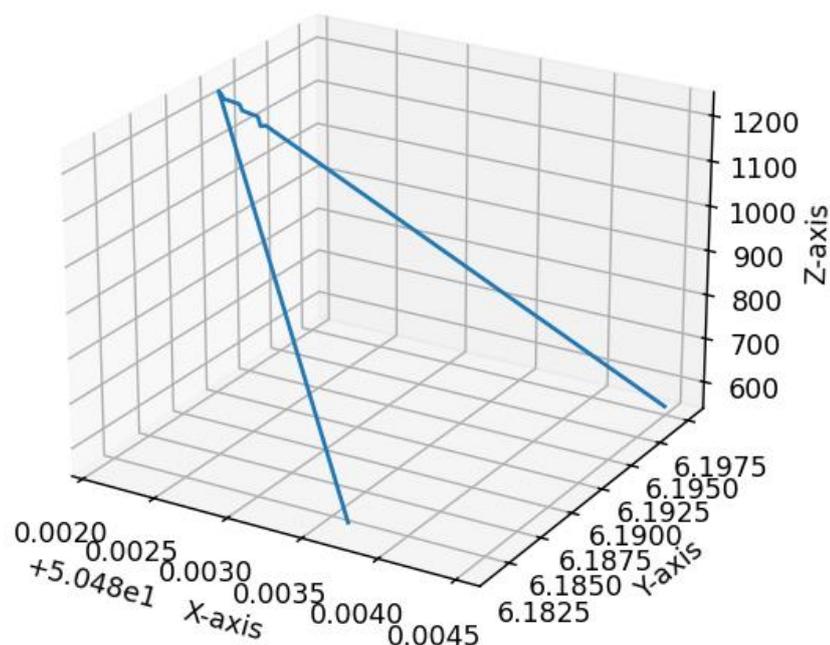
#### 4.4 Outreach

We have created a social media account on Instagram to showcase our work. We will provide content about our journey in the CanSat project. We will provide videos and pictures to give the viewer a brief idea of the project. As we didn't post regularly, we decided that the launch was a big event that we wanted to share with other people.

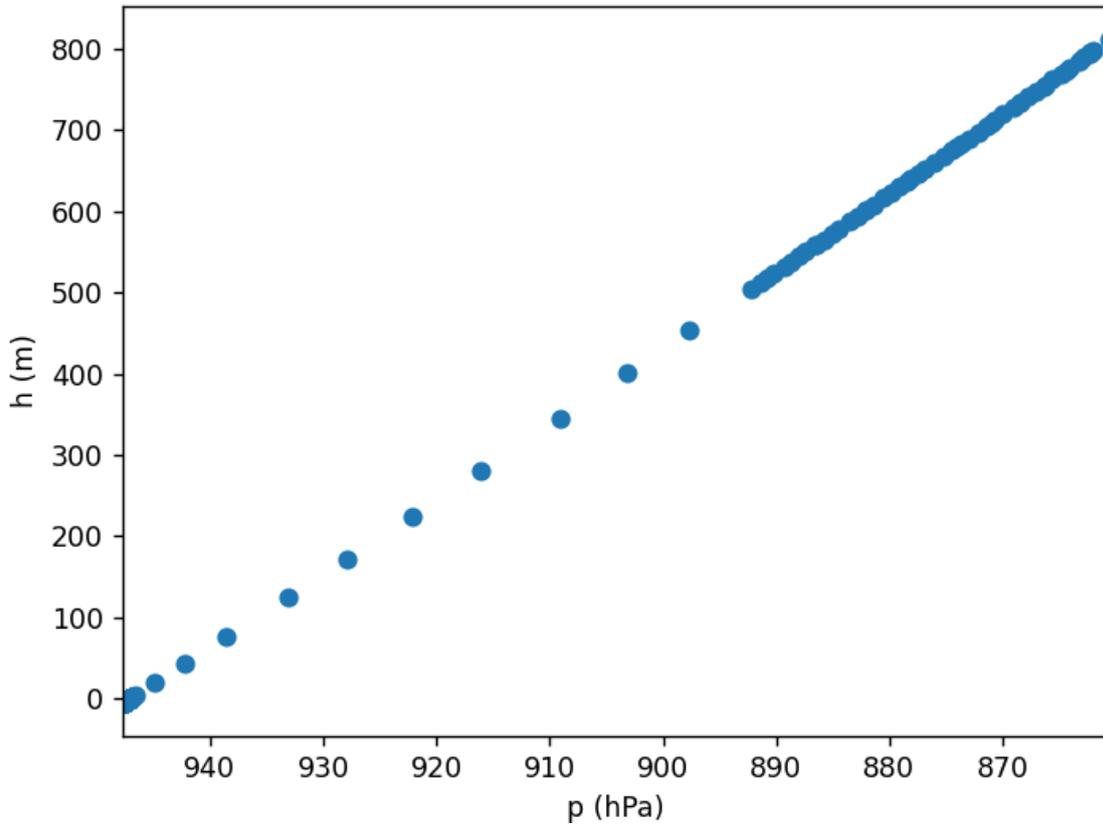
Our name on Instagram is space.banan

### 5. Scientific results

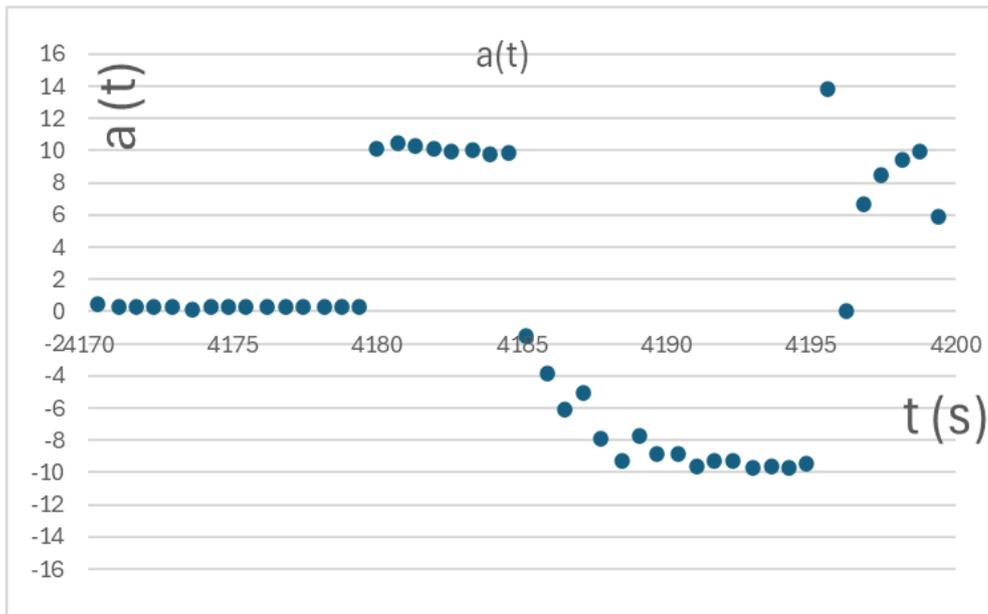
3D Trajectory



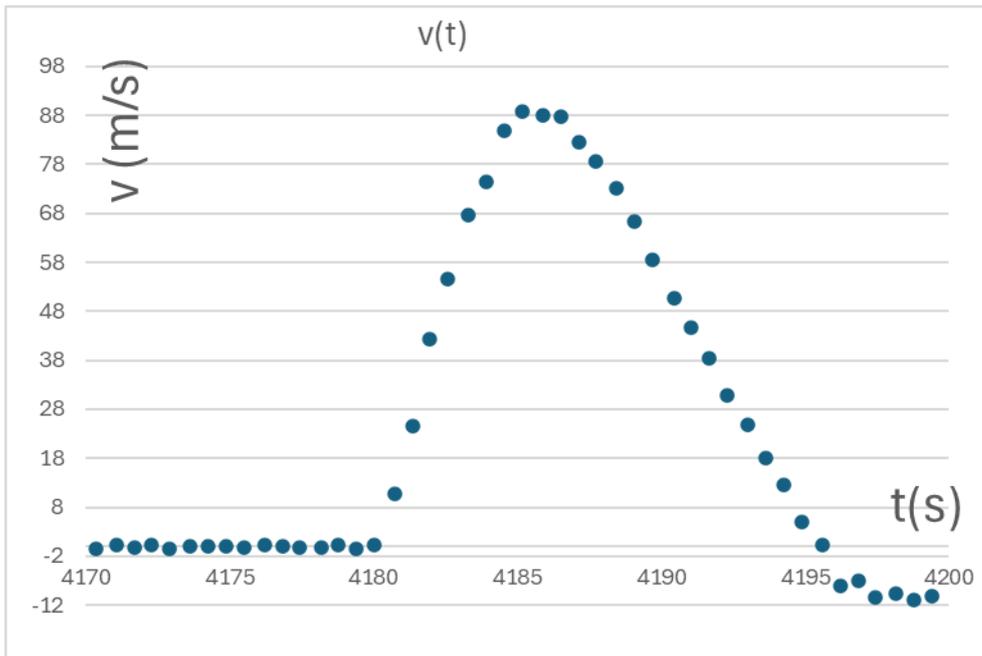
F3 h en fonction de p



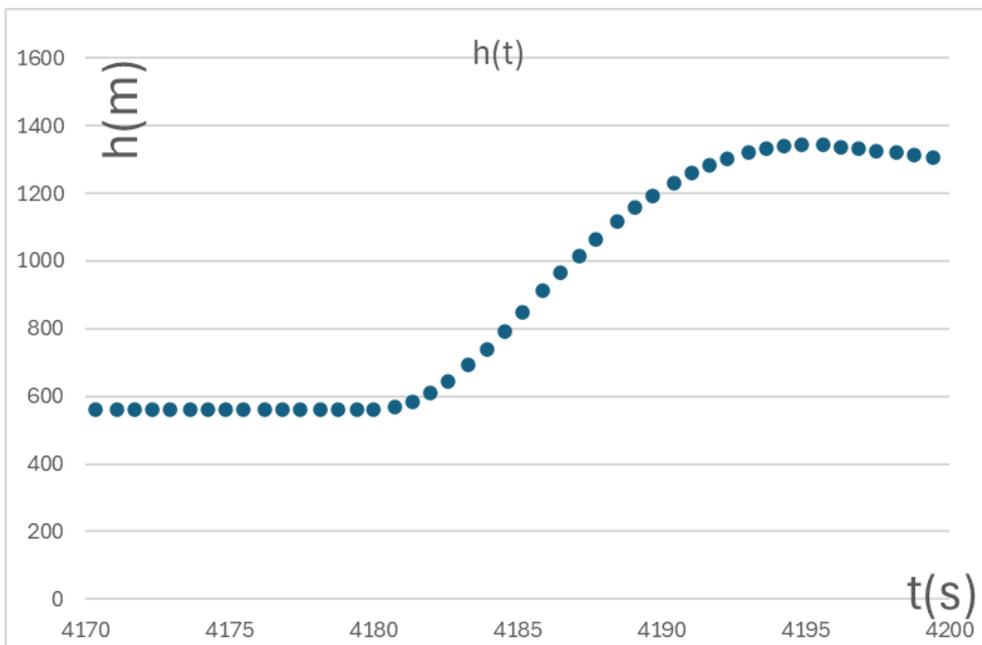
Acceleration in function of time



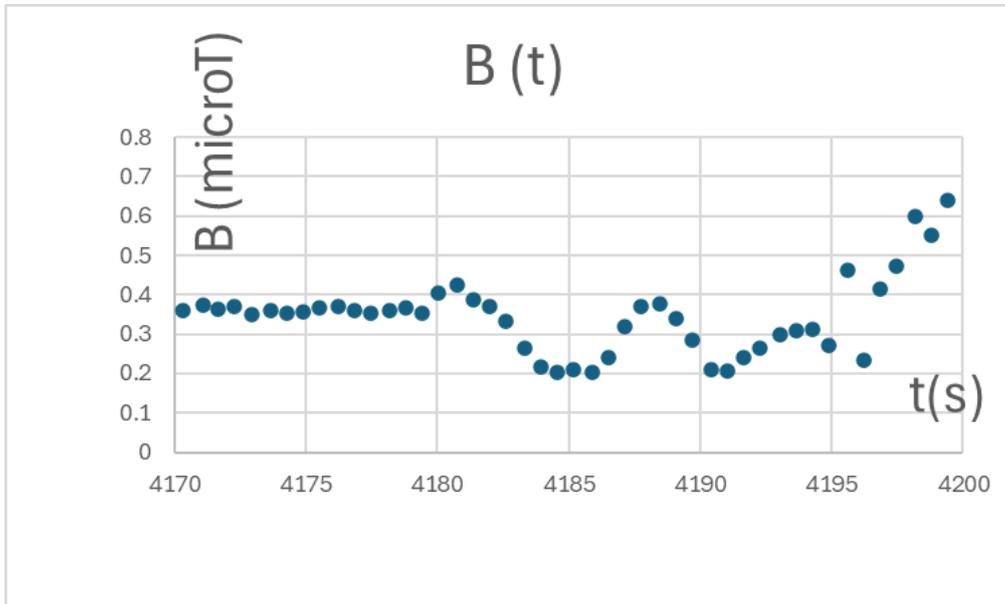
## Speed in function of time



## CanSat altitude during launch



## Magnetic field strength



## 6. Discussion

*Give your opinion about your project, results, future improvements, ...*

Our perspective on our project is that our pace is a bit slow. Although the different parts of the project are operational, we're finding ourselves moving slowly when it comes to making the assembling of various components. We expect to wrap up our project soon, but we anticipate it will still take a bit more time. Nevertheless, we're genuinely content with what we've achieved so far.

At the day of the launch, we had to do some minor changes to the rasperrico and get our antenna to work flawlessly. During the launch, our cansat was connected to our antenna and ground station and was consistently sending data. However, we lost some data during the acceleration phase and during the fall. What is more, our pico stopped saving data in the csv file during the fall, since the start took long and data was collected during that period. The next time, we should have the possibility to start the CanSat with a delay or capture the values only if they vary from the previous values.

## 7. Conclusion

Our mission started with a clear objective: to engineer a mini-satellite capable of measuring temperature, pressure, and acceleration, transmitting this data to a ground station for real-time analysis. As we dived into the complexities of our initial goal, we soon confronted unforeseen challenges that changed the complexity of our project.



Initially, our belief centered around calculating the satellite's position through an integration of height and acceleration data. However, a realization emerged — to achieve accurate calculations, we needed to factor in the rotation and change of track of the satellite. This revelation significantly complicated our mission, necessitating a deep dive into math and physics to determine the satellite's trajectory.

Despite the complexities, we started to look for solutions. We uncovered difficult calculations and a program in a different programming language that suited our purpose. Undoubtedly, integrating these discoveries into our project demanded a fusion of newfound knowledge and innovative thinking. Simultaneously, our encounter with challenges extended to the GPS sensor, prompting a shift to Circuit Python due to its compatibility with our desired tracker.

The learning curve was steep as we grappled with Python and Raspberry Pico. Despite the initial slowdown, we currently find ourselves immersed in the development of the electronic circuit for Raspberry Pico, simultaneously programming the accelerometer and GPS tracker. Progressing steadily, we have successfully crafted a script that transforms satellite positions into a 3D diagram. Now we only need to finish the script that calculates the position of the satellite with the acceleration and height and then transmit the position to the script to draw the diagram.

Our current focus centers on finalizing the parachute assembly, a critical component for the safe descent of our mini satellite. With a targeted completion date of February 26, we anticipate wrapping up this aspect, further fortifying the tangible progress achieved thus far.

During the launch we encountered problems with the antenna and the code. We managed to fix most of the problems. This led us to the conclusion that we needed to test the CanSat even more so that we don't need to fix parts last minute.

Reflecting on the journey, we acknowledge the initial learning curve, yet we now stand on the precipice of success. Our primary mission is nearing completion, evident in the functional code that captures pressure and temperature data, calculates height through various methods, and presents a platform for generating insightful diagrams.

In simple terms, our project highlights how important it is to be flexible and tough when diving into scientific stuff. As we get closer to finishing our mini satellite, the problems we faced are like stepping stones that are actually helping us reach our main goal. Yeah, it was a tough road, but we will be even happier when we have created a finished satellite to finally launch.



## References

[https://matplotlib.org/stable/api/as\\_gen/matplotlib.pyplot.scatter.html](https://matplotlib.org/stable/api/as_gen/matplotlib.pyplot.scatter.html)

python library for the different graphs.

<https://github.com/LowPowerLab/RFM69>

circuit python library for the RFM69

<https://docs.python.org/3/library/time.html>

Time conversion library

<https://stackoverflow.com/>

<https://gemini.google.com/>

Code fixing

## Appendix

*If you want to add files (keep in mind the max 20 pages)*