Microhab

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***Abstract*—A project definition for the Microhab project. Microhab is the term the HAB team has been using to describe a smaller balloon and payload than is typically used by the group (1200 grams). However, this project expands upon the term with the main goal of minimizing costs that go into building and launching a HAB.**

I. Introduction

Spex has launched 3 High Altitude Balloons (HABs) to date. The motivate for a launch is to educate students on engineering, test experiments in a near space-like environment, and to have fun. The HAB team within Spex aims to launch a balloon at the end of every full semester.

Traditional HAB launches are very expensive for the SPEX team. A large 1200g balloon can cost, at a minimum, over 125USD. Helium tank fills, which these launches require a full fill, can cost over 200USD. These two costs are a definite non-reusable resource. An avionics package consisting of COTS Arduino, breakout sensors, and a large battery pack can easily add up to over 90USD. The avionics hardware can be reused but every launch should be assumed a one time only use of hardware due to high risks of losing the payload.

II. Primary Objective

Microhab will reduce the magnitude of these three large costs that make frequent HAB launches unaffordable for undergraduate research. A smaller, simpler, more focused payload will result in cheaper avionics hardware costs. A lighter payload also doesn't require such a large balloon, enabling a cheaper, smaller balloon and orders of magnitude less helium use per launch.

III. Secondary Objectives

Educational benefit is a very large secondary objective of Microhab. This project shall be designed to be engineered in a fashion that teaches both established senior members and new greenhorn SPEX members alike.

Electrical hardware design is a skill that many members have shown a desire to pick up. Design of the PCB shall be simplistic and incorporate a few different important skills for engineering in the electrical hardware domain.

Embedded software is another useful skill that many students in the Computing skill aren't taught formally. Arduino development and embedded C software engineering skills will be obtained from writing code for the avionics board.

IV. Benefit to SPEX

Each of the objectives grant their own benefit to SPEX. Cheaper launch costs allow for more SPEX funding to be allocated to other projects while not sacrificing the quality of HAB launches significantly.

Educational benefit, while not the primary benefit, could be the largest benefit. PCB design has always been a very in demand with low supply skill. Embedded software is required for almost every large project. Arduino software design is a great stepping stone for software oriented people into the world of embedded. Avionics design in C would be the final transition, from Arduino into the real world application of embedded software.

A. Accessibility

In regards to the software half, Arduino is a very approachable language. There is a vast amount of libraries out there already for interfacing with ancillary hardware such as sensors or memory. The C portion to come at a later date (or in parallel) will be quite a bit more difficult; it requires a ton of datasheet reading, innovative code (not taking from examples), and customizing toolchains.

PCB design accessibility

V. Implementation

In the ideal case, every project begins with a design document. That design document gets sent around to SPEX members (and non-members) to draw support and build a team. Research and work takes place, documented along the way until an ending point is reached (e.g. project completion, end of the semester, team attrition, etc.).

At the end of the project (or end of semester, whichever comes first), the team writes a report of the project with what they did, if it was successful, and recommendations for future projects. A future SPEX member might pick up where the last paper left off, and the cycle repeats.

A. Deliverables

Physical or intellectual property may constitute a project's deliverables. Test articles, test stands, and other hardware, software, as well as posters, presentations or other reports are all valid deliverables. Not all deliverables may be known at the time of writing a PDD, but at least several key deliverables should be identified at the start of a project. This helps guide the final outcome and is a fundamental part of a project's life cycle.

B. Milestones

Deadlines and milestones provide clear goals from which timelines and schedules may be developed, and also set up a project for a series of “sanity checks” along the project’s development cycle. Early on, these milestones include design reviews on system and subsystem levels. Later, milestones are usually important tests or experiments. Events such as ImagineRIT may also serve as milestones to mark a project’s development progress or completion.

VI. Externalities

A. Prerequisite Skills

It is obvious that team members will learn certain skills as a project progresses, but there are always some tasks that require a minimum skill level to provide meaningful contributions to a project’s development. These prerequisite skills are best identified by examining past projects and discussing the project with faculty or subject matter experts. It is strongly recommended to be conservative in skill estimation. Underestimate team member skill levels and overestimate the challenge. Many projects have failed because the team overestimated their own abilities or underestimated the difficulty of their project.

B. Funding Requirements

Like prerequisite skills, it is wise to overestimate the cost of components, materials and other resources that a project requires. For physical projects, costs may be estimated by benchmarking the costs of similar systems or determining a representative bill of materials and using the aggregate cost of its items.

C. Faculty Support

Support from university faculty is almost always essential to a project’s success. Faculty provide not only guidance and subject matter expertise, but may also connect a team with resources and networking opportunities. SPEX projects do not require faculty support, but it is highly recommended to identify professors with an interest or expertise in a project as early as possible.

D. Long-Term Vision

As SPEX student members get more experience writing these papers, the group will build a library of meaningful work and be able to save it in an organized manner. Knowledge will be preserved and easily shared. Perhaps Project Design Document could eventually get published, in a journal or otherwise…

Acknowledgements

The author would like to thank Dr. Bill Destler and Rebecca Johnson for being exemplary humans, Anthony Hennig for founding RIT Space Exploration, and all the SPEX members that continue to invest their time and energy into the pursuit of space exploration.

Appendix A
Project Life Cycle