Space Universities Network
Supporting the Space Higher Education Community

Express CanSat

Extra-Curricular CanSat competition in 3 weeks - University of Bristol

Summary

The University of Bristol have run an extra-curricular competition to design a satellite in a sodacan, or "CanSat" using a predesigned kit over a few weeks. 5 groups of 5 students entered, soldered together a basic CanSat, designed and built payloads, then launched the CanSats one by one with a parachute from a drone at 120m.

Aims/Objectives

CanSats offer a unique opportunity for students to have a first practical experience of a real space project. Students are responsible for selecting the mission objectives, designing the CanSat payload, integrating the components, testing, preparing for launch and then analysing and presenting the data.

What was the context / background?

The University of La Sapienza, Rome, suggested to us that organising a CanSat competition is an enjoyable way to give students the experience of satellite design. There is an AAS international competition at student level where the students work all year on a project. We wanted to run a shorter project as a pilot. There is an ESA competition for school students 14-18 which also runs all year long but has previously used an electronics board manufactured by the UK company OpenCosmos called 'QBCan'. We decided to use this QBCan kit to help compress the project into a shorter timescale and make it possible for a student society to run the project (links provided at the end).

How was it organised and who was involved?

This was a staff-led, extra-curricular competition. After the first year of running it, it was handed over to the University of Bristol SEDS branch to organise (with some support). The process we went through to organise the CanSat competition was:

- Secure funding for QBCan kits, and procure them

- Organise staffing (a mix of permanent staff and PhD students) of soldering and launch day
- Plan timetable
- Advertise and select teams (we were oversubscribed)
- Run a soldering morning to assemble and test the QBCan modular kits
- Ask for a payload specification list from students and order the components
- Run a payload testing morning
- Run a launch day to drop the CanSats from the drone (good weather needed)
- Run a presentation session for students to present their findings

What resources did you need?

Costs included 5 QBCan kits+1 spare, 2 ground stations (documentation from OpenCosmos)

Budget for payload for each CanSat from Faculty (£25 each team for five teams)

2 RocketMan parachutes £30 each (these are high quality ballooning parachutes)

Drones which can carry 400g, plus hook which can be remotely triggered to drop CanSat

Staff and PhDs to supervise activities (soldering required staff supervision)

Describe the activity (Max 1000 words)

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 was to fit all the major subsystems found in a satellite, such as a payload, power, sensors and a communication system, into this minimal volume. The CanSat was then launched to an altitude of 120 metres by a UAV and its mission began: to carry out a scientific experiment and achieve a safe landing.

The UoB CanSat Competition consisted 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

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

Figure 1. A selection of CanSats [Image credit: ESA]

1. **Primary Mission**

The team were to 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 QBCan kit includes pressure and temperature sensors to do this. The team needed 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).

2. **Secondary Mission**

The secondary mission for the CanSat was selected by the team. It could be based on other satellite missions, a need for scientific data, a technology demonstration for a student-designed component, or any other mission that would fit the CanSat's capabilities. Some examples that the students tried were: camera and raspberry pi, soil moisture sensor, deployable legs, GPS and rate sensors.

3. **Competition launch campaign**

The highlight was the competition launch campaign, where each CanSat was launched by a drone. The site for the launch event was the University farm at Long Ashton. We used a drone to drop the CanSats (with parachutes attached) from around 120 metres height into a large field (see photo below). The drop allowed for approx. 20s of flight time. Drone flights are subject to strict legal and safety requirements, which were adhered to by our specially trained pilots.

Useful links:

QBCan Instructions for assembly and Arduino library test software

CanSats in Europe Portal http://www.cansat.eu

Instructions were adapted from the following esa website:

http://esamultimedia.esa.int/docs/edu/2016_European_CanSat_Competition_Guidelines.pdf

CanSats on Wikipedia: https://en.wikipedia.org/wiki/CanSat

Training videos: http://esero.ie/project/cansat-201516/

Payloads were bought at Cool Components

A presentation on the results from the launch was required from each team. The competition winners were chosen based on the team's performance throughout the project, as well as the final flight operations and results. Criteria used were: technical achievement, teamwork, safe landing, educational value.

Has it been evaluated? What feedback have you had?

Feedback from the students included the following comments:

"As a computer science student, it was nice to gain experience with physical hardware"

"Great experience, good opportunity to gain knowledge relevant to industry and alot of fun"

"I learned about the importance of testing and manufacturing constraints - absolutely awesome project"
"Amazing experience. Would love to help out next year!"

Key Learning Points

There were some significant lessons learned:

- 2 weeks was too short a time for the students. In the next iteration we extended it to 4 weeks.
- A backup launch window was planned (and used).
- Launching 5 CanSats took 3hrs, so plenty of time is needed at launch site.
- The students needed help with packaging/supporting their payloads. The next time, general AAS advice on electronics packaging will be distributed.

Thematic Categories (tick any that apply to your case study)

Method		Topic	
Online Text and Notes	☐	Orbits and Trajectories	☐
Assessment Materials	☐	Rocket Propulsion	☐
Video and Audio Lectures	☐	AOCS/ADCS	☐
Lecture Slides	☐	Payloads	x☐
Curricula	☐	Power	☐
Video and Audio Clips	☐	Communications	x☐
Recommended textbooks	☐	On Board Data Handling	☐

Useful software	☐	Systems	☐
Worksheets and Projects	☐	Mechanical	☐
Simulations	☐	Thermal	☐
Tutors' Guides	☐	Astronomy	☐
	☐	Earth Observation	☐
	☐	History of Spaceflight	☐
	☐	Other	x☐

Contact Details

Name of Organisation	University of Bristol Aerospace Engineering dept
Contact Name	Prof Lucy Berthoud
Email Address	Lucy.berthoud@bristol.ac.uk
Links	http://www.bristol-seds.co.uk/cansat/2016/10/16/cansat-2016.html

The work to prepare the case study for SUN was funded by:

UK SPACE AGENCY

and

University of BRISTOL