N6K'n'Sat: The BUDSTAR Mission has now begun.

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***Abstract*– Our aim in the CanSat competition is to create a probe that can land on a given point of the ground. Meanwhile different sensors would gather information of the environment: the pressure, the temperature and also a video record of the flight. This competition is also a way to implements different skills learn during our engineering coursework and to enjoy a great team spirit during the best and the worst moments of this adventure.**

I. Introduction

OUR CanSat is an upgrade of two Cansat experimented last year by the BudStar team. The first one allowed our predecessor to win the competition, the other one was a horizontal configuration with two servo-motors. We decided to keep the first vertical configuration but to implement the guidance system of the other one. Our missions are the Come Back Mission, the Flight Video Capture and the P-T data collecting.

II. Context of Development

A. The team

Our team was build up in purpose of completing a 2ed year project mandatory by our school (ISAE-ENSICA). Nevertheless the participation to the competition was an initiative (the CSpace being after the end of our second year).

The team is composed of second year students of the ISAE-ENSICA based in Toulouse (see Fig. 1 from left to right):

- Aurelien Belnou: Specialized in Digital Electronics.
- Pierre Bonijoly: Specialized in Systems Control.
- Xavier Guihot: Specialized in Computer Sciences.
- Victor Migeon: Specialized in Fluid Dynamics.

More than being in the same class, we are also a group of friends, which allowed us to work outside the school on the project. It is the fourth participation of our school to the Cansat.

Fig.1. Picture of the N6K'n'SAT team.

B. Work plan

We start our experience in October. A planning was imposed by our school. At the beginning we benefit from the help of last year team. Indeed, for time and budget reasons, we chose to upgrade their Cansat. We first had to learn how to use their system, to understand.

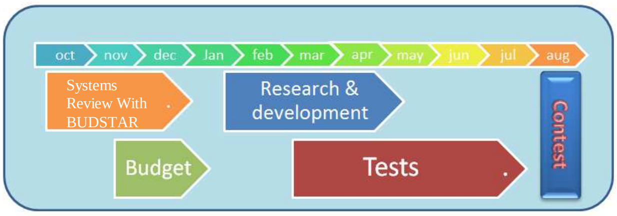

Fig. 2. Planning

After that we shared the different tasks. Pierre and Aurelien were in charge of the electronic (pining, circuits and components), Xavier worked on the processor code and on the guiding control loop with Victor who was also in charge of studying the ParaWing features.

When we finally reach the test step we had a major issue with the old electronic system. We decided to implement some tests (wing and structure) and to rebuild the electronic in parallel (as we can see on fig 2. the development step lasted during the tests step).

C. The Budgets

Financial Budget	**Cost**
2 Xbee Interfaces	14€
Xbee(Pro Wire Antenna ZB Serie 2)	33€
Xbee(Pro 50mW U.FL connection ZB Serie 2)	33€
2 servo HiTEC HS-5S	48€
Epoxy resin	50€
Arduino Mini Pro 5V	40€
20 Channel EM-406A SiRF III Receiver with Antenna (GPS)	46€
Total	**264€**

Tab.1. Financial Budget

Our project was entirely financed by ISAE and also the ISAE-SUPAERO Foundation except for the bill of expenses paid off by Planet Science.

III. Definition of the Missions

A. Scientific Mission

During its fall the CanSat records atmospheric data like temperature, pressure. Measurements are sent in real-time to a ground station via a communication system and also recorded on a SD memory card. This configuration offers a redundancy in case we lost the communication link or the CanSat itself.

B. "Come back" mission

The CanSat will land on a target defined by its GPS coordinates. It is composed of two servomotors that can pilot the wing using 4x2 wing strings as described in the IV. CANSAT ARCHITECTURE.

C. Flight recording

The CanSat is able to film the ground with an on-board camera. The images could be got back after the end of the flight to analyze the stability of the can. Moreover, this record can also provide some information about topography of the field.

IV. CanSat Architecture

A. General electronic structure

Our CanSat CPU is an arduino mini pro 5V; with an Atmega processor; it manages the other components: 2 servos, a XBee (the transmission unit) which sends information to the ground station, a GPS and a pressure and temperature sensor.
Several regulators control the tension.

B. Mechanical parts

The structure has been made by a 3D printer. We designed it on Catia. The servos are isolated from the electronic thanks to a compartment and a little door fixed by a rubber band so that they can work without being blocked by any electric wire.
There are locations to fix the GPS, the servos and the XBee. Holes on the top of the CanSat permit to attach the strings of the wing. Four wires are fixed to the servos, two on each servo. We decided to control the strings on the back of the wing because they are the ones which permit a better control.

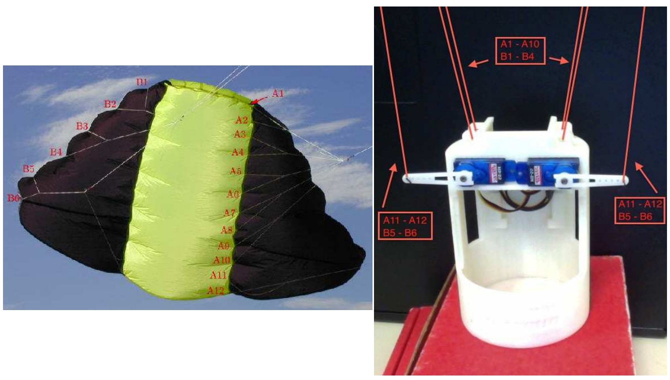

Fig.3. Strings Configuration

We also realized an extern structure made of fiberglass to protect the CanSat during our tests.

C. Telemetry

CanSat is equipped with an Xbee Pro Serie2 emitter transmitting at 2.5GHz a power of 10mW, which allows the communication between the CanSat and the ground station with a 300m of maximum range.

Each second the CanSat sends a frame to the ground station containing data flight: time, pressure, temperature and positions.

The ground station is equipped with a Java home-made application that acquires and plots all the data in real-time. Once the transmission ends, it is possible to save the data table in order to replay the flight later.

D. Type of parachute

The key word of the parachute is "reliability". This implies it has to be as simple as possible. The parachute must fulfill three requirements:

- it has to open in 100% cases;
- it must fly at least at 5m/s;
- it must be controllable.

The finally chosen configuration is NASA ParaWing 5, a single layer sail developed in the 60's by NASA for Gemini capsules. It is very simple and easy to build and to modify according to tests results.

The control is made with a single servomotor that rotates the CanSat below the parachute: it reacts like a tilting microlight, by shifting its center of gravity.

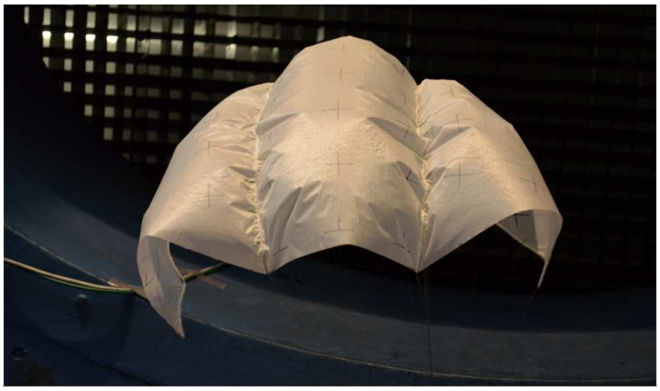

Fig.4. Stability and Piloting test in wind tunnel

V. Conclusion

Today we are testing all the CanSat systems and experiencing different flight attitude control loops. Meanwhile, we also design new electronic boards in order to optimize the voltage and the integration process.
Another team in our school is building a solar balloon and we hope to launch the CanSat at 150m high but the weather is not optimal those days.

Acknowledgment

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