cansats in europe

TeamVLO CanSat Final Design Review

Team Name: TeamVLO

Country: Poland

Contents

1 CHANGELOG

CDR

- One of the team members left the team. In her place, we have a new member.
- We specified the Mission Objectives.
- Due to lack of appropriate CO_2 sensor, we removed it from our CanSat.
- We swop the BMP280 air pressure sensor with Waveshare IMU 10DoF. It is only 15 mm longer and offers much more sensors. We also added a new temperature sensor.
- The electronic circuit prototype was built and a code for it was written.
- The exact models of batteries, sensors and modules have been specified.
- We made changes in the model of the CanSat.
- We built and tested a mass prototype of the CanSat with a parachute.
- New information in "Budget", "External Support" and "Outreach Programme"

FDR

- A case for our CanSat was designed and printed
- The final model of our CanSat was built
- The final code for the satellite was written
- New information in "Outreach Programme"
- We performed dozens of sensors, camera and radio module tests
- All additional materials are in this Google Drive folder: https://drive.google.com/drive/folders/1IfNlU0zysUX8YJTtWGyjqgS2lEIokcMU?usp=sharing

2 INTRODUCTION

2.1 Team organisation and roles

Our mentor is **Dr Dawid Kotrys**. He is our math's teacher and tutor of our class. He always devotes to all projects proposed by his students. He supports our team computationally and he motivates us to the action.

Emil Kielar is our team leader. He found the information about the competition and created a team. He supervises all the work and sets the tasks individually for every team member. Emil is interested in coding as well as electronics. He is responsible for them during the mission. Using the help of Mr. Kotrys, they will cover the computational site, which will allow us to design and build our CanSat.

Krzysztof Janota is a great lover of aeronautics that's why he engaged into the project. Krzysiek knows the construction of airplanes and their dynamics very well, what will help us greatly in the project. He is responsible for mechanical design and recovery system design.

Natalia Pierkiel oversees planning our tasks, as she is well organized and can find the most effective way of working. She's willing to help whenever it is needed, so her other duties are not strictly determined. For the time being, she writes posts for social media and is responsible for promoting our project.

Julia Zielińska is responsible for reporting and describing our activities. She is endowed with literary skills. Julka is also picking up on small errors and she is an attentive observer what allows her to correct our errors. She is still looking for her interests and she hopes that this competition will help her in it.

2.2 Mission objectives

The objective of our mission is to collect data from the sensors of the primary mission and the secondary mission to determine whether the planet and area where our CanSat is landing is suitable for growth of plants. We will also take photos that will allow us to measure various remote sensing indices as well as to classify land cover of the area where our CanSat is landing. The mission like this one will allow to determine whether the planet on which our CanSat is landing is inhabitable for humans at a low cost. The satellite can also collect data that will allow the preparation of appropriate equipment for interplanetary missions of humans.

Our CanSat can also be used during a mission on Earth consisting of measuring various remote sensing indices like Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Green Normalized Difference Vegetation Index (GNDVI), Greenness Index and other, as well as to classify land cover of places where access is difficult (e.g. rainforests, deserts, high mountains) and other places that are in our area of interest. During the flight and after the landing, the satellite will collect data such as temperature, pressure, sunlight intensity and air humidity. Such a CanSat will allow us to perform field and environmental analysis of the landing area.

We were inspired to select this secondary mission by the mission of Perseverance rover which is looking for signs of life on Mars as well as by missions of Landsat and Sentinel satellites taking photos of Earth's surface. In order to consider our CanSat launch successful, we have to get several images of the landing area from different heights as well as the readings from the sensors.

3 CANSAT DESCRIPTION

3.1 Mission overview

The secondary mission of our CanSat is to determine whether the planet and the landing site is suitable for growth of plants. When our CanSat is launched from the rocket, the parachute will be opened, and the satellite will take photos of the landing site using the near infrared camera (Raspberry Pi NoIR camera) located on the bottom. Every photo will be analyzed, and we will measure various remote sensing indices using a code written by our team. The code will prepare photos with marked remote sensing indices in colors (as on the picture below) and a photo with classification of land cover.

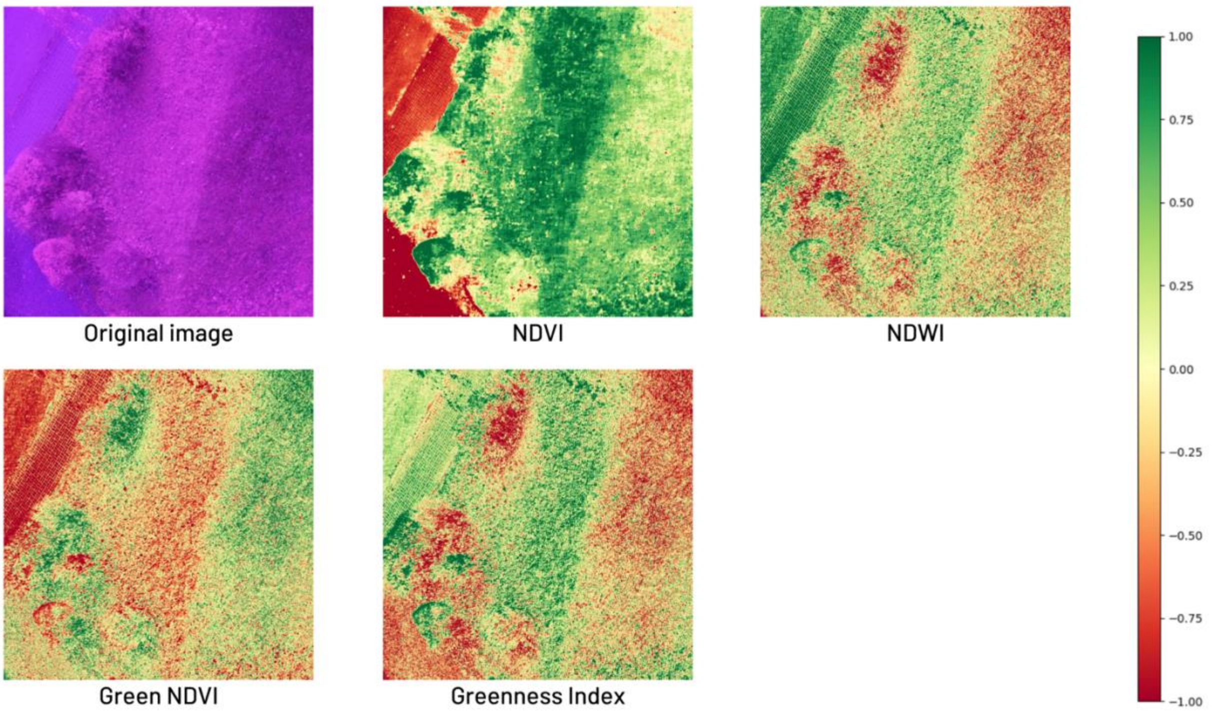

Figure 1: Composition of images

During the flight our satellite will measure temperature, humidity, air pressure, and sunlight intensity. These data will allow us to determine whether conditions in the place of landing are suitable for growth and life of plants (water, temperature and sunlight needed for photosynthesis).

We will analyze all the data after the landing and after an analysis of it, we will determine whether the landing site is suitable for growth of plants and if it's inhabitable. In case our CanSat isn't found, we will send via radio few photos and the readings from the secondary mission sensors after the landing of CanSat.

The primary mission of our CanSat will be conducted using temperature sensor, air pressure sensor and radio transmitter sending the data from those sensors to our ground station.

We will also use a GPS module, that will send the GPS coordinates to our ground station via radio. The block diagram of our CanSat looks as follows:

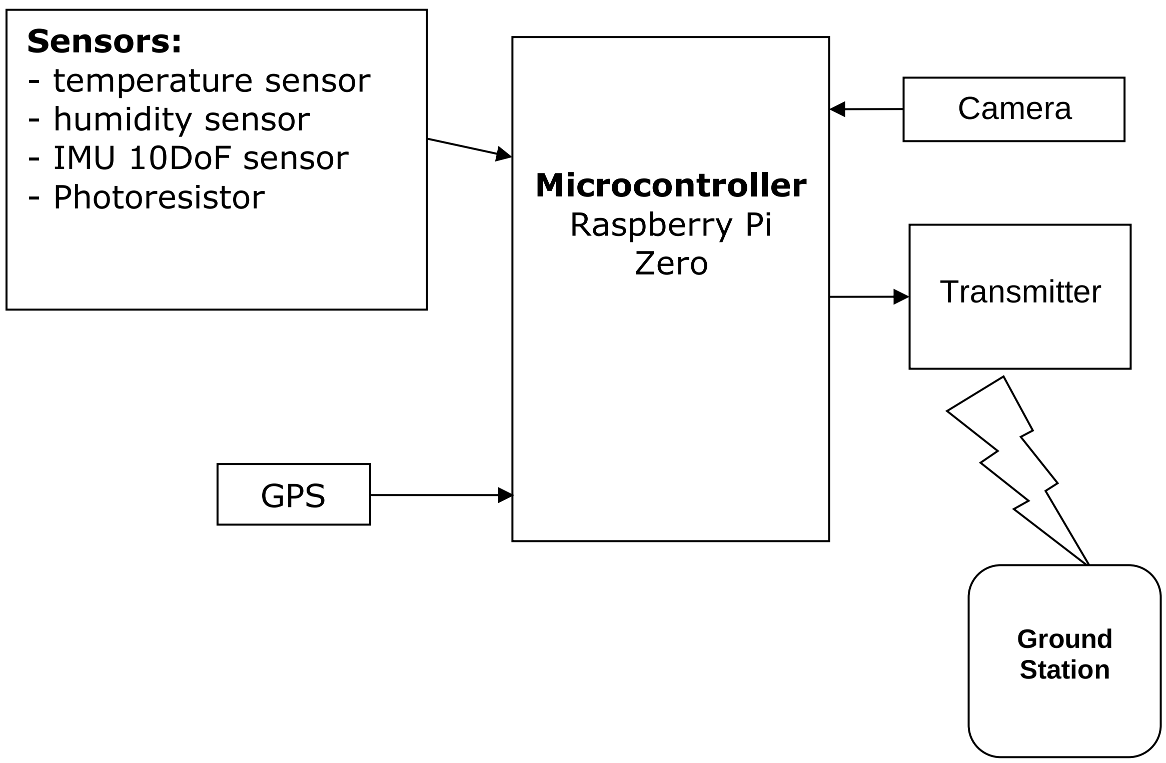

Figure 2: Block diagram of our CanSat

3.2 Mechanical/structural design

3.2.1 General idea

The overall structure of our CanSat has not changed since the last report. The main axis remains the same: two long screws that go through the centre of our model. The number of sectors into which our project is divided didn't change as well, although we have decided to make some adjustments in placement of the modules. In addition, the external module has been improved by addition of external walls that will help us to attach the parachute.

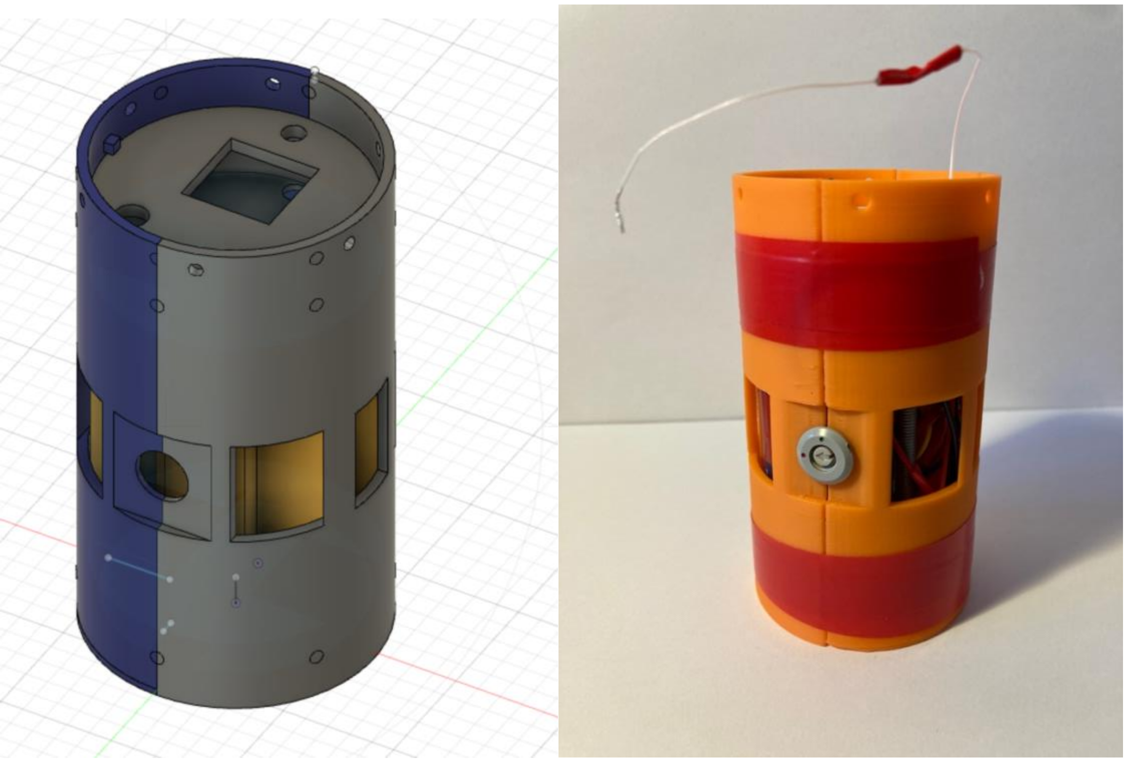

Figure 3: 3D model of the casing (on the right), Printed CanSat final model (on the left)

3.2.2 Materials used

The main material that we used to build CanSat is ABS plastic, of which we printed the casing, as well as most of the internal elements, including sector separation plates. ABS material is characterized by high mechanical strength, as well as high tolerance to temperature changes, what makes it ideal for the task it's assigned for. The main axis two screws in the center of the model, are made of stainless steel.

3.2.3 Modules mounting

In order to attach the modules to CanSat we used special Velcro tape and double-sided mounting tape, which are perfect for this role. They are very light and keep everything in place effectively at the same time. As we have used them, we don't have to worry about damaging the main structure by adjusting screws.

3.2.4 Sectors

As mentioned before, our CanSat will be divided into 3 interior sectors each of them fulfilling a different task:

- **Sector 1** is the place where the 10 DoF IMU sensor and the camera are located.

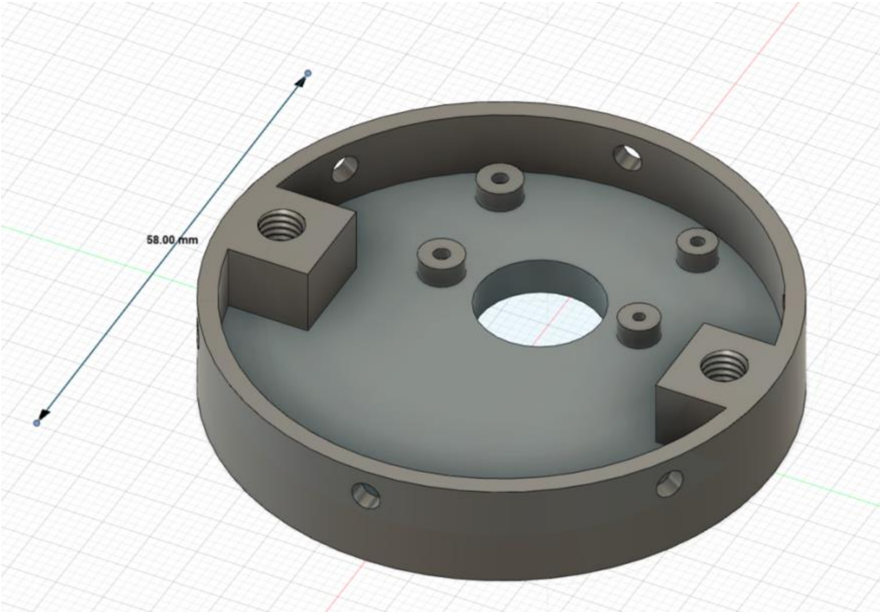

Figure 4: Sector 1 of the CanSat

- **Sector 2** is the largest section in which the power supply, the main computer, the radio transmitter, and the rest of the sensors are located.

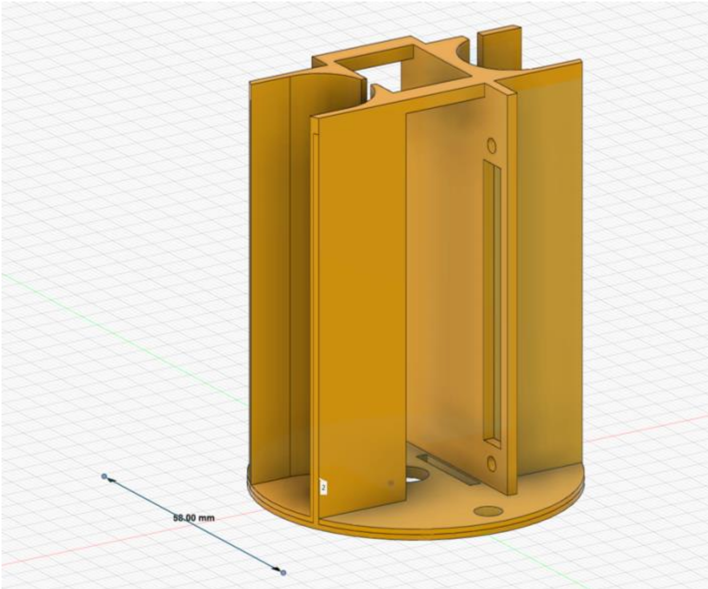

Figure 5: Sector 2 of the CanSat

- **Sector 3** is where the GPS module and a parachute mount are located.

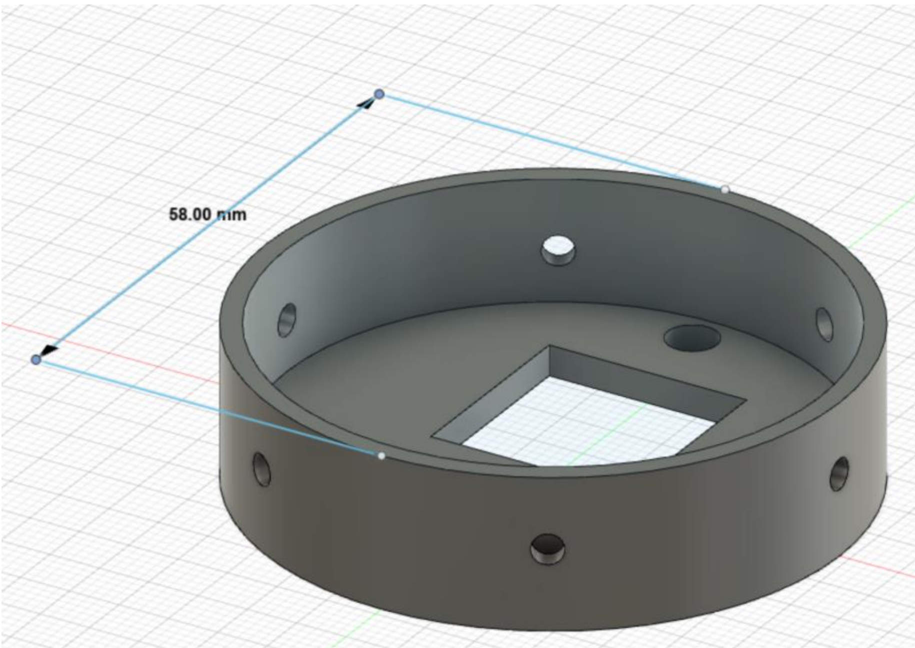

Figure 6: Sector 3 of the CanSat

- **Casing** is where the parachute and the power switch are mounted.

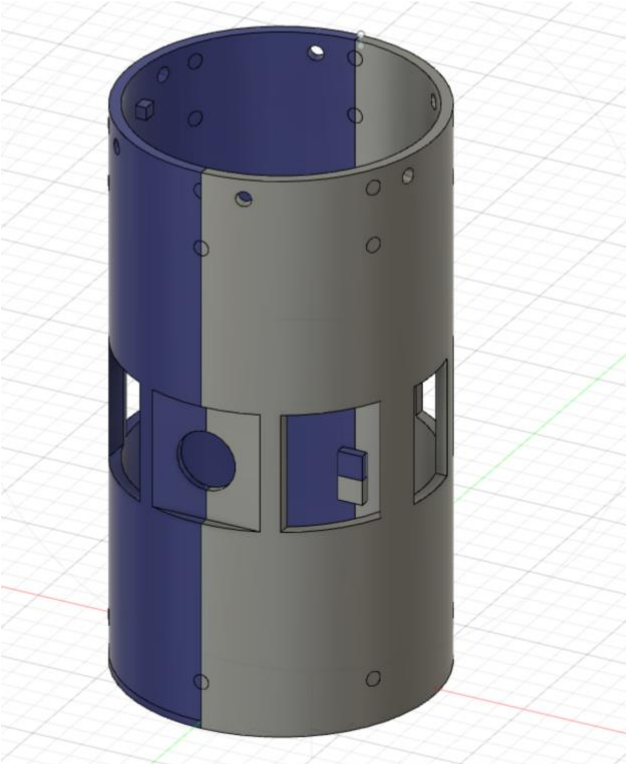

Figure 7: Casing of the CanSat

3.2.5 Mass budget

The table below represents masses of all parts in our CanSat.

Element	**Mass(g)**
Raspberry Pi Zero W 512 MB	9.0
Raspberry Pi NoIR v2 Camera	2.0
Temperature sensor DS18B20+	5.0
Waveshare IMU 10DoF sensor	3.0
2x 18650 XTAR – 3500mAh battery	98.0

Servo SG-90	9.0
Case	~96.0
Adafruit Ultimate GPS module	8.5
SX1278 LoRa RA-02 433 MHz radio module	2.0
DHT-22 Temperature & humidity sensor	0.6
Step-down converter 5V 2.5 A	3.0
2x 110 mm M5 Screw	37.0
Parachute	15
Total	**~287.0**

The overall mass is 287 g. As a minimum weight of CanSat is 300 g, we will add small weights to weight it to 300 g.

3.3 Electrical design

3.3.1 General architecture

The system of our CanSat is powered by two 18650 lithium-ion batteries (3500 mAh each). Our main onboard computer is Raspberry Pi Zero W. We also used consecutive sensors: Raspberry Pi NoIR Camera v2, DHT22 temperature and humidity sensor, DS18B20 temperature sensor, Waveshare 10 DoF IMU sensor, photoresistor, SX1278 radio module and Adafruit Ultimate GPS module. Our CanSat will also consist of a 5V 2.5A step-down voltage regulator, a buzzer and a switch-key. An electronic drawing of our CanSat looks as follows:

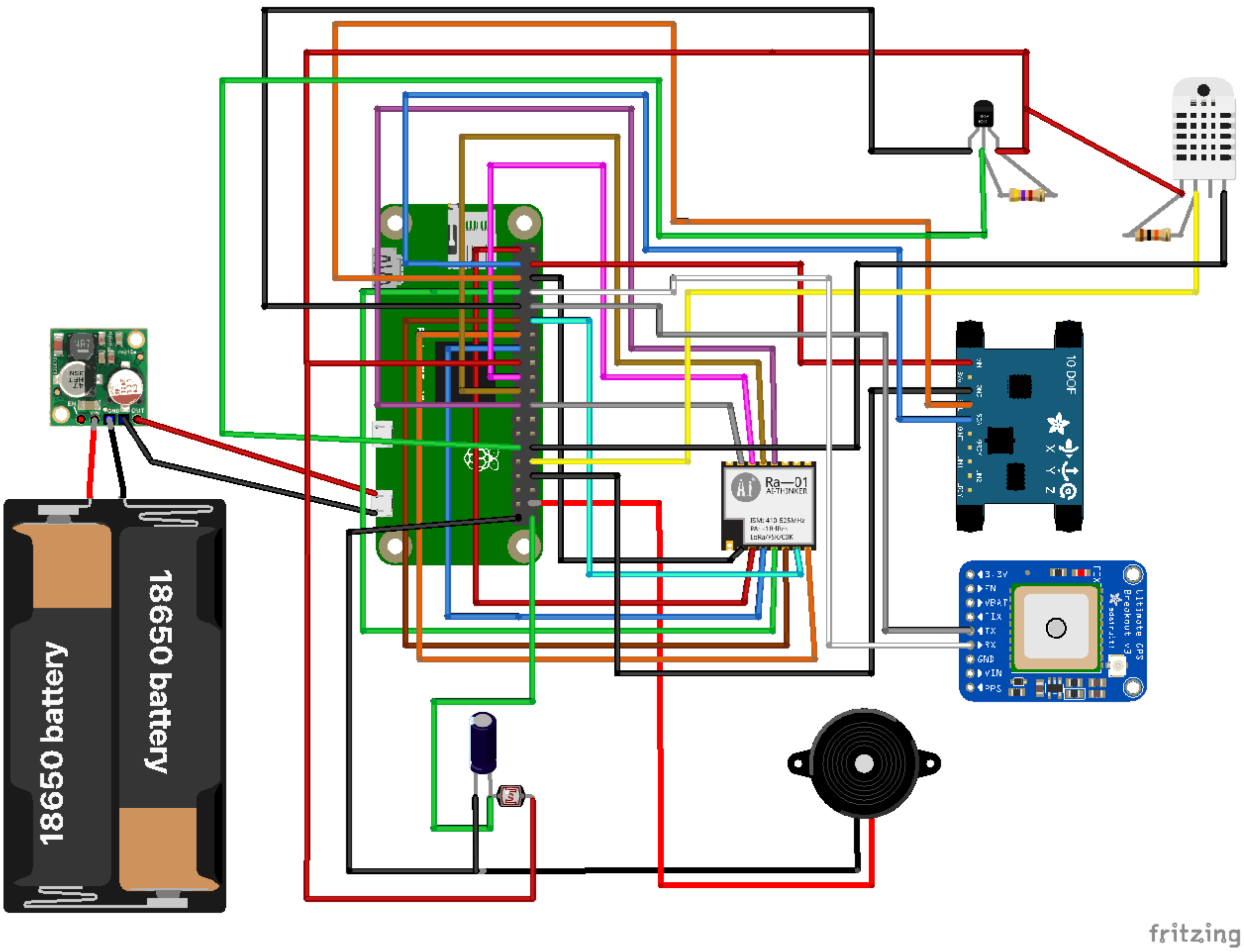

Figure 8: The electronic drawing

3.3.2 Primary mission devices

The primary mission will be conducted using consecutive sensors: DS18B20 temperature sensor to measure the temperature and a BMP280 located in Waveshare 10 DoF IMU sensor to measure the air pressure. The data from those sensors will be sent to our on-board computer - Raspberry Pi Zero W. The computer will send the readings via SX1278 radio module to our ground station. There will also be a buzzer that will start vibrating after the touchdown.

3.3.3 Secondary mission devices

The secondary mission will be conducted using consecutive electronic components: Raspberry Pi NoIR camera taking Red – Green - Near-Infrared images used in calculation of remote sensing indexes (NDVI, NDWI, Green NDVI, Greenness Index) and in land cover classification.
The DHT22 sensor will be used to measure air humidity, DS18B20+ temperature sensor to measure the temperature, Waveshare 10 DoF IMU sensor to measure acceleration, orientation and air pressure as well as a 50-100 kΩ photoresistor to measure sunlight intensity.

Our CanSat will also be equipped with Adafruit Ultimate GPS Breakout board that will gather latitude, longitude, altitude, speed and real time of our satellite.

Figure 9: The electronic components inside the CanSat

3.3.4 Power supply

Our CanSat will be powered by two XTAR 18650 lithium-ion batteries (3500 mAh each) in series circuit. Assuming 90% efficiency of batteries, we get 6300 mAh capacity and a voltage of 7.4 V. As Raspberry Pi Zero W works at 5V/2.5A, our CanSat will also consist of a Pololu 5V 2.5A step-down voltage regulator. Assuming 85% efficiency declared by producer of voltage regulator, we will get 7925 mAh and a voltage of 5V (39.6Wh). This will be enough to power our CanSat for 12 hours. We chose Li-Ion batteries due to its excellent energy to mass ratio and their reliability in different conditions.

Electronic component	Current usage	Voltage	Power consumption
Raspberry Pi Zero W	~200mA	5V	1500mW
Raspberry Pi NoIR v2 Camera	-	-	1000mW
Temperature sensor DS18B20+	1mA	3.3V	3.3mW

Waveshare IMU 10DoF sensor	4mA	5V	20mW
Servo SG-90 (only one turn)	-	-	-
GPS module for Raspberry Pi	20mA	5V	100mW
SX1278 LoRa RA-02 433 MHz radio module	<130mA	3.3V	430mW
DHT-22 Temperature & humidity sensor	0,2mA	5V	1mW
Photoresistors	4mA	3.3V	13.2mW
Buzzer	30mA	5V	150mW
Total	**~400mA**		**~3.3W**

The lifetime of our CanSat:

$$\frac{39.6Wh}{3.3W} = 12h$$

The batteries will power our CanSat for about 12 hours.

3.3.5 Communication system

We are going to use radio communication to receive data from our CanSat. The communication is one-directional as there is no need to send any commands to the CanSat. We used SX1278 radio module in both the satellite and ground station. The module in the CanSat is equipped with an antenna made of a wire. In the ground station we want to use a Yagi-Uda directional antenna.

Both CanSat and ground station are configured to the frequency of 433.0 MHz and a 125 kHz bandwidth. The spreading factor was set to 10 and coding rate to 4/6 to get the communication speed at about 2600 bps what gives about 325 characters per second. The emitting power of the radio is 100 mW.

3.4 **Software design**

Our team is going to use three programs: one for our CanSat, one for the ground station and one for image analysis. The code on CanSat is responsible for getting and saving data from sensors, taking images, sending data via radio, and turning different operation modes: preflight mode, flight mode and postlanding mode. We will get data from the sensors every 500 milliseconds. The data gathered from sensors will be saved in a CSV file and images will be saved directly on the SD card in JPG format. All software is going to be written in Python. In order not to create a queue, the CanSat's code is using threading.

3.4.1 Preflight mode

This mode will be turned on during the boot of our CanSat. During it, CanSat will only gather data from temperature sensor, pressure sensor and the GPS module as well as send them via radio. Using the readings from GPS and pressure sensor, the code will calculate the altitude of the satellite. If the difference between the initial altitude and current altitude will be bigger than 150 meters for 3 times, our CanSat will switch to the flight mode.

3.4.2 Flight mode

During this mode all the CanSat sensors will be gathering data and the camera will be taking images. The data and images will be gotten once every 500 milliseconds and saved to SD card. Temperature, air pressure, humidity, sunlight intensity, latitude, longitude, and altitude will be sent via radio to our ground station once a second. The photos will be taken in two resolutions: the images in 324x243 pixels resolution that will be sent via radio during the postlanding mode and the images in 2592x1944 pixels resolution that will be stored on the SD card. This mode will be working for 30 minutes and then the postlanding mode will be turned on.

3.4.3 Postlanding mode

During the final mode, all the CanSat sensors (except the temperature and pressure sensors) will be turned off. Only the radio module the buzzer and GPS will be working. The radio module will be sending the readings from GPS module, temperature and humidity as well as images in low resolution to the ground station. The buzzer will be turned on once every 3 seconds for 1 second. This mode will last till the batteries are discharged or until the CanSat is turned off using the switch-key.

3.4.4 Ground station software

The ground station software will receive radio data, save it to CSV file or the SD card (images) and present it in a GUI interface. The GUI is written in Python with Tkinter and Matplotlib. It looks as follows:

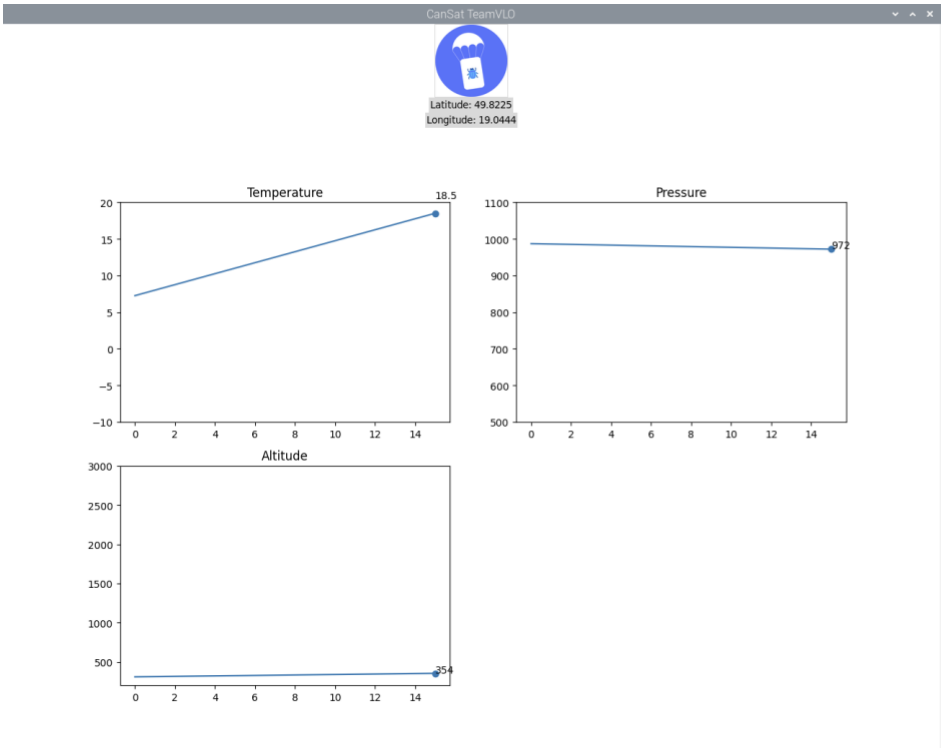

Figure 10: The GUI Interface

3.4.5 Image analysis software

The image analysis software will be responsible for calculation of remote sensing indexes (NDVI, NDWI, Green NDVI and Greenness Index) as well as in land cover classification. The code will create a composition of images.

The codes for our CanSat and Image analysis software are in our Google Drive Folder.

3.5 Recovery system

3.5.1 General idea

We use a hexagonal parachute with a surface of 1200 cm^2 and an area of 584 cm^2, which gives our CanSat a falling speed of 10.6 m/s. We have added, a new feature - parachute vent, to our project. It will stabilize the flight of our CanSat and reduce the speed of the landing.

Figure 11: The parachute

3.5.2 Materials

The material used to sew our parachute is a polyester-nylon ripstop fabric. It has a high durability and it is also waterproof. Its bright blue colour has not been chosen by an accident. It will help us to find our CanSat after the landing. To attach our parachute, we used 12 nylon lines with a diameter of 3 mm instead of 6 to increase the durability.

3.5.3 Tests and estimate performance

We have already carried out the necessary calculations, thanks to which we were able to calculate the parachute area needed to maintain the falling speed of our CanSat around 10-11 m/s. To do it we used the following formula:

$$F = \frac{1}{2} CdAv^2$$

F – resistance force; C – drag coefficient; d – density; A – surface; v – speed

Resistance force must be equal to gravity force:

$$F = mg = \frac{1}{2} CdAv^2 \leftrightarrow A = \frac{2mg}{Cdv^2}$$

We have done out the tests to check if our calculations were correct. We used test model made of a soda can, which weight was increased to 300g - the weight of our final model.

3.5.4 Mounting of the parachute

To attach our parachute, we used nylon lines inserted into interior of our model through holes in its case. At the end of these lines, we will make knots with a diameter larger than the diameter of the holes, so that the parachute will remain in place. It is a simple solution that doesn't introduce additional elements that could fail during the flight.

3.6 Ground support Equipment

Our ground station consists of a Raspberry Pi 3B+ set with SX1278 radio module, a Yagi-Uda antenna and a laptop. All the data from the CanSat will be sent to Raspberry Pi via radio and stored in the CSV file. The photos will be stored on the SD card and later analyzed on our laptop using a code for calculation of remote sensing indexes and land cover classification.

4 TEST CAMPAIGN

4.1 Primary mission tests

We have tested our primary mission sensors by running several tests. We compared the obtained results with measurements from other sensors and weather stations to check if the sensors are accurate. The temperature was measured using three independent sensors: DS18B20 (the main temperature sensor in our CanSat), DHT22 and BMP280. The gathered records are similar with an error of ±1°C. A diagram showing obtained measurements:

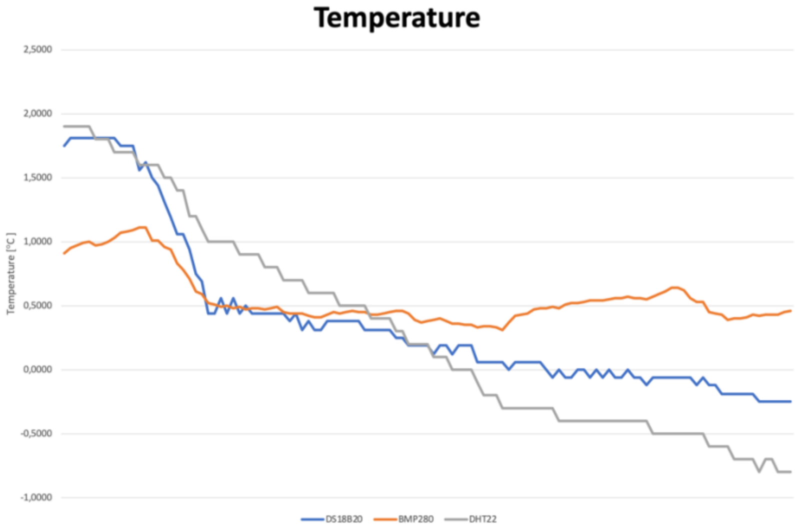

Figure 12: Temperature measurements

The obtained pressure measurements were also accurate compared with the measurements from an independent weather station. The error was ±2 hPa.

4.2 Secondary mission tests

While testing primary mission sensors we also tested the secondary mission components. The data gathered from DHT22 humidity sensor had an error of ±1%. The readings gathered from the light sensor can’t be compared due to lack of other light sensors. During the test in the night the sensors showed a value of 0.0, in the daylight 0.4-0.6 and with a torch directed at them a value of 0.95-1.0 what shows that the sensors are correctly measuring light intensity. We also tested a GPS module several times. The obtained results were with an average error of 10 meters in latitude and longitude what is an accurate result, allowing us to easily find our CanSat:

Figure 13: The proper localization of the CanSat (on the left), the localization measure by the GPS module (on the right)

We have also tested our camera and the code for photo analysis. We have tested it during different parts of the day and on few different areas. The obtained images are of good quality and indicators are calculated correctly:

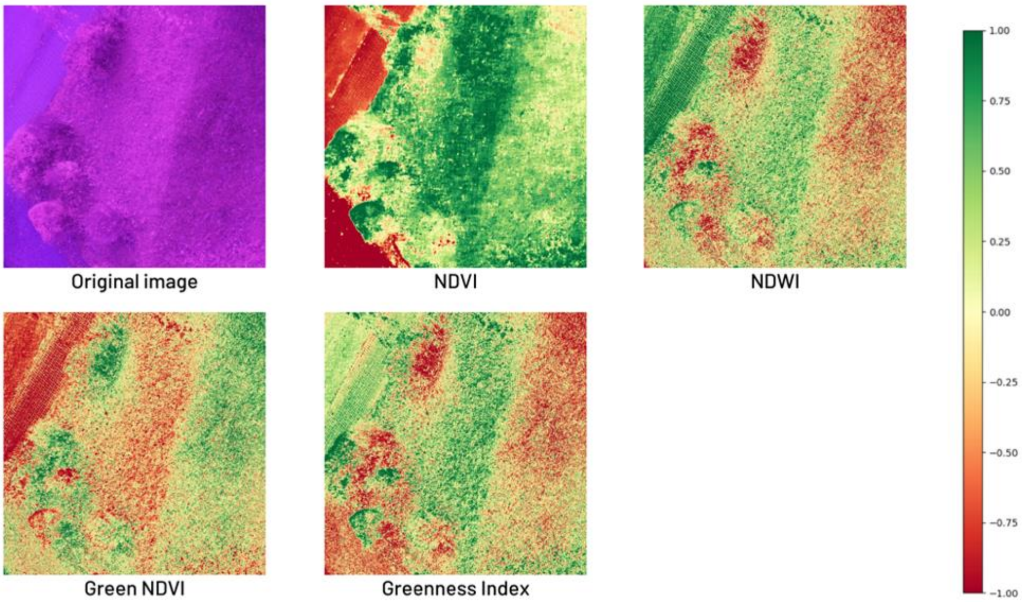

Figure 14: Composition of images

More image analysis and a sample file with the readings from sensors can be found in our Google Drive folder.

4.3 Tests of recovery system

We tested the recovery system by dropping the 300g (the weight of the final model) test models from buildings of different heights. As the models fell, we measured the time and recorded the moment of flight. This allowed us to prepare a detailed analysis of movement track, as well as the calculation of the average speed on specified route (we know the distance and time of movement).

After conducting those tests, we decided to create a parachute with a surface of 1200 cm^2 which gives the speed of 10.6 m/s which is satisfactory. Our parachute also has a vent to increase the stability of the fall.

The footages from the tests can be seen in our Google Drive Folder.

4.4 Communication system range tests

We have performed 3 radio communication tests. One on the distance of few meters in our workroom, the second one on the distance of several dozen meters and the third one on the distance of 3.6 km. In each test we sent a line consisting of 50 characters (numbers, dots and semicolons).

At first, we set the Coding Rate to 4_8 and the Spreading factor to 12 as we wanted to embiggen the certainty of transmission. Unfortunately, at those settings the majority of message was sent with errors, so we tried other settings of those parameters. At last, we found a golden mean for them: we set a Coding Rate to 4_6 and the Spreading factor to 10.

During the third test we checked if our CanSat can send data at long distances. We conducted the tests at the distance of 3.6 km between two points that have a relatively clear view. The usage of Yagi-Uda antenna allowed us to freely transfer data on this distance without interferences. The tests were conducted between the Zlote Lany estate and the Dębowiec Sports Area:

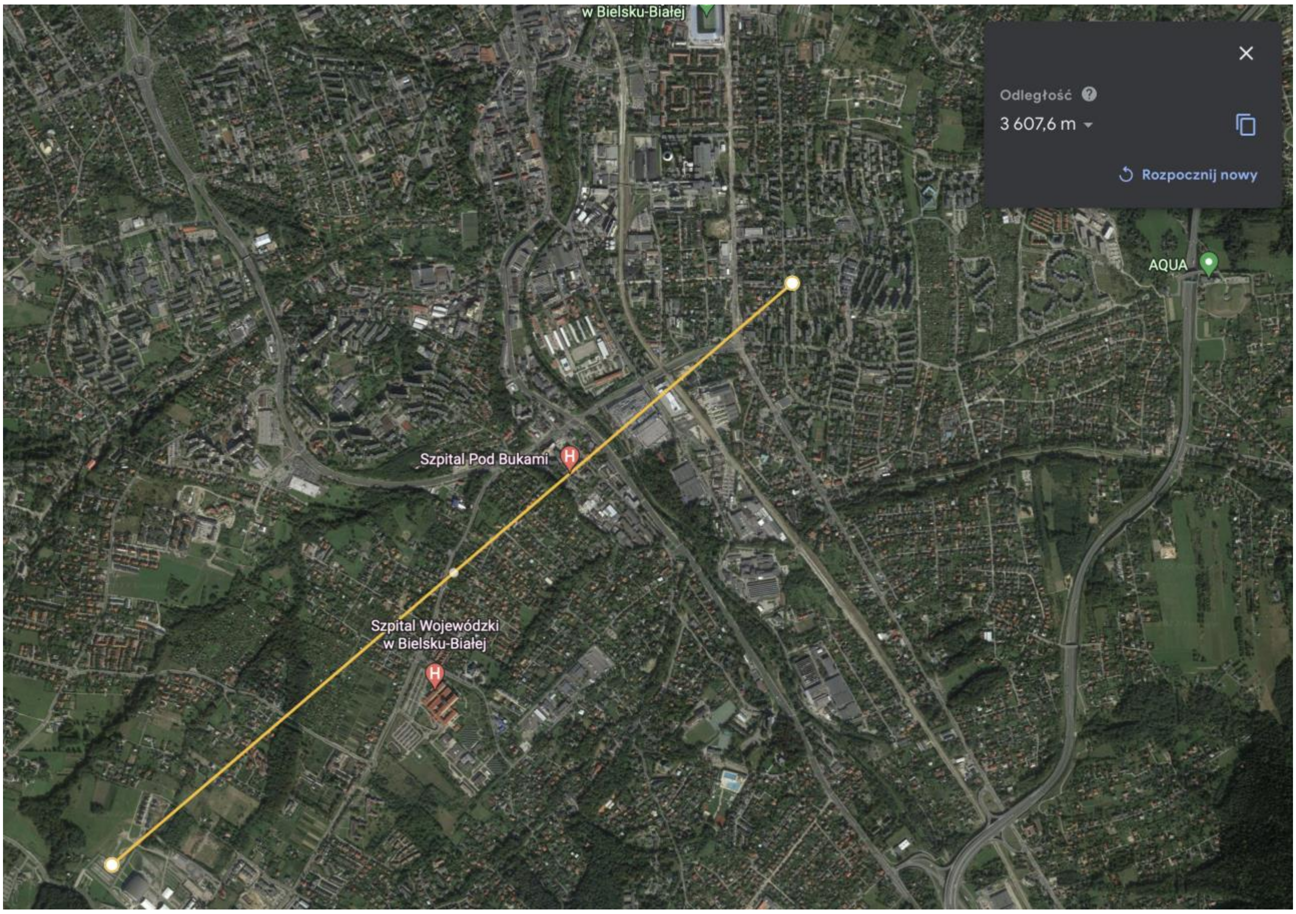

Figure 15: Map showing the places of radio range tests

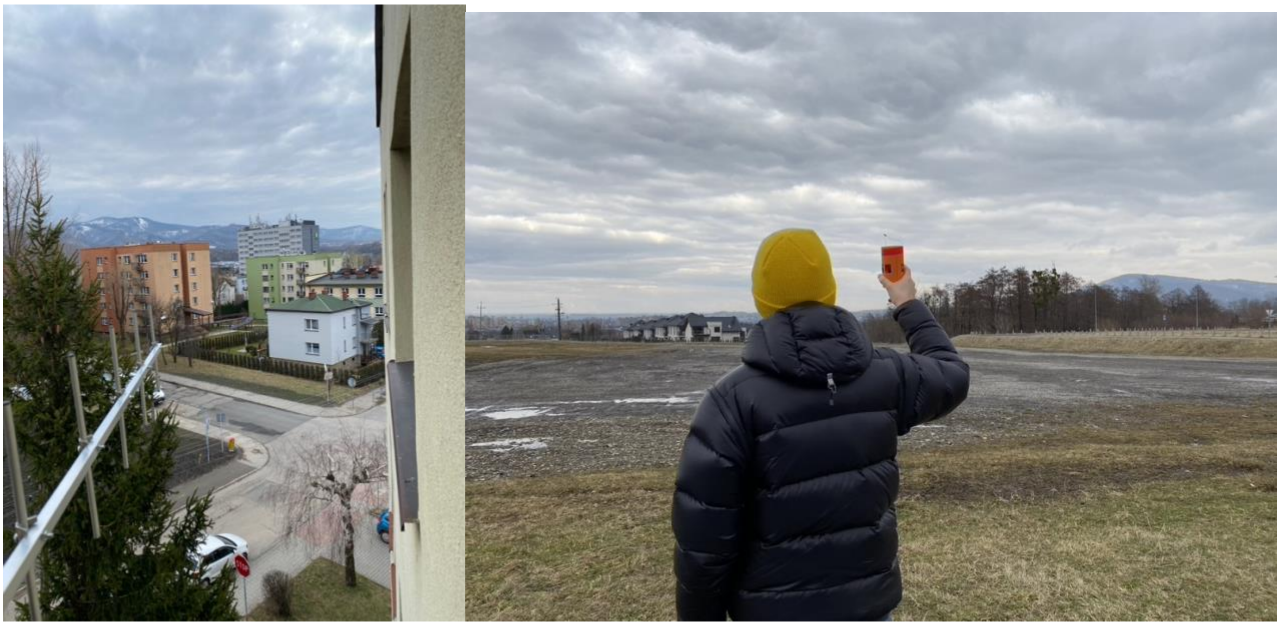

Figure 16: Tests of the radio range

4.5 Energy budget tests

We conducted a battery test to check whether our electronic circuit is giving appropriate voltage and amperage for our CanSat. The Raspberry Pi turned on correctly and it was working without "Too low voltage errors". This test assured us that we chose appropriate components for our electronic circuit.

We also conducted a battery life test that allowed us to check if our calculations were correct. To do this, we charged our batteries, put them in CanSat and started the code. We turned on the preflight mode for 5 hours, the flight mode for half an hour and the postflight mode for the rest battery time. We also logged every second the time to check on which second the CanSat will stop working. The test proved that our CanSat will work on batteries for over 12 hours, what is more than enough.

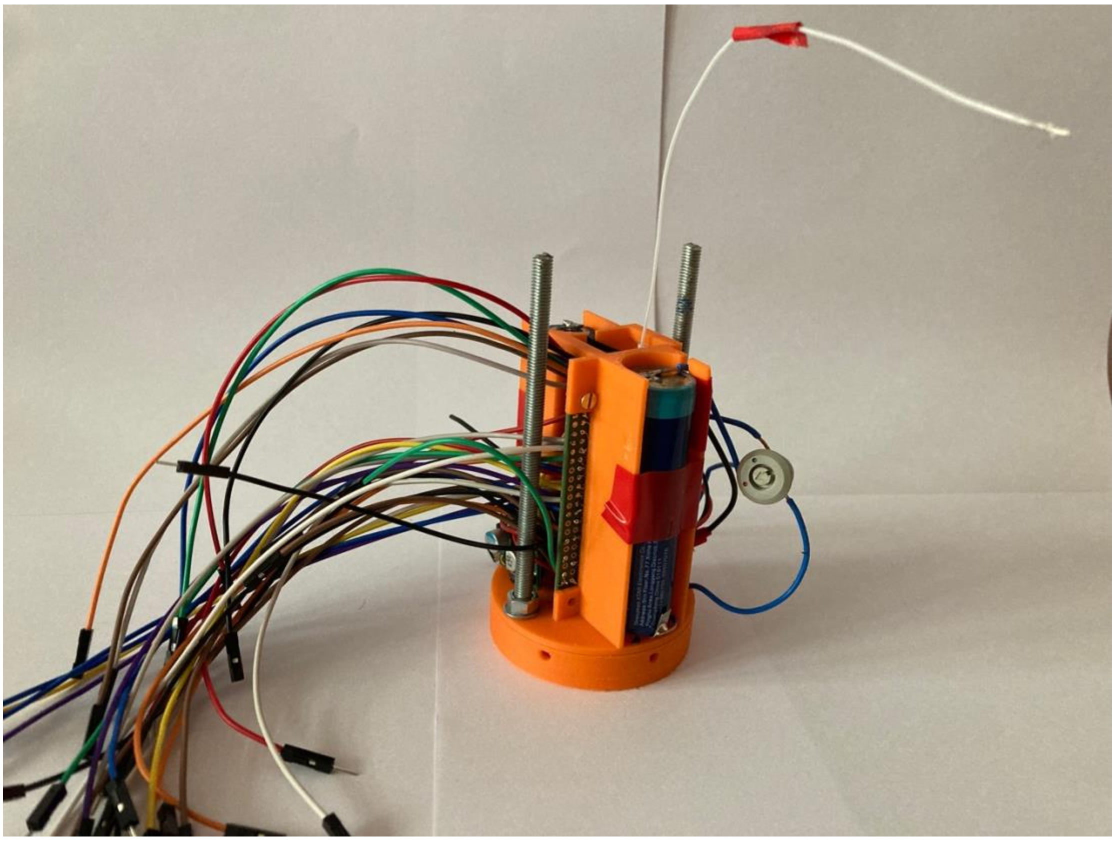

Figure 17: Assembly of the electronic circuit

5 PROJECT PLANNING

5.1 Time schedule

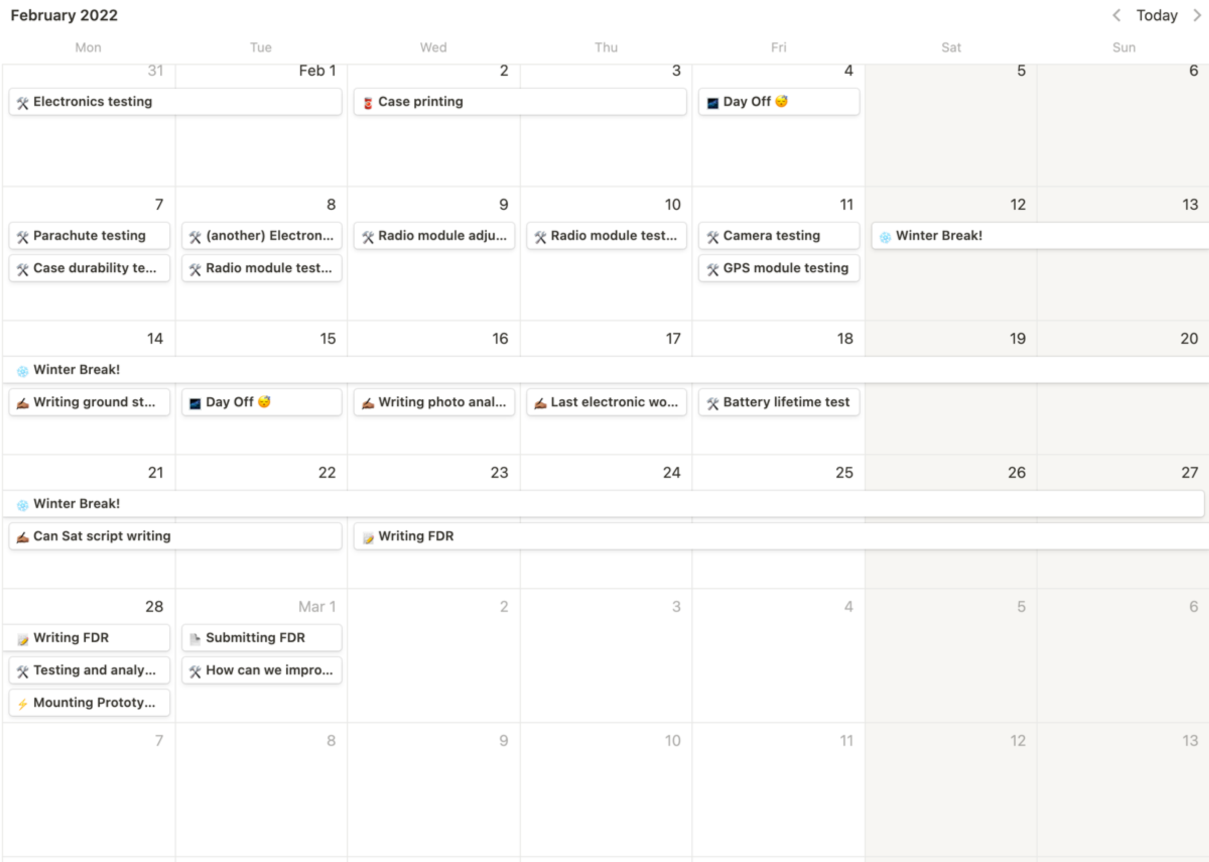

Figure 18: Calendar – Time schedule

5.2 Task list

HIGH-LEVEL TASK	LOWER-LEWEL TASK	STATUS
Writing CDR	Dividing work	Done
	Submitting CDR	Done
Outreach	Creating Facebook account	Done
	Creating Instagram account	Done
	Establishing new cooperations	Done
	Posting updates	Done
	Giving presentation in school	Done
	Giving presentation in training center for teachers	Done

Planning	Inventing mission's objectives	Done
	Designing electronics	Done
	Designing satellite	Done
	Approximating the budget	Done
	Approximating mass of CanSat	Done
Gathering all necessary things	Choosing materials and modules	Done
	Buying elements	Done
	Eventual changes in budget	Done
Prototypes	Parachute	Done
	Case	Done
	Electronics	Done
Testing	Testing parachute	Done
	Testing GPS module	Done
	Testing case durability	Done
	Testing camera	Done
	Testing battery lifetime	Done
Communication	Choosing antenna and radio module	Done
	Calibrating radio modules	Done
	Writing a script for radio modules	Done
	Testing radio module on short distance (few meters)	Done
	Testing radio module on medium distance (few hundred meters)	Done
	Testing radio module on long distance (3 kilometers)	Done
	Testing radio module	Done
GPS	Choosing GPS module	Done
	Testing GPS module	Done
	Installing GPS module	Done
Software	Writing an algorithm for each sensor	Done
	Writing script for ground station	Done
	Writing script for CanSat	Done
	Writing photo analyzing program	Done
Electronics	Choosing sensors and components	Done
	Making electrical design prototype	Done
	Testing and calibrating sensors and components	Done
	Testing final version of electrical model	Done

Final model	Printing case	Done
	Testing the final model	Done
	Installing electronics, modules, sensors in case	Done
Writing FDR	Dividing work	Done
	Submitting FDR	Done

5.3 Resource estimation

5.3.1 Budget

Here is a table showing all costs of our CanSat (€190):

Element	**Cost (€)**
Raspberry Pi Zero W 512 MB	13.00
Raspberry Pi NoIR v2 Camera	32.00
Temperature sensor DS18B20+	2.34
Waveshare IMU 10DoF sensor	14.10
2x 18650 XTAR – 3500mAh battery	21.60
Servo SG-90	4.10
Case (filament)	12.20
GPS module for Raspberry Pi	46.00
SX1278 LoRa RA-02 433 MHz radio module	7.60
DHT-22 Temperature & humidity sensor	6.50
Step-down converter 5V 2.5 A	15.21
Others (switch-key, wires, filament, photoresistors)	15.00
Σ	**189.65**

We took the prices from https://botland.com.pl/

5.3.2 External support

Since October we managed to get a lot of partners and sponsors for our project. Our sponsors are in succession: WizjaNet - an IT company that provides services to companies in field of IT, programming, and e-marketing; Abel IT – an IT company providing computer services; Botland – an electronic and robotic shop; our school's PTA, the school management, and the V High School Association.

Received support allowed our team to buy all necessary parts to build our CanSat as well as prepare promotional materials.

Figure 19: Logotypes of our sponsors and partners

6 OUTREACH PROGRAMME

The Outreach Programme is going very well. During last weeks, we were gaining new followers on Facebook and Instagram regularly. Currently, Facebook page is a place, where almost all information that a common observer needs can be found.

We still publish updates about the project, our partners, and sponsors as well as about our team. Our posts reach more than a few hundreds. recipients. Our Facebook page has 189 followers and 181 likes, while our Instagram page has 100 followers.

While working on less demanding tasks, we often post on Insta Stories. It seems like it is our followers' favorite form because they leave a lot of reactions. Those who follow us have an opportunity to see short films or pictures of our team testing, printing, or mounting elements.

Links:
https://www.facebook.com/teamvlo.cansat
https://www.instagram.com/teamvlo.cansat/

Figure 20: An example Facebook post

The leader of our team – Emil Kielar with the help of our mentor - Dr Dawid Kotrys published a research paper on the XI Inter University Conference of Students, PhD students and Young Scientists held at the University of Bielsko-Biala (ATH) in Bielsko-Biała. Emil's paper is about a program, written in Python, which analyzes images using the OpenCV function library. The code determines the Normalized Differential Vegetation Index, what is a main stage in our secondary mission.

Link to the paper: https://doi.org/10.53052/9788366249868.10

Link to the poster: http://www.engineerxxi.ath.eu/wp-content/uploads/2021/12/351.pdf

In order to promote our team, we created our own logotypes that are being used in all promotional materials of our team:

Figure 21: Logotypes of our team

We gave a presentation to students in our school. During it, we told them about the competition, showed the completely mounted satellite and talked about the significance of materials it is built from:

Figure 22: Presentation for students from our school

We were also asked by the Head of Bielsko-Biala's Teacher Training Centre (Bielsko-Bialski Ośrodek Doskonalenia Nauczycieli) to give a presentation to the teachers from our city about the CanSat competition and our satellite as well as its the mission. We gave this presentation on the 1st of March:

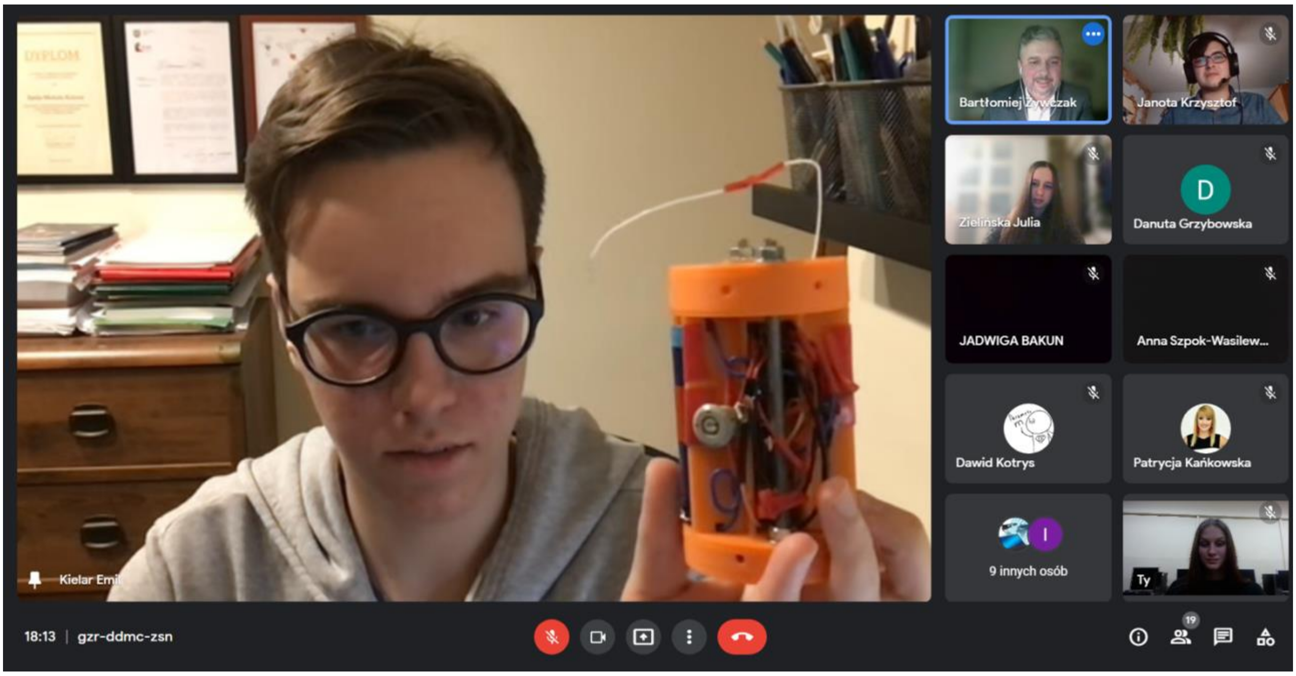

Figure 23: Presentation for teachers

Our team is also going to give a presentation about our CanSat in May for the students from primary schools that are in our city and county during the workshop that is organized for them by our school ("Zaprzyjaźnij się z V").

We also contacted local media that wrote an article about our team: https://bielsko.biala.pl/aktualnosci/47543/uczniowie-v-lo-w-bielsku-bialej-buduja-satelite-konkurs-europejskiej-agencji-kosmicznej

For promotional purposes in our school, we wrote an article on our school's webpage about our team's project: https://lo5.bielsko.pl/aktualnosci/budujemy-satelite

We also recorded a 13-minute-long video presenting our project and the CanSat competition. It can be found in our Google Drive folder.

7 CANSAT CHARACTERISTICS

Characteristics	Figure
Height of the CanSat	114 mm
Diameter of the CanSat	63.5 mm
Mass of the CanSat	300 g
Estimated descent rate	10.6 m/s
Radio transmitter model and frequency band	SX1278, 433MHz/125kHz
Estimated time on battery (primary mission)	12 hours
Cost of the CanSat	€190