Marshmallow

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***Abstract*– Marshmallow is a CanSat developed by EIRSPACE. It has the particularity to be made with a 3D printer. It will try to accomplish the "come back" mission by using a Nasa ParaWing controlled by servo-motors.**

I. Introduction

MARSHMALLOW is the first CanSat made by EIRSPACE, the aerospatial club of the ENSEIRB-MATMECA engineering school. It will accomplish the imposed mission (measuring temperature and altitude and send the data to the ground every 5 seconds) as well as 2 free missions: humidity and pressure measurement and the "come back" mission. This paper presents the CanSat, the team working on it and the project budget.

II. Context of Development

A. Club

Marshmallow is developed by members of EIRSPACE, the aerospatial club of the ENSEIRB-MATMECA engineering school, in Bordeaux. The club was created in 2010 and its aim is to design and build aerospatial projects such as miniature rockets, experimental rockets or Unmanned Aerial Vehicles. It has participated twice in the C'Space and this year, members will be launching their first experimental rocket and their first CanSat.

Fig. 1. Picture of the Marshmallow team.

B. Work plan

Anthony Bidault is the project leader and the mechanical manager. He designs the mechanical structure and the parachute of the CanSat and he is responsible of material supplies. John Nicot is the electronics manager. He particularly works on the GPS and the telemetry.

The CanSat development benefits from the engineering school structure. The club gave two projects related to Marshmallow to ENSEIRB-MATMECA students: the position control and the sensors implementation. These projects were supervised by the team and by teachers and are part of the evaluation of the students who participated in them.

C. Budget

Table 1. Marshmallow's budget

Reference	Description	Quantity	Total (€)
HIH-5031	Humidity	1	17
MPXA6115AC6U	Pressure	1	12
AD22100KRZ	Temperature	1	6
FMP04-TLP	GPS	1	20
XBEE	Transmitter	2	60
Lilypad Arduino	Processor	2	40
Arduino Usb2Serial Converter		1	13
Programming cable		1	2
Lithium 850mAh	Battery	1	15
Turnigy XGD-11HMB	Servo motor	2	10
		Total (€)	195

EIRSPACE finds its funding in its partners and sponsors. This year, the club has gathered more than 6000€ for its projects.

III. Definition of the Missions

A. Scientific Mission

Marshmallow will measure its altitude and the atmosphere temperature and will transmit these data to the ground every 5 seconds. It uses a AD22100KRZ sensor to measure temperature. To determine the altitude, it measures the pressure with a MPXA6115AC6U sensor and then calculates the altitude with an Arduino LilyPad using (1).

$$z = c \times T \times \log(\frac{P_0}{P}) \quad (1)$$

Where z is the altitude, c is a constant, T is the temperature, P_0 is the pressure at sea level and P the pressure at z. [1]

B. Free Mission

Marshmallow performs two free missions. The first one consists in gathering data about humidity and pressure variation during the flight and storing them into a SD card. The sensor used for humidity measurement is a HIH-5031 and the pressure sensor is the one used in altitude determination.

The second free mission performed by Marshmallow is the "come back" mission. It consists in landing as close to a given

target as possible. In order to execute this mission, Marshmallow measures its position with a FMP04-TLP GPS. It then controls two Turnigy XGD-11HMB servo-motors attached to the parachute's rope, to correct its trajectory. The parachute used is the Nasa ParaWing detailed in part IV.

IV. CanSat Architecture

A. Electrical architecture

Marshmallow is composed of several boards:

-A power board that converts the energy from a 7.4V battery, to fit the different voltages used by each sensor

-One Arduino LilyPad is dedicated to measurement handling and telemetry. Another one is dedicated to the parachute control.

-A board for the sensors used in each mission

-A board for the GPS, the XBEE and the SD card

B. Mechanical parts

1) Shell

Marshmallow's external structure is created with a 3D printer. It is made with polylactic acid (PLA) which offers enough rigidity for a low weight. It is designed to respect the required dimensions and to allow an easy assembly and an easy disassembly of the CanSat. The lid will hold the servo motors and will prevent the electrical architecture from moving inside the CanSat.

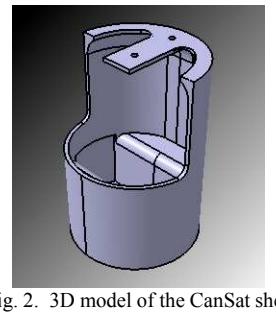

Fig. 2. 3D model of the CanSat shell.

2) Parachute

The parachute used by Marshmallow is a Nasa ParaWing. It is a controllable wing created by NASA for the atmospheric re-entry of Gemini capsules. [2]

Fig. 3. Picture of a flying Nasa ParaWing

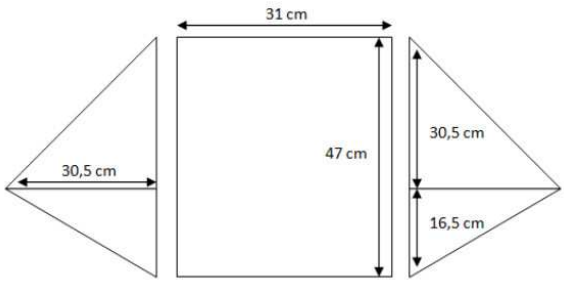

Fig. 4. Dimensions of the Nasa ParaWing

It has 18 lines on both left and right side, linked into 2 lines that will be manipulated by the CanSat.

C. Telemetry

The CanSat will use a XBEE module to send its measurement to the ground. The emission frequency will be 2.4GHz and the power will be between 10 and 60mW. Another XBEE will be use to receive data.

V. Conclusion

At this time, Marshmallow's parachute and shell are finished. The algorithm of the parachute control has been tested and validated on a fictive trajectory. The sensor board is also completed. Every component has been bought.

During the three following months, the team will finish the remaining boards and test the whole CanSat in order to be ready for the D-day.

Acknowledgment

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We also thank our sponsors [3] and of course Planète Sciences and the CNES.

References

[1] http://en.wikipedia.org/wiki/Altimeter
[2] http://freedom2000.free.fr/NPW_index_eng.html
[3] http://eirspace.fr/partenaires