Thora Storm videregående skole

Team NovaDomus

Short Project Description

The team

Role	Name
Team Captain	Tiril Svaasand Eliassen
Spacecraft Communicator (CAPCOM)	Aasmund Gabestad Nørsett
Senior Aerospace Engineer	Emilie Strømnes Meland
Failure Prevention Scientist	Sebastian Westerlund Kalland
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Senior Software Engineer	Tobias De la Plaza Domaas
Project Manager (teacher)	Adrian Heyerdahl

Did you know? The team name *Nova Domus* can be translated into "New Home". The name was chosen to fit our secondary mission and is derived from latin.

Introduction

Our CanSat team consists of six students from Thora Storm upper Secondary School in Trondheim, Norway. We are all second year students of the educational program *Sciencelinja*. Our interests range from programming websites, solving the rubik's cube, video games, cramming the periodic table, physics, creating cosplay, ballet, rock climbing, football and memorizing pi. With the guidance of our beloved project manager Adrian, we are all dedicated to conquer any storms headed our way.

Mission objectives

Primary mission

Our primary mission is to measure *temperature* and *air pressure*. These values will allow us to calculate the altitude of the CanSat at any given moment of the descent. The relationship between temperature, air pressure and altitude is given by the formula:

$$h = \frac{T_1}{\alpha}\left(\left(\frac{p}{p_1}\right)^{-\frac{\alpha R}{g_0}} - 1\right)$$

The formula contains 3 variables and 3 constants. T_1 and p_1 are temperature and air pressure at starting position. These variables can be measured before the launch. α is a constant of how temperature changes based on altitude in the troposphere, R is the gas constant for dry air and g_0 is the gravitational acceleration. Therefore, if the CanSat measures the current air pressure during the whole descent, we can calculate the altitude of the CanSat. The altitude will be useful when analyzing the values from our secondary mission, as it will allow us to know at which point during the descent the measurements were taken.

Secondary mission

- *What makes a planet sustainable for human life?*

Our secondary mission is to measure factors that are relevant to this question, and determine whether a planet is habitable.

Earth is the only planet we know of, so far, that can sustain life. Astronomers are currently searching for potentially habitable planets, and have found a couple, such as "Proxima Centauri b" and planets of the TRAPPIST-1 dwarf star. Ideally, they want to find planets just like Earth, since we know without a doubt that life took root here *(Greicius, 2017)*. We know that a planet's ability to sustain life as we know it, depends on a number of different factors. Some of these are explored below.

The Goldilocks Zone

The Goldilocks Zone is the range of distances a planet can be from its star where there is a possibility that liquid water can be found on the surface. Water would evaporate if the planet is too close to its star, and freeze if it is too far away *(Johnson, 2018)*. Thus, The Goldilocks

Zone is the place to look when searching for habitable planets. Our CanSat could become a cheap and accessible way to study planets that seem habitable. The main attribute of planets within this zone is that they *may* supply liquid water, which is one of the things our CanSat should be looking for.

Magnetic field

In addition, a planet needs to be big enough to have a liquid core. Earth's core gives us a source of geothermal energy. It allows cycling of raw materials, and sets up a magnetic field around the planet that protects us from radiation. To protect against solar winds and the charged particles that come with them, it is crucial to have a magnetic field. Without a magnetic field, a planet's atmosphere would be torn apart by its star. Mars presumably had a molten core, but as a result of its small size its heat dissipated more rapidly.

Atmosphere

A planet's atmosphere serves a multitude of different purposes. The atmosphere acts like a giant filter. It protects the planet's inhabitants by providing warmth and absorbing harmful solar rays. It also makes most meteoroids lose their kinetic energy before reaching the planet's surface. For example, Earth's atmosphere maintains the temperature on Earth and the Ozone layer acts like a shield that protects against harmful ultraviolet radiation emitted by the sun.

One of the most crucial aspects of Earth's atmosphere, which makes it possible for us to survive, is the presence of oxygen. It is theorized that it is possible to populate a planet without oxygen, for example Mars. But we still believe that an optimal target for interstellar colonization will have an atmosphere with oxygen. The atmosphere we are looking for therefore needs to contain chemicals vital for life such as oxygen and carbon dioxide.

The atmosphere also serves an important purpose as a medium for the water cycle. Water vapor evaporates out of oceans, condenses as it cools and falls as rain. This process sustains life and has a dramatic influence on Earth's climate and ecosystems. Without an atmosphere, the water on Earth would boil away into space, or remain frozen in pockets below the surface of the planet (*Kazmeyer, 2018*).

Components

We plan on building two different versions of a CanSat. The first version based on an *Arduino Uno* (or Teensy 3.5) will only contain the most crucial components; temperature sensor, pressure sensor, and an accelerometer. Ideally, we also want to build a more advanced version based on an *Arduino Mega 2560*. This version will include more measurements which will give us a more accurate representation of the planet's ability to sustain human life. The advanced CanSat may measure temperature, pressure, humidity, biologically essential gases, UVB and UVC radiation, and the magnetic field. We also want the advanced CanSat to contain a gyroscope and an accelerometer.

List of potential components:

- Temperature and pressure sensor (BME280 or the MPX5050D + MLX90614)
- Humidity sensor (Sparkfun HIH-4030)
- Gas sensor (MQ135)
- Oxygen sensor (Grove O^2 Gas Sensor)
- SparkFun UV Light Sensor Breakout (VEML6075)
- Photodiode UV 220-320NM TO46 (SD012-UVB-011)
- Ratiometric Linear Hall-Effect Sensor (OHS3151U)
- Triple Axis Magnetometer Breakout (MLX90393)
- 3 axis Gyro, Accelerometer and Compass (GY-91)

Competition requirements

The simple version of our CanSat will be made of a soda can, but the more advanced one will be 3D-printed. Both versions will meet the requirements regarding size, but the advanced version will probably have more mass because the shape allows it to contain more components. The simple version will therefore probably contain an additional ballast to reach the minimum mass limit required.

Both CanSats will fulfill the requirements from NAROM. They will include a parachute which will facilitate the landing and include a retrieval system. They will also operate with an easily accessible 9 volt battery (or 3.7V 1000 mAh battery) able to power our systems for 4 continuous hours and have an easily accessible master power switch. None of the CanSats will have a budget higher than the upper limit of €500.

Sources

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