



# Embedded, IoT Environmental Monitoring Emulator

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## **Company Background:**

Lunar Outpost Inc. is an advanced technology company with a focus on developing technologies that have both terrestrial and space applications. Comprised of engineers with experience working on NASA, defense, and commercial programs, Lunar Outpost is engaged in contracts with the USAF, NASA, local and state government organizations, and leading research institutions. Other current projects include multiple product lines of Canary Environmental Monitors; the MAPP rover, a prospector designed to map resources and carry payloads on the lunar surface; mission operations for MOXIE onboard the Perseverance rover on Mars, and more...

## **Description of Work to Be Done:**

The goal of this project is to develop a comprehensive emulator for Lunar Outpost's Canary-S product line. The Canary-S is a solar-powered, IoT environmental monitor capable of detecting a wide variety of pollutants and meteorological parameters in diverse operational settings. From forests to oil and gas sites around the country, the Canary is on the frontlines of the battle against climate change, forest fires, and industrial pollution.

In the ever-changing landscape of regulation and public health, it is vital that the Canary can evolve and expand rapidly to incorporate the latest innovations in environmental technology and address the evolving needs of our stakeholders. We have addressed this through a modular design that allows for constant improvement and customization; however, these design modifications require meticulous manual testing and engineering effort to ensure that all subsystems are performing at the high-level that our mission demands when another subsystem is altered. Students will work towards addressing this bottleneck to progress through development of a comprehensive Canary emulator and testing environment.



**Figure 1: The Canary-S Environmental Monitor in the field.**

In designing the Canary emulator, students will focus their efforts into two specific areas:

1. Designing a solution to automatically update embedded applications using state-of-the-art IoT architectures.
2. Emulating external sensors for the Canary to interact with to ensure proper functionality.

The students will be involved in every phase of the project 'from design through implementation'. During the design phase the students will interact with Lunar Outpost engineers to see what will provide value for operation. From there the project overview will be created and the work divided into tasks. As a final product, the Field Session team will develop an all-in-one solution that incorporates an ARM microcontroller, an embedded IoT device, and a web server. The microcontroller software will work in tangent with the web server to ensure correct firmware is applied and the expected behavior is observed from the emulated Canary and external sensors. Test hardware will be provided.

Jeffrey Stenerson, the lead Software Engineer at Lunar Outpost, will be managing this project on the Lunar Outpost side. Mr. Stenerson, a graduate of CSM, has extensive software development experience and can help mentor the student team throughout this course.

**Desired Skills for Students:**

- C++
- Arduino Experience
- PHP
- HTML/JS/CSS

We understand not all the students in the group might have the desired technical skills. However, if they can problem solve and have a willingness to learn, they can excel in this project with the help of our talented engineers.

**Preferred Team Size:** 3-4 students

Given the scope of this project a group of 4 students is preferred but 3 students could also excel given they are willing to problem solve and learn.

**Internships at the End of the Course:**

We are happy to consider offering internships at the end of the course.

**Location Where Work Would Be Performed:**

We have offices in Golden and in Arvada, CO. The office in Golden, CO is located at 17700 S Golden Rd Unit 102 and has space for a student team. This office is less than a 5-minute drive from CSM campus and should provide a convenient location for the students to meet. We also provide free beverages and snacks to keep the team fueled throughout the day.