Apr 20th, 12:00 AM - 12:00 AM

Mask-on Breathing Awareness Trainer (MOBAT)

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ABSTRACT

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Keywords: Hypoxia, Naval Aviation, Aviation Training, Aerospace Physiology

NOTICE

The information presented in this paper is for academic purposes. The thoughts and conclusions expressed herein are those of the authors and not official Department of Defense or Department of the Navy policy or regulation. There is nothing in this paper that is classified or controlled unclassified information.

INTRODUCTION

Currently there is no low-cost solution to teach large quantities of Naval Aviators on how to correctly breath on an oxygen mask. This report will discuss the design and implementation of a mask-on breathing apparatus for use with United States Naval Aircrew for initial and annual familiarization. With the current uptick in physiological episodes within the naval aviation enterprise, there has been a need to find solutions to this problem. Currently when a naval aircrew is trained in aviation physiological threats, they do so with normobaric hypoxia tools in the form of the 9A19 Normobaric Hypoxia Trainer for aircrew who do not normally wear a mask during flight and the 9A17 Mask-on Breathing Trainer which is for aircrew who do wear a mask throughout an entire flight. This training evolution only lasts around 15 minutes for each student and does not go over the proper breathing techniques to use to breath while on mask provided oxygen. It would take too long and would be overly costly to use the existing training methods to perform this task. The goal of this project is to rectify the gap in training by providing a low cost means to give positive feedback training to large numbers of students at once.

MATERIALS AND METHODS

The training device will make use of both additive and subtractive manufacturing methods. Many of the more complex shapes that involve the air breathing loop are made using resin stereolithography 3D printing technologies (Figure 1). While these parts could potentially be made using traditional subtractive or casting techniques, the costs in material and machine hours would make them prohibitively expensive for this project. With regards to the enclosure itself that will be made using traditional metal working techniques. It will be laser cut out of a sheet of aluminum then bent into shape using hydraulic brakes. It will then be powder coated (cost dependent for the prototype) to protect the metal and give a more professional appearance. Hard coat anodization is also a possibility as the case will be made of 1/8in aluminum sheet.

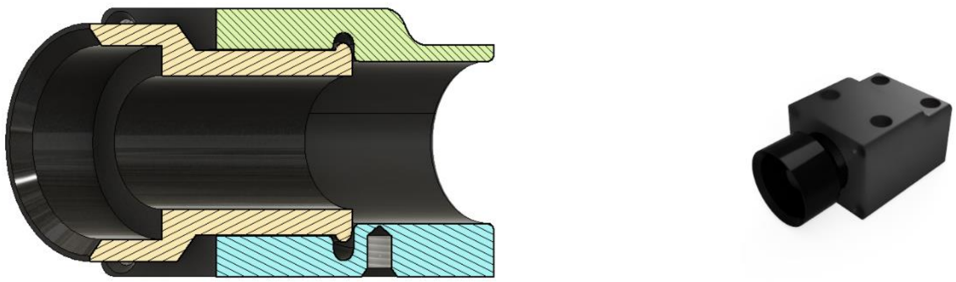

Figure 1. Aviator mask interface cross section and render.

The electronics consist of a Raspberry Pi Pico microcontroller powered by a USB Type-C power rail (Figure 2). The sensor used will be a Siargo MEMS type sensor, and finally a small OLED display will show the student their current breath flow rate and instructions given to perform based on the curriculum. There will be a series of momentary push buttons to interact with the device and a toggle switch to power the device.

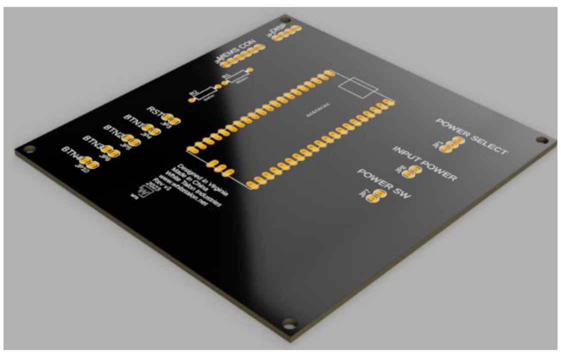

Figure 2. PCB Design.

The training device is programmed using the Thonny IDE utilizing the MicroPython language.

CONCLUSIONS

While this project is my Doctor of Engineering final project and as such is not complete, there are several components that have been built and are working as designed. Initial software testing of the sensor has been successful.