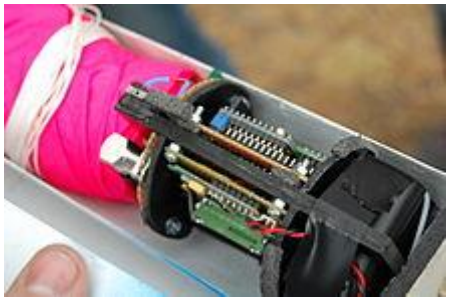
2016
UoB CanSat Competition
Guidelines



Internal mechanism of CanSat

Table of contents

1 INTRODUCTION

This competition is based on a competition that the European Space Agency runs for sixth form students. You are going to do it in a much shorter time and we will hope for even greater things!

A CanSat is a simulation of a real satellite, integrated within the volume and shape of a soft drink can. The challenge for the students is to fit all the major subsystems found in a satellite, such as a payload (the bit that makes the mission worthwhile), power, sensors and a communication system, into this minimal volume. The CanSat will then launched to an altitude of 120 metres by a UAV and its mission begins: to carry out a scientific experiment and achieve a safe landing.

CanSats offer a unique opportunity for students to have a first practical experience of a real space project. You will be responsible for all aspects: selecting the mission objectives, designing the CanSat, integrating the components, testing, preparing for launch and then analysing the data.

Fig. 1: The Flying DutchCan - a CanSat from the 2012 European CanSat competition

2 COMPETITION OVERVIEW

The UoB CanSat Competition will consist of four phases:

1. Call for teams and team selection
2. Basic build and payload selection
3. Payload design, build and test
4. Launch campaign

2.1 Call for teams and team selection

Teams are reviewed against certain selection criteria and 5 teams will be selected for the UoB competition.

Eligibility

- The team should comprise 5 undergraduate students.
- The team members must be enrolled as full-time students.
- The students shall be available on the 8th/9th October and 15th/16th October.
- A completed team application must be submitted to this address: https://goo.gl/forms/yZHNdRnL9EDJc9Eo1

  before **5pm Wednesday 5th October 2016.**

Selection

If the competition is oversubscribed, the selection will be based on a paragraph written by the team on why they should be selected, to include relevant experience of team members and ideas for secondary payloads.

At least some members of the team should be willing to act as mentors for Secondary schools in the Bristol area running similar projects either this year or next. The time commitment will not be onerous.

2.2 CanSat construction and test activities

Students are encouraged to follow an accelerated version of a space project lifecycle as follows:

- Selection of mission objectives
- Definition of requirements
- Design of hardware and software
- One or more reviews of the design (leading to design refinement)
- Integration and testing
- Launch and operations

- Data analysis and reporting of results (a 5 slide presentation is expected at the end)
- Outreach and dissemination

2.3 **Competition launch campaign and prize event**

The highlight will be the competition launch campaign, where each CanSat will be launched by a drone.

The site for the launch event will be the UoB farm at Long Ashton. We plan to use a drone to drop the CanSats (with parachutes attached) from around 120 metres height.

Drone flights are subject to strict legal and safety requirements, which will be adhered to by our specially trained pilots.

Fig. 2: Students track their CanSat during its descent

A presentation on the results from the launch is required from each team. The competition winners will then be chosen based on the team's performance throughout the project, as well as the final flight operations and results.

2.4 **Timeline**

Please see Table 1.

Phase 1: Call for teams and team selection	
Activity	**Deadline**
Call for teams opens in Welcome Week	19th September
Deadline for application forms	17:00 5th October
Announcement of selected teams	09:00 7th October

Phase 2: CanSat construction and test activities	
Activity	**Timing/deadline**
1st build phase, building and testing ground station and satellite kits (soldering skills will be useful but not necessary)	09:30-13:30 8th October
Deadline for definition of list of parts for payload procurement by SEDS (up to £30) for each team	24:00 9th October
Design and programming of satellite and payload	8th October – 14th October

Phase 3: CanSat Payload construction and test activities	
Activity	**Timing/deadline**
2nd build phase, building and testing of payload with satellite/ground station	9:30-17:00 15th October

Phase 4: Competition launch campaign and post-flight activities	
Activity	**Deadline**
Competition launch campaign	17:00 15th October
Alternative launch	09:00 16th October
Presentation of results	15:00 16th October
Prize ceremony	16:00 16th October

Table 1: Timeline of competition

Fig. 3: A selection of CanSats from the 2012 European CanSat Competition

3 CANSAT EQUIPMENT AND ASSEMBLY

3.1 CanSat kits

Designing and building a Satellite from scratch is a challenging prospect for students with no prior experience. For this reason, our teams will start with a CanSat kit, which already contains the basic elements, and adapt it to their own requirements.

A CanSat kit will contain:

- A main circuit board comprising an Arduino micro pro controller, pressure and temperature sensors and a radio, plus necessary connectors and interfaces. These are manufactured by QBCan who have a forum which you are welcome to post (politely) on.

Other equipment provided will be:

- A parachute (construction of your own parachutes is not allowed)
- Cord for attaching the can to the parachute
- The hook for attaching the CanSat system to the drone
- A ground station for testing (2 of these will be shared between the 5 teams)
- Instructions for assembly and Arduino library test software

The teams will need to design and build:

- mechanical structure and mounting components
- the secondary payload – an experiment eg: accelerometers, camera, GPS (see below).

Some knowledge of soldering would be helpful, but don't worry if you don't have any. There are some excellent videos as part of the EEVblog soldering tutorial. Part 1 covers the equipment, Part 2 covers through-hole soldering techniques and Part 3 covers surface mount soldering. You will need to design the mechanical structure and support. You can use cans and/or 3D printing (please do this Mon-Fri). Some 3D print models are available here but they may not be suitable for your payload.

Fig. 4: The Canduino 3D printed model

3.2 **Primary and secondary CanSat missions**

3.2.1 Primary mission

The team shall build a CanSat and program it to accomplish the compulsory primary mission, as follows:

After release and during descent, the CanSat shall measure the following parameters and transmit the data as telemetry, at least once every second, to the ground station:

- Air temperature
- Air pressure

The kit includes pressure and temperature sensors to do this. It must be possible for the team to analyse the data obtained (for example, make a calculation of altitude) and display it in graphs (for example, altitude vs. time and temperature vs. altitude).

3.2.2 Secondary Mission

The secondary mission for the CanSat must be selected by the team. It can be based on other satellite missions, a perceived need for scientific data for a specific project, a technology demonstration for a student-designed component, or any other mission that would fit the CanSat's capabilities.

Some examples of missions are listed below, but teams are free to design a mission of their choice, as long as it can be demonstrated to have some scientific, technological or innovative value. Teams should also keep in mind the limitations of the CanSat mission profile, and focus on the feasibility (both technical and administrative) of their chosen mission.

Some example secondary missions:

1. Advanced telemetry

After release and during descent, the CanSat measures and transmits additional telemetry to that required for the primary mission, for example:

- Acceleration
- GPS location
- Radiation levels

2. Telecommand

During descent, commands are sent from the ground to the CanSat to perform an action, such as switching a sensor on and off, changing the frequency of measurements, etc.

3. Planetary probe

The CanSat simulates an exploration flight to a new planet, taking measurements on the ground after landing. Teams should define their exploration mission and identify the parameters necessary to accomplish this.

3.3 **CanSat Requirements**

These requirements have been adapted from
http://esamultimedia.esa.int/docs/edu/2016_European_CanSat_Competition_Guidelines.pdf

The CanSat hardware and missions must be designed to the following requirements and constraints:

[1] All the components of the CanSat shall fit inside a standard soda can (115 mm height and 66 mm diameter), with the exception of the parachute. An exemption can be made for radio antennas and GPS antennas, which can be mounted externally (on the top or bottom of the can, not on the sides), based on the design.

[2] The antennas, transducers and other elements of the CanSat shall not extend beyond the can's diameter until it has left the launch vehicle.

[3] The mass of the CanSat shall be between 170 grams and 250 grams. CanSats that are lighter must take additional ballast with them to reach the 170 g minimum mass limit required.

[4] Explosives, detonators, pyrotechnics, and flammable or dangerous materials are strictly forbidden. All materials used shall be safe for the personnel, the equipment and the environment.

[5] The CanSat shall be powered by a 9V battery and/or solar panels. It must be possible for the systems to be switched on for two continuous hours.

[6] The battery shall be easily accessible in case it has to be replaced / recharged.

[7] The CanSat shall have an easily accessible master power switch.

[8] The CanSat shall be designed so that the payload and structure can be separated easily from the rest of the electronics, so that the QBCan kit can be reused.

[9] The CanSat shall be designed so that the QBCan kit and payload has highest possible chance of surviving landing.

[10] The CanSat shall be able to withstand an acceleration of up to 20 g.

[11] For ease of ordering, all refundable payload components shall be selected from the online catalogue at Cool Components.

[12] The selection of payload components to be ordered shall be sent to Richard Meadows (rm13361.2013@my.bristol.ac.uk) by 24:00 Sunday 9th October.

[13] The CanSat shall be flight-ready upon arrival at the launch site. A final technical inspection of the CanSats will be done by authorised personnel before launch.

4 EVALUATION AND SCORING

The teams will be evaluated on an ongoing basis, with the following items being taken into account:

4.1 Educational value

For this item, the jury will consider the quality of the team presentation, the level of effort made by the team and how much the team appear to have learned throughout the project.

4.2 Technical achievement

Innovative aspects of the project will be judged, for example: the mission selected and the hardware/software used. It will be also taken into account how the teams obtained the results, how reliable and robust the CanSat was and how the CanSat performed. If the CanSat did not succeed in accomplishing the missions but the team is able to explain the reasons why and suggest improvements, it will be also taken into account positively.

4.3 Teamwork

The jury will assess how well the team worked together on the assignment, the distribution of tasks, the planning and execution of the project and the team's success in obtaining the necessary funding, support and advice.

4.4 Safe Landing and Reusability

Reuseability is the latest launch buzz word! The jury will assess how safely the CanSat lands and whether the components are suitable to be reused for the next competition.

4.5 Marking scheme

1 Educational value	10%
2 Technical achievement	50%
3 Teamwork	20%
4 Safe Landing/Reuseability	20%
TOTAL	**100%**

5 COSTS

This section outlines the costs for the competition.

UoB will pay for:

- One basic Cansat kit per team
- Parachute and cord
- Payload components to the value of £30. A list of parts from must be sent to Richard Meadows (rm13361.2013@my.bristol.ac.uk) by 24:00 on Sunday 9th October.
- Transport to and from the launch site. The minibus will leave Student's union at 16:00 on Saturday 15th October or 08:30 on Sunday 16th October.

The students are responsible for:

- Any additional electronic equipment required for the secondary mission or ground support
- Supplying any 9V batteries required
- Any other costs incurred by the team not specified above
- Returning all equipment at the end of the competition (we recommend you take photos and videos to record your designs).

6 CONTACTS AND FURTHER REFERENCE

All questions should be directed to:

Questions on logistics, minibus and ordering of components:
Richard Meadows
Email: rm13361.2013@my.bristol.ac.uk

Questions on applications and selection:
Dr Lucy Berthoud
Email: lucy.berthoud@bristol.ac.uk

Further Reference:

CanSats in Europe Portal http://www.cansat.eu
CanSats on Wikipedia: https://en.wikipedia.org/wiki/CanSat
Training videos: http://esero.ie/project/cansat-201516/

Fig. 5: Participants of the 2012 European CanSat Competition, 22-26 April 2012, at Andøya Rocket Range, Norway