Problem Statement

W Keith Stirby Jr

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Abstract

Providing quality avionics and information technology systems for the airline industry is a task that Rockwell Collins has been capable of doing since its start. However, the research and development of these industry specific systems results in costly solutions. More....

1 Problem

Rockwell Collins is looking for an economic solution regarding a flight deck product that they currently offer for their clients in the aviation industry. The product is a head-up display (HUD) that is transparent, and assists pilots during low visibility conditions during the day, night, and inclement weather during all phases of flight. When lowered in the pilots forward field-of-view (FOV), the HUD displays a variety of indications from on-board sensors and databases, and real-time images taken from on-board cameras. Specifically, Rockwell Collins has requested that our project focuses on duplicating the Enhanced Vision System (EVS) of their HUD, which uses input from three detection channels of the electromagnetic spectrum to display images that are beyond human vision. The output from the channels provide thermal images of the landscape and various types of lighting, for example incandescent, halogen, and LED lights, which help guide pilots during critical, low altitude stages of flight. The in-house development and custom manufacturing of this system is very costly, and therefore the company is unable to attract all customers from the public and private airline industries.

2 Proposed Solution

An EVS that has system hardware composed of affordable off-the-shelf hardware, which reduces the total cost of the HUD for the airline industry customers of Rockwell Collins. For multiple camera and spectral band image processing and the added constraint of the projects size, weight, power, and cost (SWAP-C) limitations, the EHS will needs to be deployed with the use of a system on a chip (SoC) or a system on a module (SOM). These SoCs and SOMs integrate

systems that typically would plug into the motherboard of a personal computer with the motherboard. For example, the motherboard and video card are combined as one. Due to our project requiring image processing our SoC or SOM must have a graphics processing unit (GPU), and the perfect example of a product would be the NVIDIA Jetson TX1 and TX2. With the latest being the TX2, internal real-time processing is one of its many capabilities that make this an attractive solution, in addition to the Camera Serial Interface (CSI) being capable of supporting six cameras simultaneously. The TX2 also supports High Efficiency Video Encoding (HEVC) or H.265, which is the new video compression standard capable of providing double the compression efficiency that the previous standard was capable of. To allow for future compatibility of future cameras, a camera interface board is a likely solution, and is required to be compatible with the SoC or SOM. Another limitation that must follow the projects SWAP-C is the need for the system to run independent of a development kit or external computer.

3 Performance Metrics

The following is a list of metrics that must be met in order for the project to be deemed a success.

3.1 System Research

The GPU, camera interface board, and cameras must be capable of being integrated for the system to produce an output to a screen. Researching compatible components for system integration will be the first major step, and most specifically a camera interface board capable of communicating with the GPU. The is potential that the camera interface board may require minor modifications to meet full requirements of the project. These components must also meet size, weight, power, and cost (SWAP-C) requirements due to the application for the EVS. Due to a Jetson TX2 being readily available, research and tinkering will also occur during this process to gain better understanding of its software.

3.2 System Integration and System Output with One Camera

Once the system components are finalized, purchased and in-hand, system integration is required for the major components to communicate. This may be capable of being confirmed without an output display and signal input from a camera, but until more information is capable of being gathered on the hardware this metric will be confirmed by such. All desired wavelengths that provide input to the existing EVS utilize will be tested for output.

3.3 System Output with Two or More Cameras

Due to the EVS requiring input from multiple cameras, the next goal for the project will be to have two camera inputs being fused together on an output display. At a minimum, the three wavelengths that provide input to the existing EVS will be tested for a fused output.

3.4 Overall and Stretch Goals

The system should be capable of being integrated for a quality video output near-real-time. Different conditions of input to the types of cameras will be tested, and the recording and plotting of data will be expected. Once two camera inputs are capable of being fused on an output screen more camera inputs will be added one at a time and tested.