1. Overview

1.1. Objectives

The objective of this project is to design, build, and test an environmental control system (*ECS*) that controls the breathability of air in a closed system. The ECS will regulate the percent CO_2 in the environment by producing O_2 and venting excess pressure and CO_2.

1.2. Interactions with Existing Systems

The system will use the TM4C123 microchip, an ST7735 color LCD, an 8 ohm speaker, and be powered using batteries.

1.3 Terminology

- *Environment Subsystem:* Closed system where air quality will be controlled to maintain breathability. Contains sensor measuring CO_2 in air.
- *Electrolysis Subsystem:* Actuator producing O_2 through electrolysis of H_20.
- *Controller:* Monitors input from sensor and provides output to actuator based on environment requirements. Includes an LCD and switches as input UI to manage desired environment. Includes a speaker and LEDs as output UI.

2. Function Description

2.1. Functionality

The *Controller* monitors CO_2 levels in the environment and provides a UI for the user to control the soft and hard limits of CO_2 in the environment. The soft limit will trigger the Electrolysis Subsystem to begin the production of O_2. The hard limit will continue the production of O_2, set off a loud audio alarm, and flash a red LED. To simplify the ECS, maintaining O_2 levels below a specific threshold to reduce fire hazard in the environment is not a requirement.

The *Electrolysis Subsystem* produces O_2 and safely vents H_2 (byproduct) through some form of containment (e.g. into a sealable container). The O_2 is transported to the Environment.

The *Environment Subsystem* can be modified by 2 mechanical inputs: the O_2 from the Electrolysis Subsystem and a separate input for CO_2 (via exhaling). The Environment will also have 1 output to vent excess pressure and CO_2. These inputs and outputs must not allow backflow of air.

2.2. Performance

UI must be easy to use. CO_2 measurement accuracy must be within 1% of actual. H_2 production must remain below 500mL / 5 minutes to allow for safe and manageable venting. Current usage of electrolysis must remain below 6.26A.

2.3 Usability

The *ECS* will provide an LCD interface to read current CO_2 measurement, soft limit, and hard limit. There will be 3 switches to modify the soft and hard limits. A speaker will provide a loud warning sound if the hard limit is passed. An LED will provide a flashing red warning signal if the hard limit is passed.

2.4 Safety

The top priority for the *ECS* is safe operation. H_2 is a highly flammable gas and a byproduct of the electrolysis of water. Two things will be done to ensure safe operations: First, all H_2 produced will be captured and released outdoors. Second, the production of H_2 will be limited to a maximum rate of 500mL / 5 minutes so the byproduct can be easily managed and vented. This will be achieved by limiting the current used for the

electrolysis reaction to 10A, which is controlled through the applied voltage level and conductivity of the solution.

3. Deliverables

3.1. Report

Written final report containing hardware and software design and relevant system measurements.

3.2. Outcomes

Video documenting system working and live presentation.