

Project Brief and Requirements

Release 1.0
12th October 2021

Overview

You will work in teams to deliver the mission planner, control systems and interfaces required to survey an active volcano, and deploy and recover an active sensor. The mission is based at the UoB aerial robotics test facility at Fenswood Farm (“Volcàn de Fenswood”) and contains a realistic set of challenges, as summarised in Figure 1.

For 2021-22, the project will focus on the development of the software, which will then be delivered to the “customer” (i.e. the teaching team) for testing. This minimizes risk to the project from unexpected access restrictions, enables hybrid online/in-person delivery, and has the strong educational benefit of bringing operator interface and training into scope.



Figure 1: Map of Group Project Scenario (.kml file available)

The scenario has been chosen to facilitate both simulation and real flight. While the complete problem would include the deployment (and potentially retrieval) of scientific sensing, the flight and interface problems are of appropriate complexity for this project. **You are only required to fly to and land in an appropriate location, respecting limits on flight trajectory and available information.**

User Requirements

Note that the key technical deliverable for the project is the software, while the drone, .kml file of key locations and a representative simulation model will be provided or based on open-source resources.

In the following, the phrase “the drone shall...” should be read as short for “the software shall control the drone such that the drone shall...”

UR	Requirement	Notes
UR01	The drone shall only fly within the Flight Region.	1
UR02	The drone shall not fly in the given No-fly Zone(s).	1
UR03	The drone shall not exceed an altitude of 50m above the Take-off location ground level.	
UR04	The drone shall take off from a region within 10m of the Take-off location.	
UR05	The drone shall land within an Area of Interest.	
UR06	The drone shall remain on the Area of Interest until user confirmation, and then take off and return to within 10m of the Take-off location, landing safely (noting UR07)	
UR07	The drone shall not overfly any region in the Area of Interest marked with red colouring on the ground, and must not land on either yellow- or red-marked regions.	2
UR08	The software shall communicate with the drone using ROS2 (via the MAVROS package) using standard MAVLINK multirotor (ArduPilot) capabilities and receiving an image topic from the on-board camera.	3
UR09	The software shall be delivered as a ROS2 (Foxy) package or set of packages.	3
UR10	The software shall be executable on a laptop computer with an i7 processor running the Ubuntu Linux (Focal Fossa 20.04 LTS) operating system.	3
UR11	The software must be accompanied by documentation including precise instructions for installation and execution.	
UR12	The software shall be operated by a volcanologist who has only had basic UAS flight training to CAA General VLOS Certificate (GVC) level.	4
UR13	The software shall provide a graphical interface to the operator (see UR12) accepting mouse or keyboard input.	
UR14	The software and interface shall include user ‘Return to Home’ (RTH) and ‘abort’ functionality and other appropriate failsafes.	
UR15	The software shall be accompanied by a training video for the operator of no more than 10 minutes in length.	
UR16	The software shall be delivered via a public GitHub repository and licensed under the MIT licence.	

1. The Flight Region and No-fly Zone(s) will not be visibly marked in any field trials, but teams should report any excursions/incursions verbally during trials and in post-flight reports, and flight logs may be examined to verify compliance.
2. The yellow and red areas in the provided .kml file are examples only. The exact configuration of landing/no-overfly areas will not be observable from the operator’s location and will likely be different to this due to changing and uncertain volcanic activity.
3. Software requirements are based on the University of Bristol’s ‘Project Starling’ stack <https://github.com/UoBFlightLab/ProjectStarling/>.
4. Assume that any operation will be undertaken by a GVC-level operator, under the supervision of a BVLOS pilot if required by regulations. The goal is that the supervisory pilot should not need to intervene.

Location coordinates

Label	Lat/Long
Take-off	51.4234178N, 2.6715506W
No-fly Zone 1	Polygon enclosed by: A: 51.4224669N, 2.6720597W B: 51.4235482N, 2.6673723W C: 51.4228490N, 2.6670013W D: 51.4217450N, 2.6714016W
Area of Interest	Annulus between 35m and 50m of: 51.4219206N, 2.6687700W
Flight Region	Polygon enclosed by: A: 51.4234260N, 2.6717208W B: 51.4212462N, 2.6701340W C: 51.4224401N, 2.6656878W D: 51.4246918N, 2.6670602W

- Acceptable precision is on the order of $\pm 1\text{m}$, or as determined in discussion with Customer.
- Coordinates are available as a .kml file.

Project Deliverables

D	Deliverable	Description	Due	Assessment
D1.1	Project Outline	Exploration of the application areas and challenge; outline project plan. 4 pages inc Gantt chart.	12:00 Thu wk10 Bb submission	20%
D1.2	Project Pitch	Presentation of D1.1 to academic team and peers. 10 mins plus Q&A.	Tue wk10 In-person	Formative
D2.1	Technology overview	Downselection of available technologies; software and user interface plan. 6 pages.	12:00 Thu wk17 Bb submission	30%
D2.2	Initial simulator demonstration	Working prototype of simulation, demonstrating subset of URs to academic team and peers; plan to completion.	Thu wk17 In-person	Formative
D3.1	Software delivery and demonstration	Software, documentation, and demonstration.	Thu wk23 In-person	50%
D3.2	Training video	As UR15.	12:00 Thu wk23 Bb submission	
D3.3	Project report	Structure and page count TBC.	12:00 Thu wk23 Bb submission	
D3.4	Evaluation: Reflective Account	Individual submission.	12:00 Thu wk23 Bb submission	

- Week numbers as given at <https://www.bristol.ac.uk/university/dates/calendar/>.
- Blackboard (Bb) submission guidelines at <https://www.bristol.ac.uk/digital-education/students/>.
- Late penalties as detailed in §17.4 (modular programmes) at <https://www.bristol.ac.uk/academic-quality/assessment/regulations-and-code-of-practice-for-taught-programmes/penalties/>.
- Submissions will be checked for academic integrity and are subject to University regulations, information at <https://www.bristol.ac.uk/digital-education/assessment-online/academic-integrity/>.
- Further deliverable, process, and assessment guidelines will be released in due course.

Clarifications, amendments and errata

This section will be populated in subsequent releases following client-team discussion.

Items should be considered to be additions to the core URs etc. above.