Micro-LED Displays for Aerospace Applications – Korry Electronics

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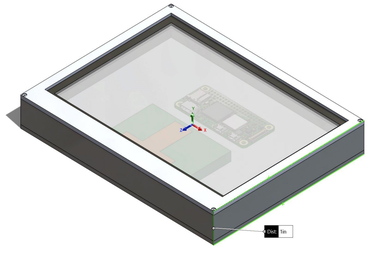
Introduction

- Korry Electronics aims to design and develop a prototype micro-LED (emissive) display system that addresses the need for lighter, more efficient, and higher quality displays in aerospace applications
- Traditionally, displays in avionics are LCD (transmissive) because of its durability, sunlight readability, and compatibility with existing systems
- This emerging technology will improve the optical performance while reducing weight and power

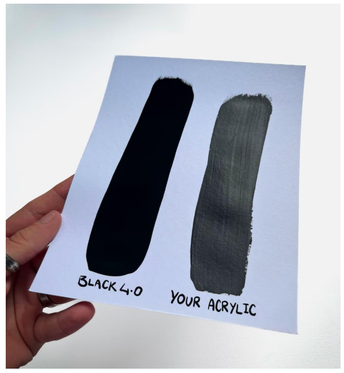


Prototype Requirements

- The prototype will serve as a proof of concept for future integration into possibly both commercial and military avionics systems
- As a benchtop display, it will be able to cycle through pre-loaded images with the only external source being power

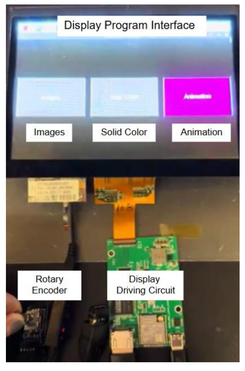
Prototype Features

- There is an acrylic plate painted with Black 4.0 (world's blackest paint) right behind the display to help with the contrast ratio since it's 40% emissive
- Rotary encoder to adjust brightness
- Single port external connection
- All 3D printed material with size #00 screws in all holes
- Detachable kickstand positions display at a fixed optimal angle
- Touchscreen input for GUI program



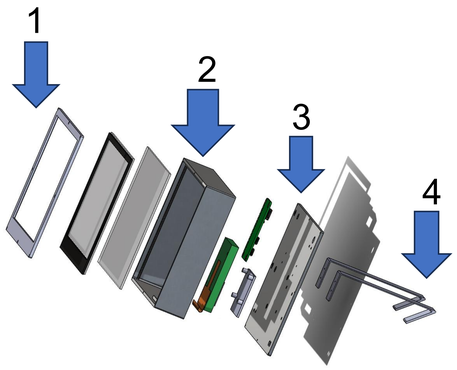
Micro-LED Display Software

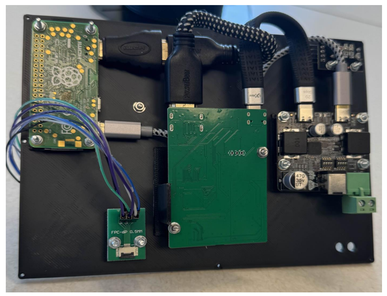
- One of our main objectives of this project was to design a software solution that demonstrates the needs for the users in the aerospace field. We implemented three functions into our program
  - Display Images: To ensure accurate image display, we applied image processing techniques to optimize the images
  - Generate solid color images: Our program generates solid color images at various brightness levels to evaluate and calibrate display performance
  - Display video and animation: We implemented a function for dynamic visual information display, such as maps or altitude indicators
- Integrated rotary encoder as one of control methods in our embedded system. It has high reliability, intuitive operation and low resource consumption
- Added touchscreen input that is handled in a separate threat to run concurrently with the rotary encoder



Micro-LED Display Enclosure

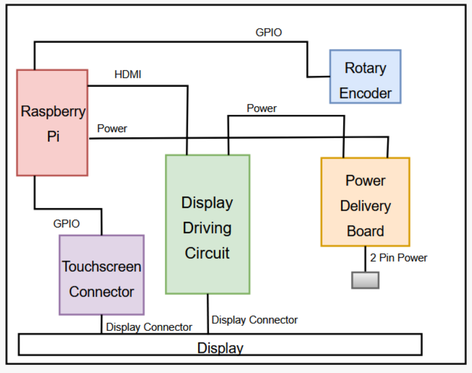
- The goal for our enclosure was to create a structurally sound and compact display module, focusing on optimizing electronics to be as thin as possible
- 3D modeling was done in SolidWorks, where we created three components each undergoing multiple iterations, using 3D printing to refine design and fit (labeled 1,2,3)
- The display is suspended on a ledge within the middle component where a compression gasket created by silicone rubber layers from the ledge and the lid securely holds it in place
- 3D printed kickstand for optimal viewing angle as benchtop display (labeled 4)





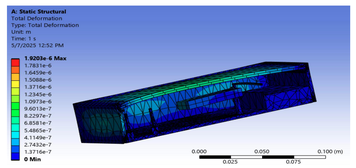
Micro-LED Display Hardware

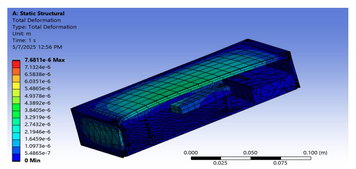
- Objective was to power all hardware modules from a single port
- We used a Power Delivery Board to effectively split power between the display and the Raspberry Pi
- Addressed wiring and space constraints with flat, flexible cables and soldering
- An FPC connector board was used to interface with the display
- Implemented I2C protocol for touchscreen interface

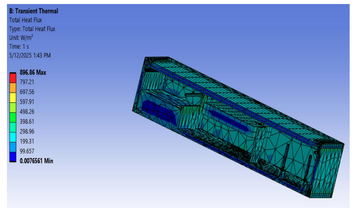


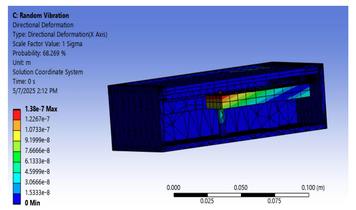
Finite Element Analysis

- FEA was done to the entire structure with force, vibrational, and transient thermal analysis to the standard of DO-160G and all results are within an acceptable range
- Simulations were done for an average environment and max conditions (section views are shown)









Future Work

- Further improvements to software to display real time flight data
- Add sensors and hardware chips to capture and process real time data
- Improve start-up time and add more features for GUI

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