Lightning Talks

Week 1: The Problem & Users

Project Overview

- We will be developing a video pipeline from a MIPI-connected COTS camera module to a video monitor
- The MIPI video data will be sent through a custom FPGA-based video pipeline
- The augmented video will be sent to a monitor connected via an active displayport cable
- The software will execute within a Linux operating system
- STRETCH GOAL: Video may be passed into a machine learning algorithm and the output of the ML algorithm will be used to augment the video sent to the monitor

Function Requirements

Functional

- The product will compute machine learning in real-time
- Software that routes data will use a Linux image
- The product will use C and Python code
- The product will need to work in a variety of lighting conditions

Resource

- The product will require a 12V power input

Physical

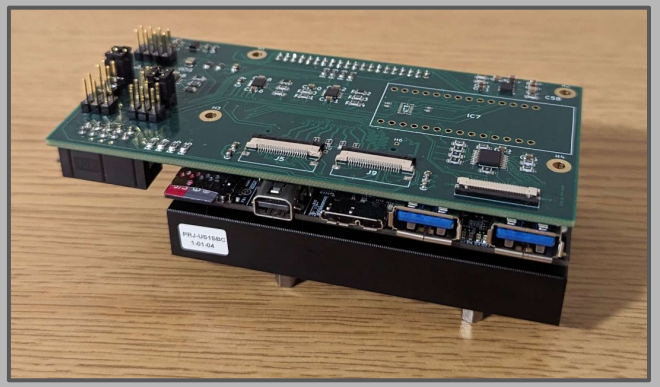
- The product will use a Sony IMX219PQH5-C image sensor
- The product will use an Ultra96-v2 FPGA board
- The product will utilize off-the-shelf and open source components

User experiential

- Output is sent through mini DisplayPort

Environmental

- The product will take a video feed as input from the image sensor
- The product will need to withstand wear and tear from normal weather conditions



Problem Statement

There are numerous applications for a computer vision pipeline that makes use of Machine Learning algorithms: from medical imaging to self-driving cars to surveillance drones. This project aims to create a proof-of-concept video pipeline using common off-the-shelf materials and software. The inspiration for this design comes from the desire to help disabled or injured individuals increase their quality of life by tracking their eye movements. These individuals can have inhibited fine motor skills that make acute navigation challenging, and individuals confined to a wheelchair often require a helper to perform daily living tasks. Capturing eye movements in real-time for these individuals will be vital in assisting them with their communication and navigational needs. This is just one application for this product which can be used in a broader range. For example, this product could be used as a ready set of components for a programmer to explore an interest in machine learning.

User 1: Ethyl

Characteristics

- Has a disability and is wheelchair bound
- Has poor fine and gross motor skills, is confined to a wheelchair, has difficulty performing daily tasks by themself, occasionally gets seizures

Hears

- “There are certain tasks that you can’t do”

Says

- “I want to be able to color inside the lines”

Thinks & Feels

- Wishes they didn’t always need as much help
- Wishes they could better communicate their needs

Pain

- Medical problems limit the ability to perform daily tasks

User 2: Elon

Characteristics
- Enjoys computer programming and finding practical solutions to everyday challenges

Hears
- Favorable reviews of ChatGPT, AI, and machine learning

Says & Does
- “Why spend 5 minutes doing something manually when you can spend 8 hours automating it”

Thinks & Feels
- Tired of wasting time when computers can do the job instead

Pain
- Requires a lot of research and fine-tuning

User 3: Nurse Jackie

Characteristics

- May not be very tech-savvy or up to date with recent technological trends (like ML) and is open-minded to new ways of helping their patients

Sees

- Maybe they have difficulty seeing and need a computer to help out

Thinks & Feels

- Machine learning and AI are the future

Says & Does

- Look for ways that new technology can help people in need

Pain

- Seizures can occur and medical staff need to be notified ASAP

User Needs

- Ethyl needs a way to consistently navigate and perform her daily tasks without risk of injury or fatigue because she has limited fine motor skills due to her disability.

- Nurse Jackie needs a more effective and efficient way of taking care of their patients that is easy to learn so that they can have more time to take care of multiple patients at the same time.

- Elon needs a device that easily processes video data for machine learning applications because he wants to create an innovative product.

Conclusion

This product implements a video pipeline for machine learning that has a wide range of applications. Users could range from anyone in need of medical imaging to drone surveillance to someone with an interest in machine learning. All of which, users will need a camera that works in real-time and in a variety of lighting conditions. Our project is inspired by the needs of disabled or injured individuals with the goal of improving their quality of life through tracking eye movements to assist caretakers with identifying a disabled/injured individual’s communication and motor skill needs.