**Multidisciplinary Senior Design**

**Project Readiness Package**

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| **Project Title:** | High Altitude Balloon Instrumentation Platform |
| **Project Number:**  (assigned by MSD) | P18104 |
| **Primary Customer:**  (provide name, phone number, and email) | Dorin Patru, EME Department, RIT. 585 475-2388, dxpeee@rit.edu |
| **Sponsor(s):**  (provide name, phone number, email, and amount of support) | Boeing via the Multidisciplinary Senior Design |
| **Preferred Start Term:** | Fall 2017 |
| **Faculty Champion:**  (provide name and email) | Dorin Patru |
| **Other Support:** | The METEOR lab, equipment, surplus components, and radio station is available to the team for design, verification, manufacturing, integration, and testing throughout the project. |
| **Project Guide:**  (assigned by MSD) | Vince Burolla |

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| Dorin Patru (Modified by Harold Paschal [skills checklist] June 21, 2017) | 06/14/17 |
| Prepared By | Date |
|  |  |
| Received By | Date |

**Project Information**

**\* Overview:**

From 2003 to 2010 successive generations of senior design teams have built and launched high altitude balloon instrumentation platforms. In 2016-2017 two senior design teams, P17104 and P17105, have performed a complete redesign of such an instrumentation platform based on current state of the art technology. They had a successful launch and mission during May 2017. In addition, the SPEX group at RIT did and will continue to perform high altitude balloon launches to test cubesat subsystems in a near space environment, i.e. >100,000 feet. To that end, this project intends to create an instrumentation platform that will serve as a design and implementation reference for future, custom missions.

The goal of this project is to acquire data from several sensors (pressure, temperature, humidity), an off-the-shelf GPS unit, a minimum of three digital image sensors, and an Inertial Measurement Unit (IMU). The three video channels and a high data rate channel are stored on board on SD cards and transmitted to the ground using a Digital Video Broadcasting – Satellite 2 signal (DVB-S2) in the 1.2 GHz Amateur Radio Band. In addition, a reaction wheel is used to stabilize the rotation of the platform in the vertical axis. An independent APRS unit serves as the backup position reporting system.

This is a direct follow-on project of the following two prior projects:

<http://edge.rit.edu/edge/P17105/public/Home>

<http://edge.rit.edu/edge/P17104/public/Home>

**\* PreliminaryCustomer Requirements (CR):**

* Sensor data is acquired and stored on a SD card
* Sensor data is telemetered to ground
* The rotation of the HABIP is controlled
* Ground commands are received, decoded, and executed correctly
* Independent APRS unit transmits position information periodically
* Controller interfaces to all units, including the video transmitter and data transceiver
* Standalone, independent, ground recovery signaling system (GRSS) comprised of LEDs and Buzzer

**\* Preliminary Engineering Requirements (ER)**:

Include both metrics and specifications. Each ER should map to one or more CRs (see above).

Metrics: what quantities will be measured in order to verify success?

Specifications: what is the target value of the metric that the team should design to?

**\* Constraints:**

* System must operate nominally in the atmospheric environment from 0 to 120,000 feet, for a target mission duration of a minimum of 3 hours.
* The target system weight is less than 6 pounds. The maximum acceptable weight is 10 pounds!
* GRSS system operational for 24 hours after launch.
* The radio communications are constrained to the following amateur radio bands: 2 m (144 MHz) or 70 cm (440 MHz) for the uplink of commands, and 1.2 GHz for the downlink of the DVB-S2 signal (3 simultaneous video and 1 high data rate channels).

**\* Project Deliverables:**

Minimum requirements:

* All design documents (e.g., concepts, analysis, detailed drawings/schematics, BOM, test results)
* working prototype
* technical paper
* poster
* All teams finishing during the spring term are expected to participate in ImagineRIT

Additional required deliverables:

* List here, if applicable

**† Budget Information:**

Include total budget, any major cost items anticipated, and any special purchasing requirements from the sponsor(s).

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|  | Major Item | Anticipated cost | Comments |
| 1 | Electronic components\* | 300 | Excluding the IMU and the Motor |
| 2 | IMU | 0 | Available - 2 |
| 3 | Custom PCBs | 600 | One run, three different boards |
| 4 | Color Board Cameras | 0 | Available - 5 |
| 5 | Design Software | 0 | Available |
| 6 | Mechanical materials and components\* | 200 |  |
| 7 | Raspberry Pi boards | 300 | = 6x50 |
| 8 | Motor | 0 | Available |
| 9 | Launch costs – one time | 600 | Two Helium tanks and a 1500g balloon |
| 10 | GPS | 0 | Available |
| 11 | APRS | 0 | Available |
| 12 | DVB-S2 transmitter | 500 | Available |
| 13 | Data transceiver | 0 | Available |
| 14 | Antennas and cables | 0 | Available |
| 15 | Design Software | 0 | Available |
|  | Total: | **2,500** |  |

\* The team is encouraged to make good use of all mechanical and electronic components available in the Meteor lab. A new component order won’t be approved until the team has demonstrated that what is being ordered is not already available in the lab.

Boeing through MSD will provide up to $2,500.

**\* Intellectual Property:**

Describe any IP concerns or limitations. According to RIT policy, students have the right to retain any IP they generate during a course, but some students voluntarily agree to be placed on projects where they will be asked to assign their IP. If a sponsor wishes to have a team assign their IP, we need to know ahead of time so that we can place appropriate students on the team.

In order to ensure that students can discuss their projects openly during presentations and job interviews, we ask that no more than ~20% of the project be considered confidential.

No portion of this project is or will be considered confidential.

**Project Resources**

**† Required Resources (besides student staffing):**

Describe the resources necessary for successful project completion. When the resource is secured, the responsible person should initial and date to acknowledge that they have agreed to provide this support. We assume that all teams with ME/ISE students will have access to the ME Machine Shop and all teams with EE students will have access to the EE Senior Design Lab, so it is not necessary to list these. Limit this list to specialized expertise, space, equipment, and materials.

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| **Faculty** list individuals and their area of expertise (people who can provide specialized knowledge unique to your project, e.g., faculty you will need to consult for more than a basic technical question during office hours) | **Initial/date** |
| Dorin Patru, Mark Indovina |  |
| **Environment** (e.g., a specific lab with specialized equipment/facilities, space for very large or oily/greasy projects, space for projects that generate airborne debris or hazardous gases, specific electrical requirements such as 3-phase power) | **Initial/date** |
| Access to the METEOR lab, its equipment, components, and radio station. In addition, the ME Machine Shop and the CAST Electronic Manufacturing Lab. |  |
| **Equipment** (specific computing, test, measurement, or construction equipment that the team will need to borrow, e.g., CMM, SEM, ) | **Initial/date** |
| Only standard equipment is necessary |  |
| **Materials** (materials that will be consumed during the course of the project, e.g., test samples from customer, specialized raw material for construction, chemicals that must be purchased and stored) | **Initial/date** |
| Gaseous Helium and latex balloon during launch and mission. |  |
| **Other** | **Initial/date** |
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**† Anticipated Staffing By Discipline:**

Indicate the requested staffing for each discipline, along with a brief explanation of the associated activities. “Other” includes students from any department on campus besides those explicitly listed. For example, we have done projects with students from Industrial Design, Business, Software Engineering, Civil Engineering Technology, and Information Technology. **If you have recruited students to work on this project (including student-initiated projects), include their names here.**

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| **Dept.** | **# Req.** | **Expected Activities** |
| BME |  |  |
| CE |  |  |
| EE | **3-4** (Brandon Codi and Daniel Mitchell – both confirmed; Ryan Chojnacki – maybe; 4th TBD) | * Selection of electronic components * PCB level, analog and digital, hardware design * Assembly and C based programming * FPGA digital hardware design * System level integration |
| ISE | 1 (TBD – **optional**) | Project management, system level design, documentation, regulatory, accounting, purchases, etc. |
| ME | **1-2** (James Brumbaugh – confirmed; 2nd TBD) | Design and implementation of custom enclosure (not only a box!) and mechanical interconnect; heat transfer model and passive heat transfer system, i.e. can be only analytical; CFD/FEA – optional; refinement of the reaction wheel control algorithm. |
| Other |  |  |