Starliner

Critical Design Review

Team Name: Starliner

Country: Poland

1.Changelog

-added chapter 4.5 Energy budget tests
- we changed the adapter for SD card on Pololu sdc01a.
-to the previous transfer to the ground station (temperature, pressure, GPS coordinates) we have added another one (gyroscope, accelerometer and current time).
-the construction of the parachute will be changed - it will be slightly larger and it will have a hole in the middle.
-During the competition we choose our new logo. (Visible on the title page)
-a few improvements in CanSat construction have been done
-we changed the material and 3D printer.

2.Introduction

2.1 Team organisation and roles

The team's work was divided proportionally among all team members. Each element of the project will have its lead member, who will be responsible for their part of CanSat, where each of the 6-person group will have part in each element, so that in case of illness or temporary indisposition of one of the people the project will not .Mr Michał Żurawski is our supervisor. He is a physics teacher at our school.

Tasks of individual group members:

Kacper Grobelny - team captain; deals with programming the controller and connecting sensors to the main system.

Mikołaj Koralewski- antenna construction, soldering CanSat system and ground station system.

Mikołaj Krzyżostaniak- 3D printing, translations of the reports and taking care of our Facebook page.

Piotr Skoracki - deals with the frame,cover design and construction and is responsible for the project’s website.

Dawid Betka - deals with the construction of the parachute and is responsible for reading GPS coordinates. He is also responsible for reading and interpretation data from accelerometer and gyroscope.

Michał Jędrzejak - deals with powering the system and the selection of appropriate batteries

2.2 Mission objectives

The objective of the project is to examine the vertical distribution of suspended particles PM 2.5 and PM 10. In the case of research missions to foreign planets, it will allow to obtain information about atmospheric dust and possible subsequent research missions using optical tools. From the point of view of the Earth's mission, we want to investigate how high suspended particles are raised by vertical air movement and at what height the dustiness decreases to acceptable values. The range of drones is too small and optical tools (lidars) are out of our reach. Air dustiness changes seasonally, however, even in summer (field work), standards for suspended particles are often exceeded. We want to see at what heights (hypothetically) peoples should live to limit the impact on human life. Would placing an object in Poland modeled on the Burj Khalifa from Dubai solve the problem for its residents and whether living in high-rise buildings allows people to breathe clean air without mechanical filtering.

In order for the project to be considered completed, we want the sensors to be placed in the system to correctly read all the information needed for our tests. Then we will process them and take conclusions.

3.CanSat description

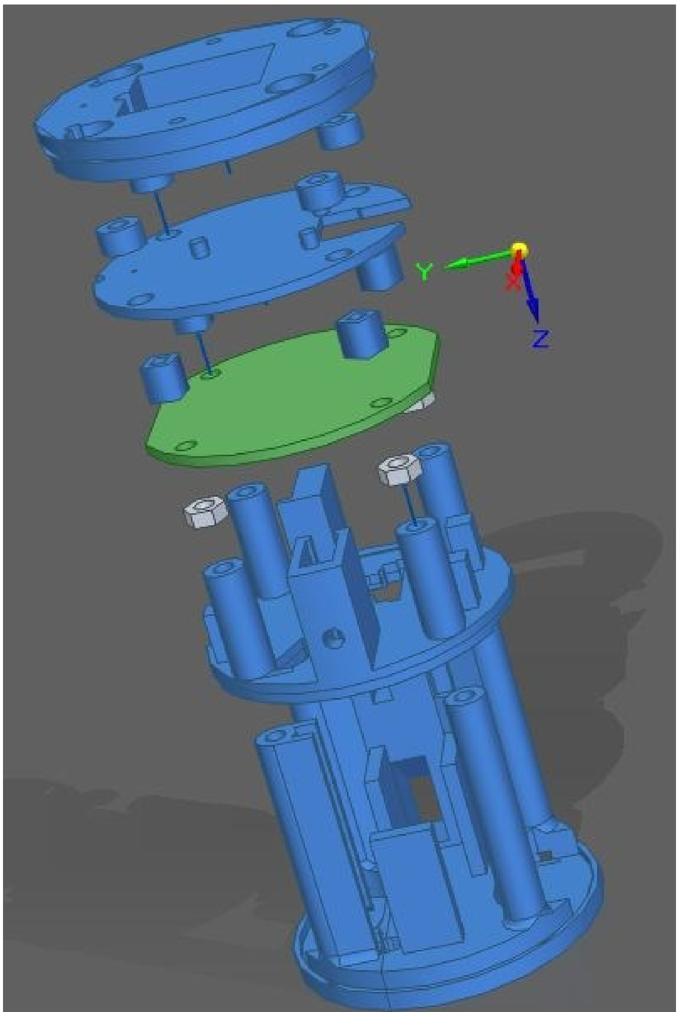
3.1 Mission overview

Our mission is to build a CanSat with a cylindrical shape measuring 115mm x 66mm which will be released from the rocket to examine the following values: temperature, pressure, humidity, acceleration, vertical distribution of the dust, location and the position of the CanSat plane relative to the ground. Temperature, pressure, gyroscope, accelerometer,magnetometer and GPS coordinates will be sent to the ground station. All measurements will be saved on the microSD card.

Ultimately, CanSat will be dropped on a parachute at a speed of 10 m / s.

3.2 Mechanical/structural design

3.2.1 3D design project



Scheme 1: 3D design

CanSat cover was designed in Solid Edge 2020 to print it on a 3D printer.

The box consists of two bases, an outside cover, four columns and place for contact plate. One of the bases is permanently attached to four columns, while the other will be attached with four screws through the holes in the columns. In order that the heads do not protrude outside the cover, in bases there are holes in which these heads will be hidden.

The bottom base will contain a dust sensor protected by three 25 mm high walls with four batteries (each with a capacity of 800mAh and weight of 20g). They will be placed in special holes and attached with appropriately shaped metal plates. Two channels are discharged from the dust sensor: one for the inlet, the other for the air outlet. Holes are cut out in the cover to fit the outlet and inlet air channels. Wires coming out of the sensor and battery will be led to the board through a channel mounted on one of the columns, then through the floor and then directly to the board. An outside temperature sensor will be placed in the hole inside the base, which will also be led to the plate.

The first level is also permanently attached to the columns. It has rectangular columns with holes for placing the main board and a place for the swith and regulator. A hole will be made in the cover to the switch, through which will be placed to turn on and off whole wystem. (If the screw is in, everything will be off.) A higher level will be placed the plate, which task is to connect all wires. It will be attached with bolts passing through the holes in the columns, which are coaxial to the holes in the plate. The other sensors will be soldered directly on the board.

On the last level there will be a platform with the space for the motherboard.

The cover will be applied from above, it will rest on the lower base and will be locked by the upper base. It will be locked against rotation by a tongue in it and a groove in the rack.

A GPS module will be placed in the hole in the top base. 6 holes will also be made through which the parachute lines will pass.

Protection against water: Because we are not able to predict weather conditions during the satellite drop, we must consider the possibility of precipitation. There is no problem when it comes to sealing the housing itself and the temperature sensor as well as the gps antenna

It is debatable to limit the amount of water sucked in by the air quality module intake. The best solution seems to be to use a protective mesh with small mesh sizes (perhaps against insects) that would limit the sensor damage. We will test available solutions in the near future.

Material:

The can will be printed in a 3d printer. Our plans have changed. Instead of being filled with ABS filaments, we chose 70% (or less) honeycomb structure filling with PLA filament. We changed also our 3D printer- instead of DaVinci XYZ we are using Ender 3 Pro.

3.2.2 CanSat building

The whole printed can with batteries, necessary electronics and parachute weighs 347g. We plan to reduce the weight to 340g by reducing the filling. We reduce the loss of strength with help of additional supports (they will still be lighter than high fill). This our first prorotype (buildt before we designed On/Off system with the screw).

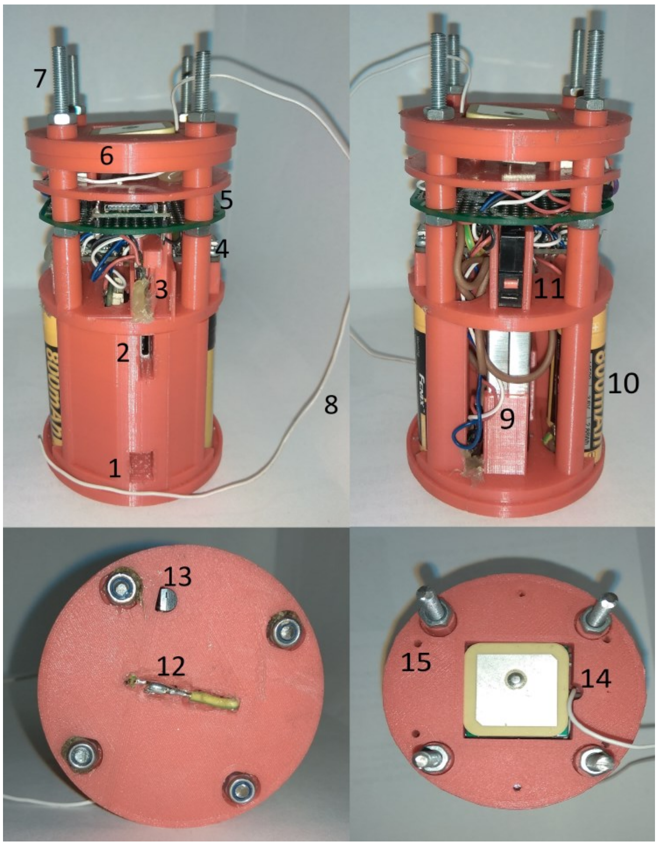


Photo 1: First prototype construction

Descriprion:

1.Air inlet to the dust sensor.
2.Air outlet to the dust sensor.
3.Step-up module for the dust sensor (3.3V → 5V).
4.Main control board (Adafruit Feather M0).
5.Contact plate with sensors (BME280, AltiMU-10 v5) and microSD card adapter.
6.Upper base with GPS module.
7.Too long fastening screws (In the prototype they are longer to facilitate quick access, in the final CanSat they will be hidden as on the bottom base).
8.Temporary transmitting antenna (in the next prototypes it will be a braided cable, only outside the CanSat it will be without a braid).
9.PMS7003-dust sensor.
10. 4 batteries.
11.Main switch.

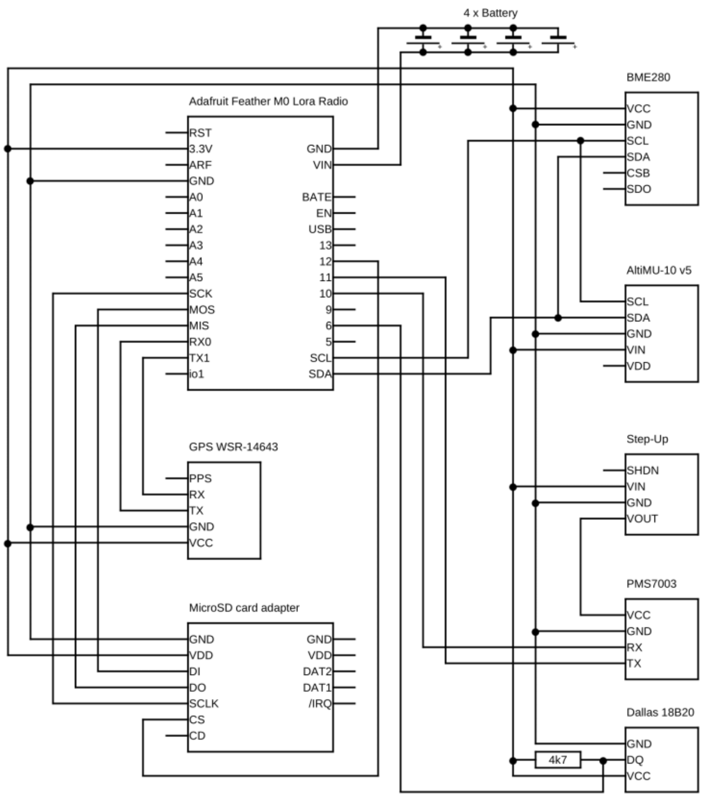
12.Battery parallel connection (it will be covered - the wires will not be visible).
13. Outside temperature sensor.
14.Hole for antenna (in future prototypes)
15. 6 holes for parachute mount.

3.3 Electrical design

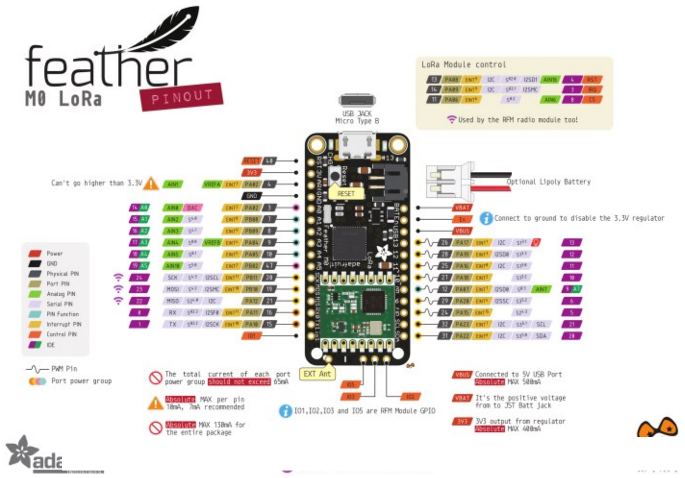
3.3.1 General architecture

The modules presented in this report are connected on the "Adafruit Feather M0 433mhz RFM96 LoRa radio". The final model will be built on this. The built-in LoRa radio module communicates with the Adafruit Feather M0 via the SPI bus.

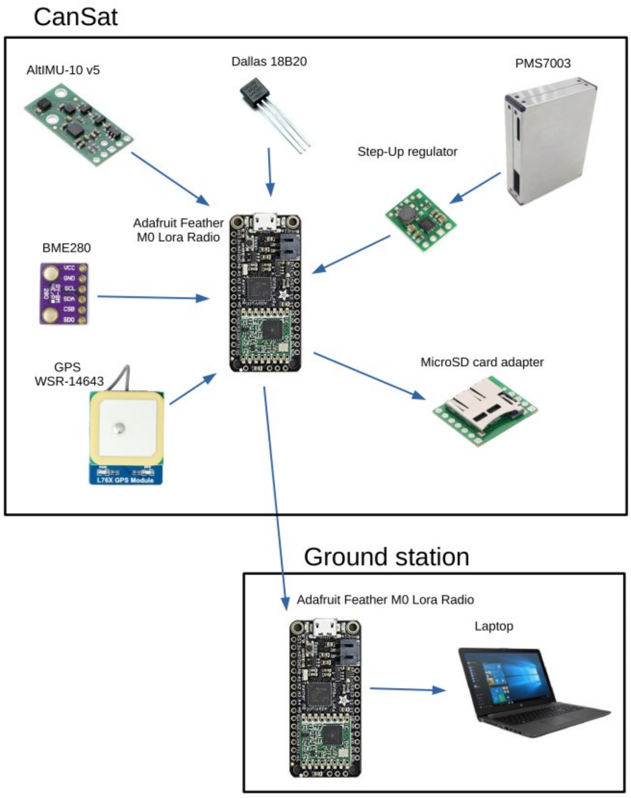
Characteristics:
Input: 3,3V
Radio frequency: 433Mhz
Mass: 6g
Size:51x23x8[mm]
Pins:20 GPIO, 8PWM, 10 inputs and 1 analog output.



Scheme 3: Detailed elecronics connection



Scheme 2: Our main control module



Scheme 4: Overall mission plan

3.3.2 Primary mission devices

<u>BME280</u>- digital sensor connected to the Adafruit Feather M0 via the I2C bus, able to measure:
1) temperature:
-measuring range: from -40°C to 85 °C
-accuracy ± 1°C
2) humidity:
-measuring range from 10% to 80% RH
-accuracy ± 3 % RH
3) atmospheric pressure
-measuring range from 300-1100hPa
-accuracy ± 1 hPa

Dallas 18B20- to outside temperature measurment. Connected with 4,7kΩ resistor. It connects to the Adafruit Feather M0 with the 1-Wire bus.
-measuring range from -55°C to 125°C
-accuracy ±0,5°C in -10°C to 85°C range
MicroSD Card Adaprer with microSD card. It communicates with the Adafruit Feather M0 via the SPI bus.

3.3.3 Secondary mission devices

AltiMU-10v5- all-in-one accelerometer and gyroscope (LSM6DS33), magnetometer (LIS3MDL) and barometer(LPS25H). It is connected to the Adafruit Feather M0 via the I2C bus.
PMS7003 for air dust pollution measurment. The data is sent over the serial bus with a hardware UART device.
GPS WSR14643- to determine CanSat's position and landing place.
In PMS7003 and GPS module the data is sent over the serial bus with a hardware UART device.

3.3.4 Power supply

Due to the weight and dimensions imposed by the designed CanSat capsule, we used batteries: 4 pcs. Li-lion 14500 3.7V, 800mAh, parallel connection, weighing 20g piece which gives (according to our calculations) theoretically 5.8h battery life. CanSat electrical power consumption:

Device name	Current electricity consumption [mA]	Supply voltage [V]	Effi-ciency	Battery power consumed [W]
Adafruit Feather M0 RFM 96 LoRa radio	180mA	3,3V	0,5	0,6W
GPS module	11mA	3,3V	0,5	0,36W
Humidity Sensor BME 280	0.0036mA	3,3V	0,5	0,0036W
AltiMU10v5	6mA	3,3V	0,5	0,03W
Dust sensor Adapter PMS7003	100mA	5V	0,8	0,5W
Temperature sensor	1,5mA	3,3V	0,5	0.05W

Table 1: CanSat electrical power consumption

Ground station electricity consumption:

Device name	Average electricity consumption [mA]	Supply Voltage [V]	Effi-ciency	Battery power consumed [W]
Adafruit Feather M0	180mA	3.3V	0.5	0.594~0.6 W
GPSL76x Multi	11mA	3.3V	0.5	0.36W
Humidity Sensor BME 280	0.0036mA	3.3V	0.5	0.0036W
Dust sensor Adapter PMS5003	100mA	5V	0.8	0.5W
Dallas 18B20	1.5mA	3.3V	0.5	0.05W

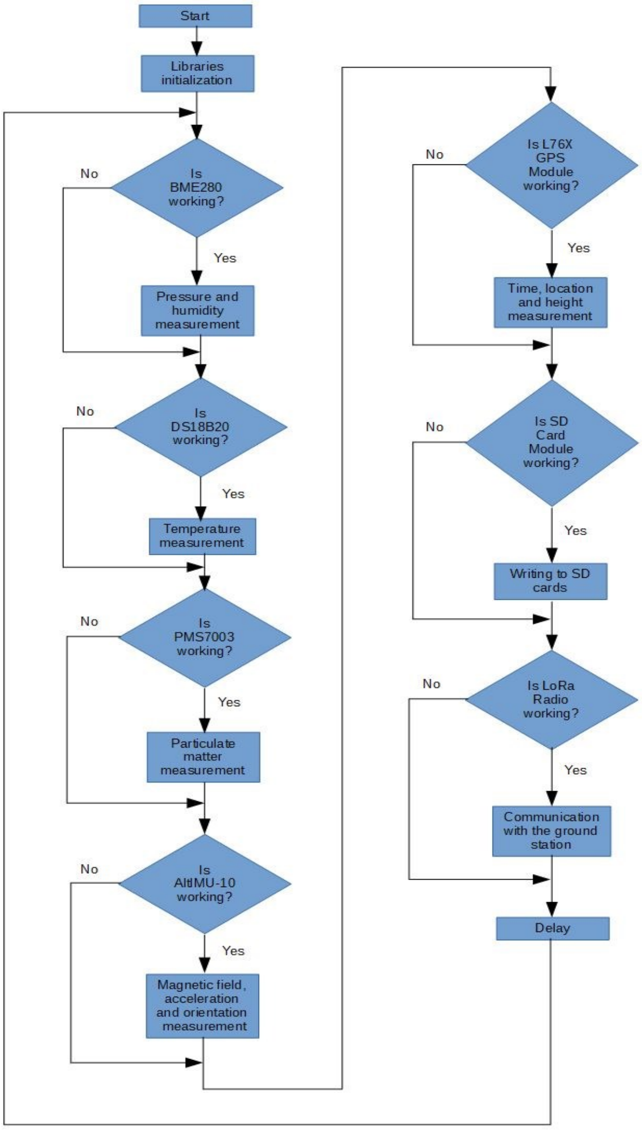
Table 2: Ground station electricity consumption

3.3.5 Communication system

We use the 433 MHz open frequency which we will change when we get the exact bandwidth on which we are supposed to work. We use 2 devices transmitting data from the probe and a receiving module on the ground that receives signals, both modules operate at the same frequency. The transmitters used for communication are "Adafruit Feather M0 433mhz RFM96 LoRa radio" with the appropriate antennas mounted, the communication works unilaterally, that means we send the signal from the probe and receive it to the receiver, but the receiver does not send the response to the transmitter.

3.4 Software design

Our program on GitHub: https://bit.ly/37ubDGy



Scheme 5: Overall program structure

The program has been written in such a way that in the event of a failure of one of the sensors, the program will not hang. In the program we used the following libraries: Adafruit unified sensor, Adafruit gps library, Adafruit BME280 Library, SD Library, RadioHead Library, OneWire. Added following libraries: lis3mdlarduino-master, lps-arduino-master, lsm6-arduino-master. Using the transmitter, we will send temperature, pressure and GPS coordinates. Now we added measurements of the accelerometer, magnetometer and gyroscope. All measurements will be saved to the microSD card.

Data from the sensors will be collected every 1s. The estimated flight time is about 5 minutes, (about 300 measurments).The program was written in C ++ in the Arduino IDE.

During testing, we encountered a problem with the program hanging when one of the wires was broken. Test results are shown in the table:

Sensor	Broken wire	Result
BME280	VCC or GND	complete hang of the program
	SCL or SDA	does not hang the program, weird values are read, after reconnecting everything returns to normal
SD Card	CS, SCK or MOSI	does not hang the program, does not save, returns to normal after reconnection
	SD card, VCC or GND	does not hang the program, does not save, after reconnecting does not return to normal and does not save
GPS	RX	does not hang the program, no visible effects
	TX, VCC or GND	does not hang the program, the same values are read all the time, after reconnecting everything returns to normal
PMS7003	TX, VCC or GND	does not hang the program, weird values are read, after reconnecting everything returns to normal
	RX	does not hang the program,no visible effects
AltiMU-10 v5	SCL, SDA, VCC or GND	permanent hang of the program
Dallas 18B20	GND, pin10, resistor	does not hang the program,no values read, after connecting is working correctly
	VCC	does not hang the program, incorrect values read, connected is working correctly

Table 3: Effects of sensors failures

We were able to fix it. We had to edit the libraries so that the program would not hang in the event that it does not receive a response from the sensors (a cable will be disconnected or the sensor will stop working). The program waits a certain amount of time for a response from a given sensor. If it does not receive it, it bypasses the sensor. This required only changing the libraries from AltIMU-10 and BME280, because disconnecting other sensors does not cause the program freezing. We are still working on making the AltIMU-10 and BME280 read the values again after reconnection and the microSD card module to write again.

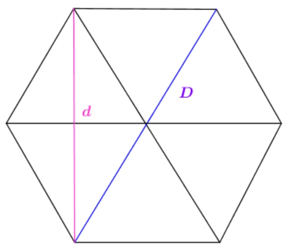
3.5 Recovery system

During the recovering the most important thing are geographical locations of CanSat. Our current equipment is GPS WSR 14643 module with antenna. GPS gives different coordinates according to the record NMEA. The record was successfully converted into more readable form. The module gives geographical coordinates, altitude, number of satellites in range, speed, and correctness of reading. In addition to geographical coordinates, measurements are burdened with an error due to the accuracy of the antenna and the number of satellites nearby. The minimum number of satellites should be at least four. To recovery system we can also include falling inhibitory system. For this purpose we apply the parachute. After our calculations, in which we considered the maximum CanSat weight (350grams), the falling speed, which is on average 10 m/s, air density, resistance coefficient equal to 0.5. The pattern itself looks like this:

$$S = \frac{2Q}{cVg}$$

When:
s-parachute surface
Q-weight
c-drag coefficient
v-falling speed
q- air density

After an in-depth analysis and proper calculation, the satellite at constant drag and stable flight, the flight time is ideally at the assumption of a maximum altitude of three kilometers, (it will be five minutes) it needs to include additional drag and a larger distance when the satellite will endure, the time can be up to seven minutes.
In first prototype we used a parachute in the shape of a hexagon without a hole at the top, so it could not catch air properly and it had not fully unfold. The hole will have about 5cm diameter. The whole parachute has 55cm maximum diameter (D).



Scheme 6: Parachute diameter

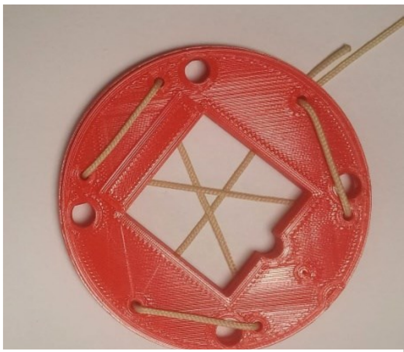


Photo 2: Parachute mounting to the top base

3.6 Ground support equipment

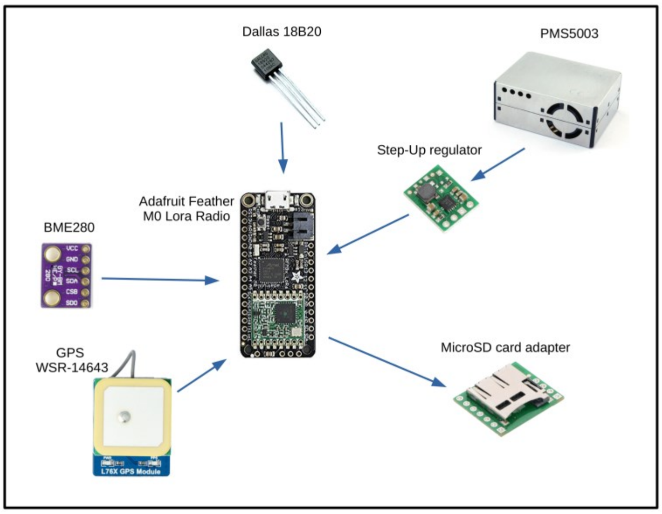
To collect the data we need, at the ground we will use:
- “Yagi” antenna cooperating with "Adafruit Feather M0 433mhz RFM96 LoRa radio"
-a laptop for live monitoring of collected data. It also be used for reading location of our CanSat landing.
- ground testing station containing the same sensors as in CanSat to compare the results

Antenna:
We are currently using makeshift transmitting antenna made of ¼-wavelength wire, (17,5cm).

We are using the receiving "Yagi" antenna, because by making many analyzes regarding the collection of the signal sent from the transmitter, we came to the conclusion that this antenna will suit best, it can be easily modified and adapted to our needs, it offers a relatively wide reception angle of signal, and receiving a weak signal over long distances, using a signal amplifier built into the receiving system.

Adafruit Feather M0 433mhz RFM96 LoRa radio is a system programmed to receive and proceess data from CanSat and to send data to the computer. This system consists of the Adafruit Feather M0 board and a built-in transmitter-receiver module (transceiver) that allows us to contact the device transmitting over long distances (stick program suction and translation)

In the ground station, we are planning to place a research station containing PMS5003, BME280, Dallas 18B20 sensors and a GPS module and SD card adapter. This will give us the opportunity to compare dust, pressure, humidity and temperature measurements from CanSat and measurements on the ground at the same time. Adafruit Feather M0 433mhz RFM96 LoRa radio will also be a computer in the ground station. All measurements will be saved to the SD card.



Scheme 7: Ground station scheme

We are planning to supply the ground station with a battery, which in turn will be charged constantly by the solar panel. This enables long, uninterrupted and stable work of the entire system. We are currently selecting models and parameters for the panel and battery. More information about ground station electricity power shown in chapter “3.3.4 Power supply”.

If time permits, we plan to build a system that will move the antenna so that it is directed exactly at our falling CanSat. The rotation angle and elevation angle of the antenna will be determined using CanSat GPS coordinates and ground station. For calculations we assumed that the Earth is a perfect sphere. The distance (in meters) between points for every 1 degree of latitude and longitude is calculated. Then the difference between the CanSat coordinates and the ground station is calculated and converted into length units (meters). The distance in a straight line is calculated from Pythagorean theory, and the angle of rotation and elevation are calculated using trigonometric functions. The distance determined on the basis of the algorithm differs by only about 307m at a distance of 100 km.The tracking

program is almost ready. We need to connect it with stepper motors and construct a transmission.
Our program on GitHub:

https://bit.ly/2rXugni

4. Test campaign

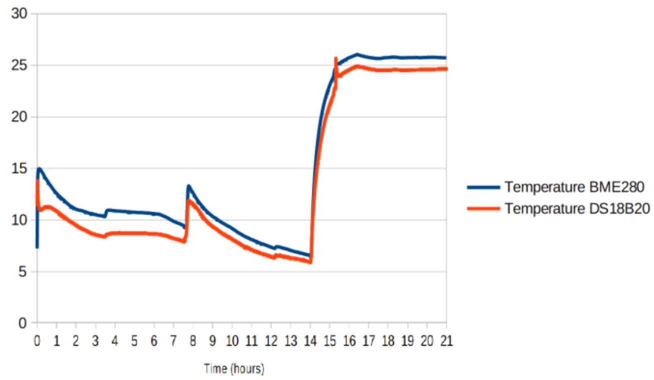
4.1 Primary mission tests

We intend to test our CanSat by dropping it from the observation tower in Sieków. In this way, we examine the strength of the cover and sensors and cable connections by dropping CanSat without a parachute. On the observation tower we will also check the correctness of the parachute and its attachment to the cover. In this way we will obtain large overloads comparable to those prevailing in the rocket.
We tested our sensors by connecting them and recieving data, which we compared to the other, more accurate sensors. The deviations were within the measuring error.
Durability and reliability: We dropped our CanSat from a height of about 8m (tower in Sieków) to check the strength of the entire structure and sensors inside. Thanks to this, we were able to achieve an overload comparable to those during the launch of the rocket, equal to 17G. All sensors survived and served their purpose. During the impact, the housing cracked, on which we later attached a sticker with our sponsors.
In addition to advertising for our donors, the sticker significantly strengthened the whole structure, so we could carry out several more drops.

We noticed a serious problem - the main switch interrupts electrical circuit and the whole system is reseted. We have an idea how to change the switch to solve this problem.

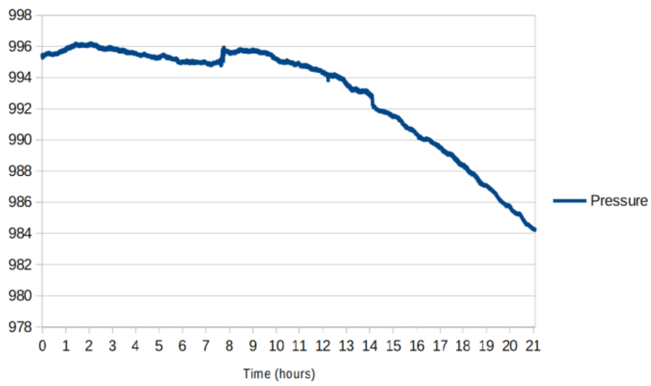
Photo 3 Broken cover after drop and sticker

During the tests of working time we collected data from some sensors:

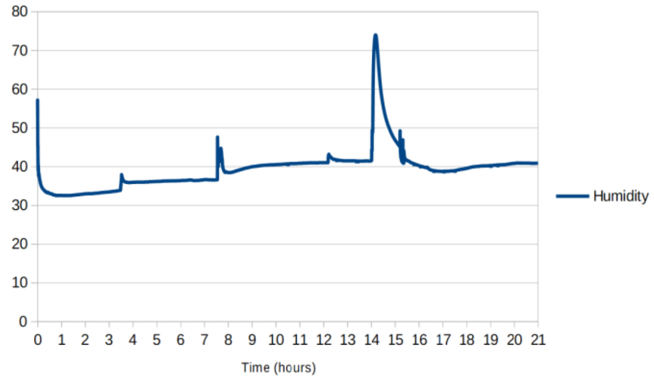


Graph 1:Temperature

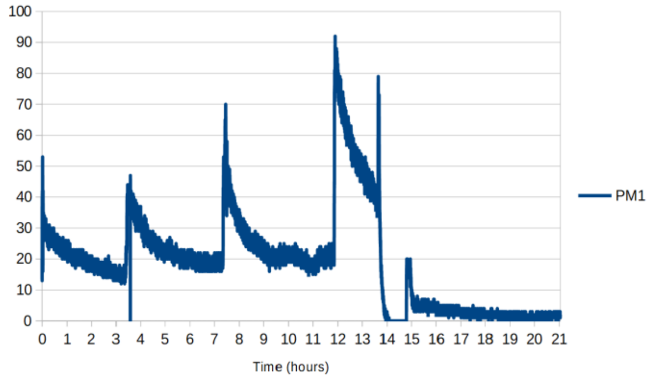
DS18B20 is outside temperature sensor, BME280 is inside temperature sensor. Higher temperature inside CanSat probably result from heat emitted by electronics.



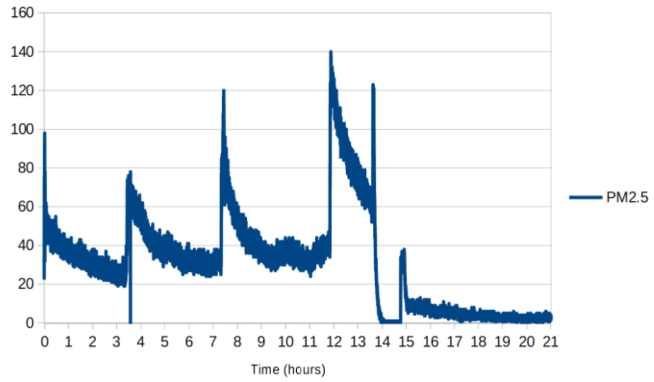
Graph 2:Pressure



Graph 3: Humidity

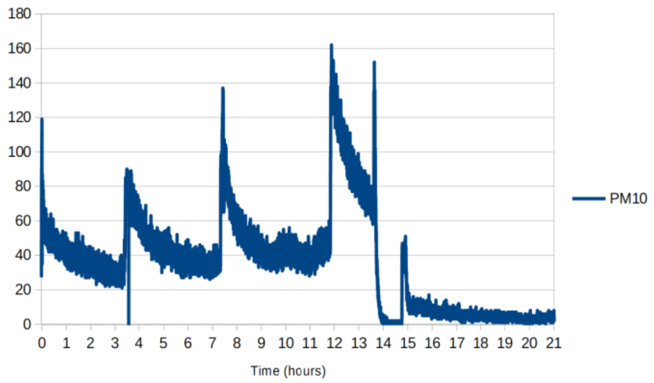


Graph 4: Air pollution PM1.0



Graph 5: Air pollution PM2.5

Graph 6: Air pollution PM10



The graphs may look a bit strange but this is due to CanSat's permanent relocation. (school, car, home, garden).

4.2 Secondary mission tests

We conducted the tests by turning the gyroscope in all axes, it shows in the Cartesian system the appropriate values. A minor error is occured due to the inaccuracy of the device. We tested both the PMS7003 and PMS5003 sensors - the data was practically the same, so we decided that PMS7003 will be located in CanSat (smaller and lighter)and PMS5003 in the ground station. The final test of the parachute and the entire CanSat software will be dropped with a drone, hang glider or even plane from a height of 500-3000m. We are planning to contact with the local aeroclub.

4.3 Tests of recovery system

The tests we were planning to do in two stages: the first stage involved checking the GPS module in the field, namely we will see GPS coordinates in several places and their compatibility with Internet map coordinates. In the second stage, We are planning to attach the parachute to a satellite model weighing 300-350 grams and make calculations and observation. When compared to the coordinates of online maps, it turns out that GPS gives exact coordinates despite the small number of satellites. The final conclusion is that the GPS made an error in the form of showing speed despite stillness, a height slightly different from the basic one by about 3 meters, it means that the module is not the most accurate, but it is sufficient for our purposes. Currently, we managed to drop the test model together with the parachute from the tower in Sieków from a height of 15m (we could not go higher because the wind was too strong). Our parachute did not have a hole in the middle, which was why it caught the air weakly and did not fully unfold. This is another element we must improve. You can find the video of our tests on our Youtube channel. The exact drop time is given in the description of each video.

Photo 4: Our antenna during tests

4.4 Communication system range test

The first tests were carried out using quarter-wave antennas made of ordinary copper wire. We managed to send a signal over a distance of 1.4 km. After building the receiving antenna, we conducted further tests. We managed to achieve a horizontal range of 6.4 km with a large supply of signal strength. The antenna will be in the future improved.

In our next test we mounted our CanSat at the top of the tower, moved away 1150, 3000 and 5550 meters and examined the quality of the received signal both when the antenna was directed at the tower and when we tilted it vertically and horizontally. We have prepared graphics on how the signal quality changes depending on the distance (0 means lossless signal, -127 means complete signal break,). The graphics below show what results we received.

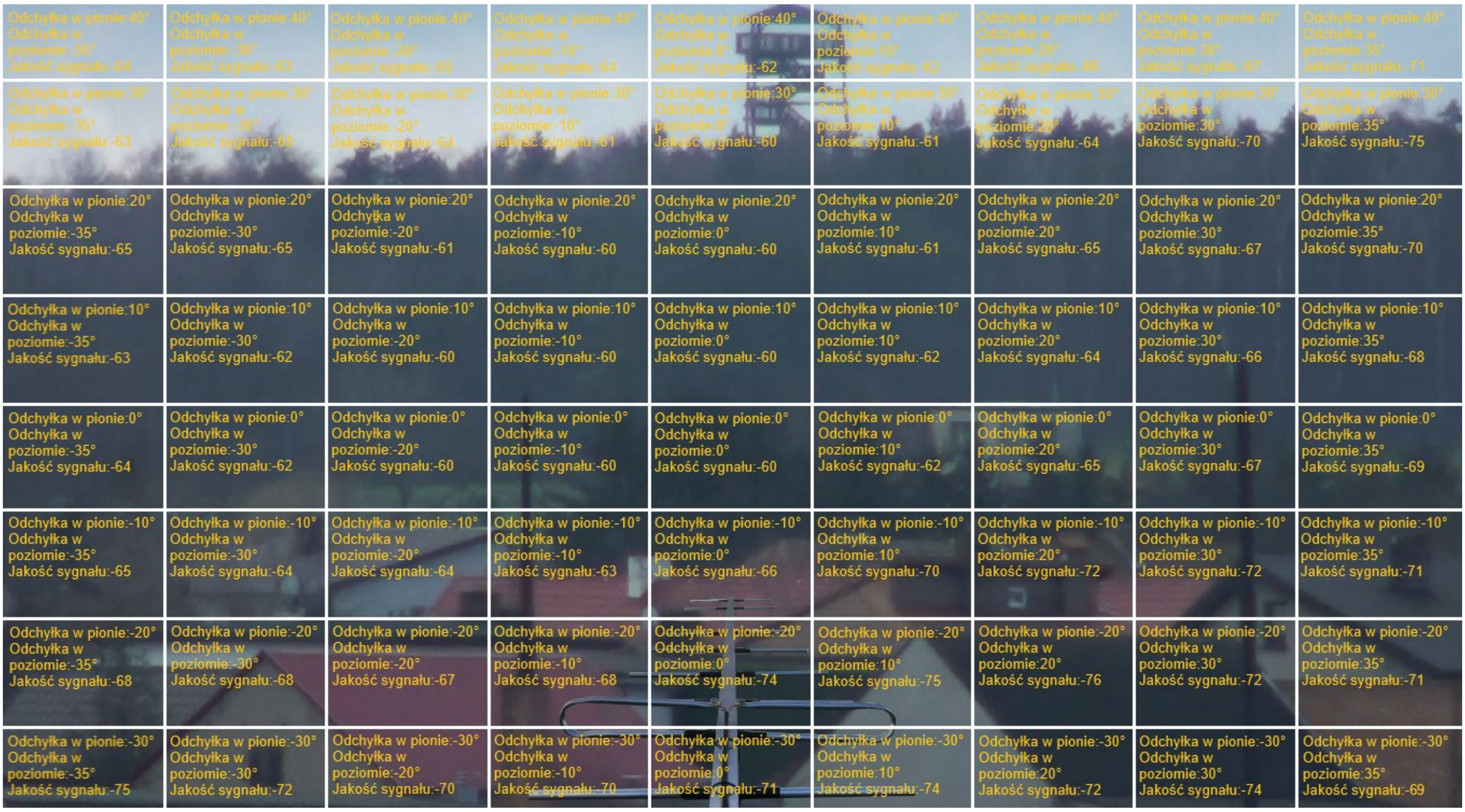


Photo 5: Signal strenght at 1150m

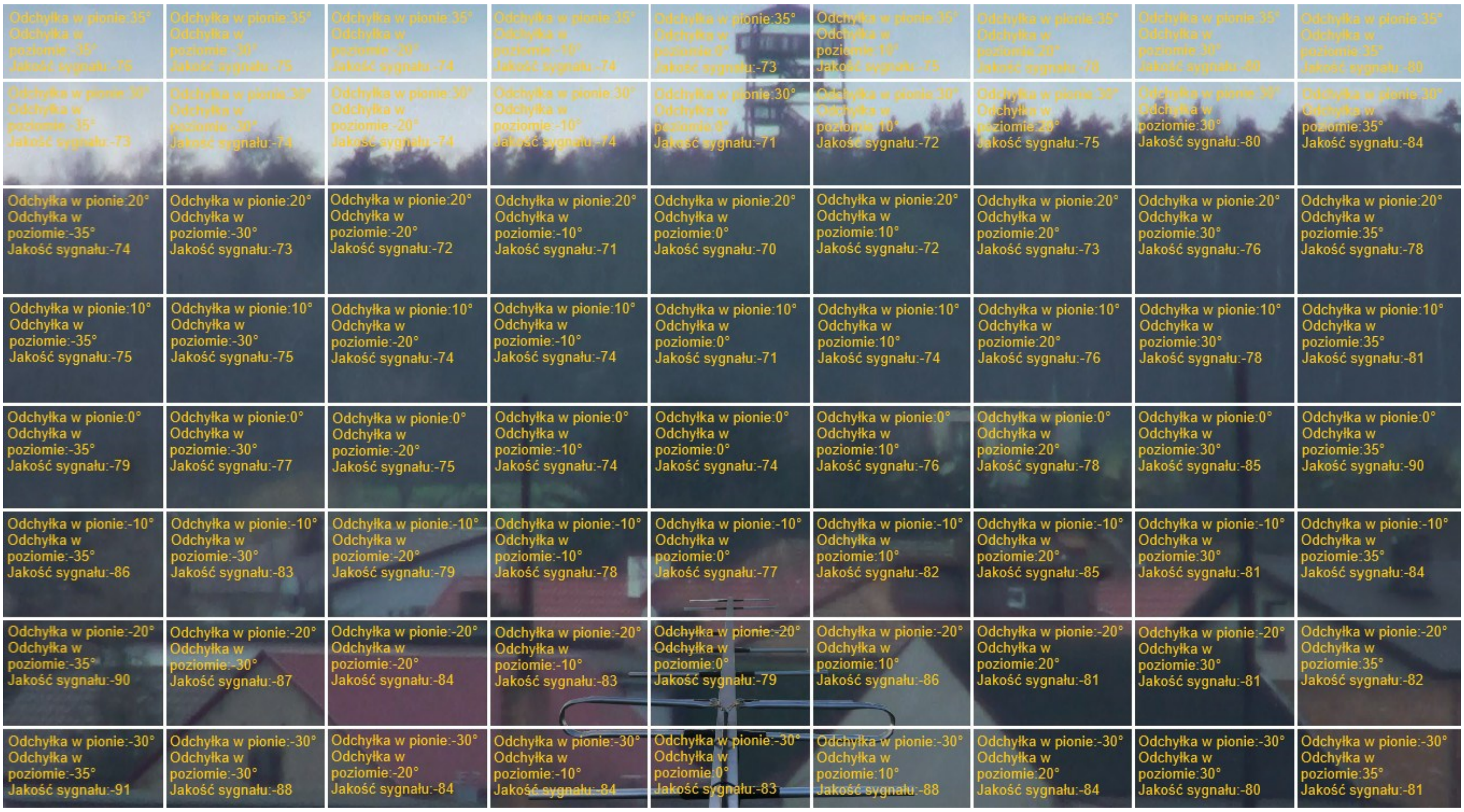


Photo 6: Signal strenght at 3000m

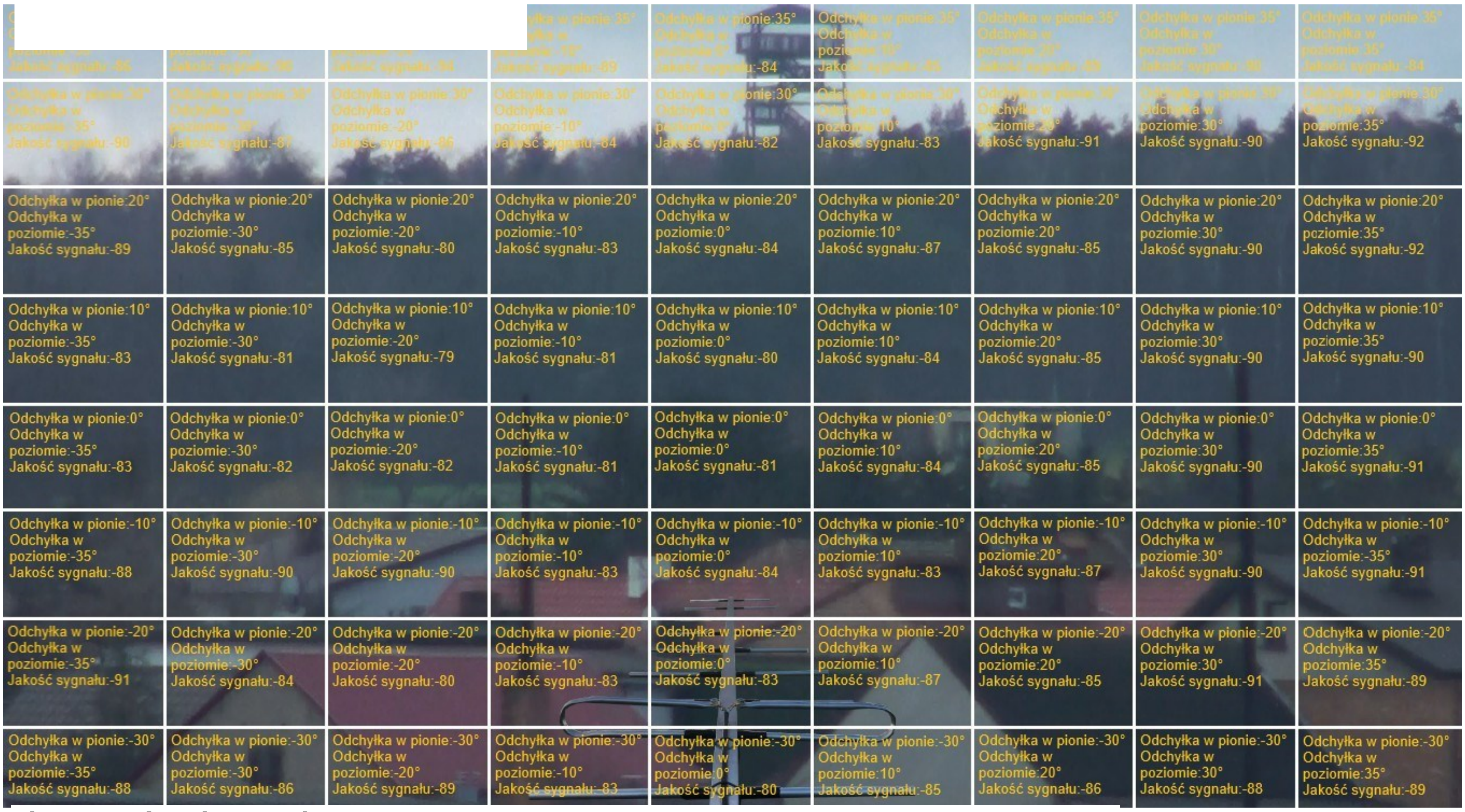


Photo 7: Signal strenght at 5550

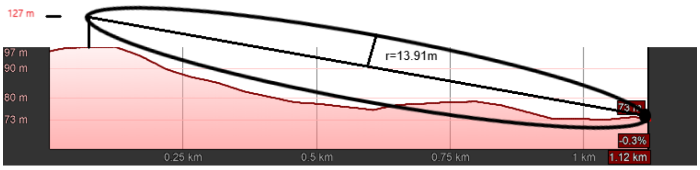
Note: "Odchyłka w pionie" means vertical antenna deflection, "Odchyłka w poziomie" means horizontal antenna deflection, "Jakość sygnału" means quality of the signal.

After this test we were turning antenna in random directions and we were checking the signal strength. We came to the conclusion that no matter how we turn the antenna, it will receive the signal anyway.

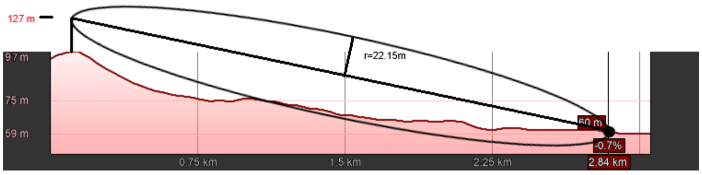
Photo 8: Our teammate turning antenna in every possible directionn

The Fresnel zone in radiocommunication is the area of propagation of the radio signal energy along the line connecting the transmitter and receiver. Objects such as hills, trees, buildings, etc. located in Fresnel zones have a large impact on wave propagation. In our case, we wanted to reduce the impact of the obstacles, so we went to an area with a large difference in elevation to map the conditions during the satellite flight as much as possible, when we have the entire Fresnel space at our disposal.

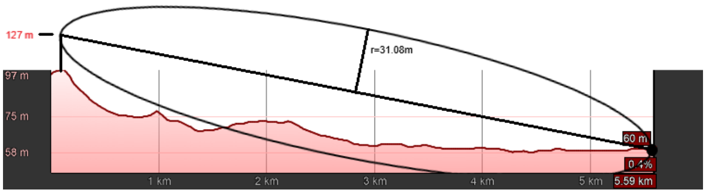
On the next page we present calculated Fresnel zones and landform during our measurements (in sequence 1150m, 3000m and 5550m):



Scheme 8 Fresnel zone for 1100m



Scheme 9:Fresnel zone for 3000m



Scheme 10: Fresnel zone for 5550m

4.5 Energy budget tests

Working time: We launched our CanSat with fully charged batteries. It performed all measurements at various temperatures. The power supply was disconnected (probably out of voltage) after 21 hours. After checking the data on the SD card, it turned out that it performed faultless work for just over 20 hours. After this time, the measurements were duplicated, sometimes it looked as if it hang and saved the same values all the time, it did not work properly anymore. We think that we made a mistake in the calculations because we assumed that he would work for about 6 hours. In further tests we will check how much power will every component take and we will know why is it working much longer than we expected (we expected 5-6 hours)

5. Project planning

5.1 Time schedule

Done:

Date	Activity
30.09-06.12.2019	Layout of CanSat construction
07.10-06.12.2019	Sensor connection
07-18.10.2019	Design power system
07.10-22.11.2019	Design 3D frame
10.10.2019-08.01.2020	Marketing activities
12.11-10.12.2019	Finding sponsors
25-29.11.2019	3D printing
02-06.12.2019	Implement power system
02-06.12.2019	Soldering entire system
04-06.12.2019	Assembly first prototype
07.12.2019	Tests of first prototype
09-16.12.2019	Analysis of collected data
10.12.2019-08.01.2019	Writing a running program and program upgrades
10-20.12.2019	Drawing conclusions
16.12.2019-08.01.2019	Fixing program to not hang (libraries)
23.12.2019-04.01.2019	Ground station plans
27.12.2019-08.01.2020	Creating CDR
02-07.01.2020	Parachute fixing
02-07.01.2020	Main switch fixes
02-07.01.2020	Improvements in the CanSat construction

Table 4: Things done

To do:

Date:	Activity:
06-17.01.2020	Ground station construction
09-14.01.2020	Development of water protection
07-10.01.2020	3D printing of second prototype
09-24.01.2020	Logo competition summary
13-14.01.2020	Second prototype assembly
15-15.01.2020	Working time tests
18.01.2020	Test drops
20-31.01.2020	Visualization of gyroscope operation
01.02-29.02.2020	A lot of tests
17-29.02.2020	CanSat manual writing
17-29.02.2020	Creating FDR
20-22.03.2020	Taking part in CanSat finals (probable date)

Table 5:Things to do

5.2 Task list

Done:	To do:
Layout of CanSata construction	Ground station (work in progress)
Some marketing activities (local newspaper, local radio and schools)	More marketing activities
Finding sponsors	A lot of tests and test drops
Writing a running program	Further program improvements
Sensor connection	Visualization of gyroscope operation
Design and implementation of the power system	Create manual of CanSat switching On/Off
Printing all elements on a 3D printer	Development of water protection
Soldering the entire system	
Assembly first working prototype	
Tests of first working prototype (measurement, falling with parachute, falling without parachute, long-time battery test)	
Analysis of collected data	
Drawing conclusions and plans for necessary corrections	
Exact ground station plans	
Parachute fixing	
Main switch fixes	
Some improvements in the CanSat construction	
Fixing program to not hang when one of the wires is broken	

Table 6 Time schedule

5.3 Resource estimation

5.3.1 Budget

Element	Cost (PLN)
Adafruit Feather M0 with RFM96 LoRa Radio	200
GPS	65
PMS sensor	100
AltiMU-10v5 (gyroscope)	90
Dallas 18b20 sensor	5
Bme 280 sensor	50
PMS adapter	10
4x battery	112
mechanics	50
Filament	20
Parachute	70
MicroSD Card Adapter	3
MicroSD Card	37
Together	812

Table 7: CanSat value

5.3.2 External support

Powiat Gostyński

Zespół Szkół Zawodowych w Gostyniu im. Powstańców Wielkopolskich

ZSZ Gostyń
Stowarzyszenie Absolwentów i Sympatyków

Lucyna Przybył
BIURO RACHUNKOWE

mondi

ArdaghGroup

4Lan.eu

MEBLE
JAROCIN GOSTYŃ

FMW

KORAL Sklep RTV
Tomasz Koralewski

6. Outreach programme

During the searching for sponsors and donors, we disseminated information about our activities among local entrepreneurs. According to the schedule, we will organize workshops for primary school students, this will be our participation in the promotion of the school. We are planning to have our own stand in the upcoming science picnic. In recent days we had a meeting with the starosta Gostyński, thanks to whom we received a large amount of funding. On our facebook we recorded more than 400 original users. In local newspapers ("Życie Gostynia, Fakty Powiatowe") were also published some articles about us and audition in local radio "ELKA Leszno". Two people from our team took part in the Climate Conference in Krobia, presenting our project and what does our school do to improve environmental protection. In our school there are screens presenting current events from school life. The photos from our test are also there.

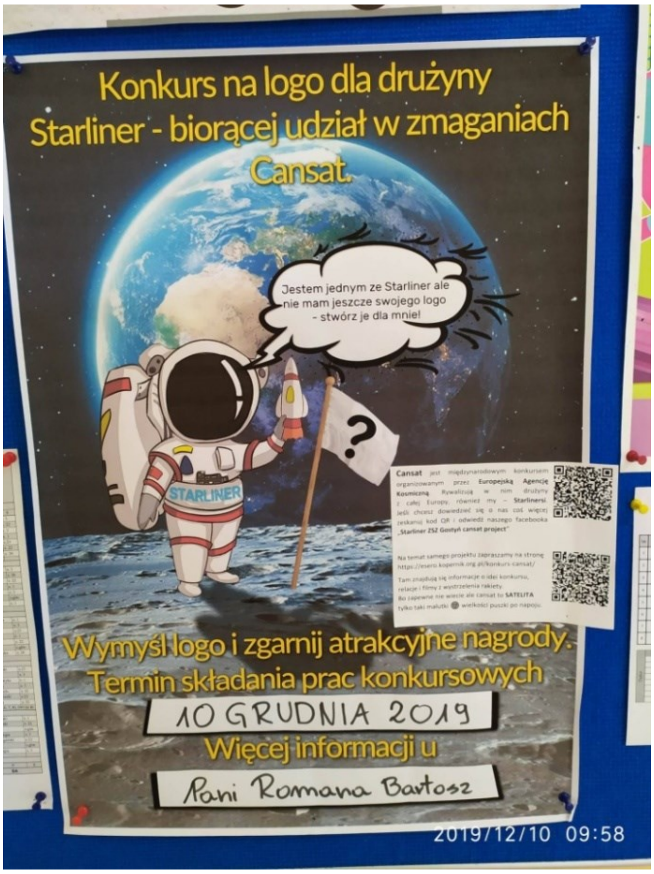


Photo 9: Poster informing about the competition

In local elementary schools, we ran a competition to design our logo. There were also QR codes referring to our Facebook page on the posters announcing the competition. We chose 2 works, one as our main logo (visible on the title page) and the other which will serve as the background on Facebook. In our time schedule, we planned the announcement of the winners and the distribution of prizes right after completing the CDR.

Our website:

https://bit.ly/2PIqxDv

Our facebook:
https://bit.ly/2tOgeVr

Our school website:
https://zsz-gostyn.com.pl

Our school facebook:
https://bit.ly/32cwHP1

Our Youtube channel, where you can find videos recorded during our tests:
https://bit.ly/2FlVirr

Articles about us:
https://bit.ly/35pUUmg
https://bit.ly/32cQTjq
https://bit.ly/2ZtcIf7

7. CanSat characteristics

CHARACTERISTICS	FIGURE
Height of the CanSat	113,5mm
Diameter of the CanSat	63,8mm
Mass of the CanSat	347g (we want 340g to have margin of error)
Estimated descent rate	10m/s
Radio transmitter model and frequency band	Adafruit Feather M0 RFM96 Lora with radio module 433Mhz
Working time on battery	20h of stable work
Cost of the CanSat	812PLN

Table 8: CanSat properties

8.Register: