PROJECT ELM

Design Check-In

sdmay25-01 “ProJect ELM”

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PROBLEM STATEMENT

PROBLEM

- People with **mobility** and **cognitive impairments** face many challenges including maintaining **independence** and **safety**.
- Lack of advanced wheelchair technologies, leaving **gaps in autonomy**, communication, etc.

OUR CLIENT

- Formerly volunteered to help with individuals with cerebral palsy and is motivated to help them further.
- Wants to develop assistive wheelchair tech with features including mobility assistance and real-time seizure detection.

OUR TEAM

- Create a subsystem that detects, locates, and presents info on a user's eye in a camera.

OBJECTIVE

Develop a fast and accurate pupil detection subsystem using machine learning algorithms on an FPGA to support our client's vision of advanced assistive technologies.

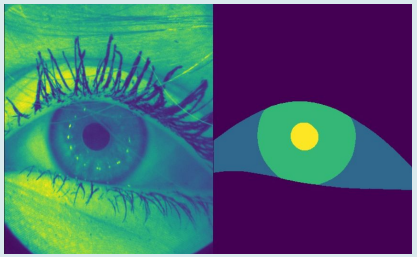
PROJECT OVERVIEW

SYSTEMS

- Camera
- Eye location algorithm
- Semantic segmentation ML model
- Ultra96 v2 FPGA
- Display

REQUIREMENTS

- Real-time
- Accurate and performant to [NDA] fps
- Display model outputs and debugging information



PROTOTYPING

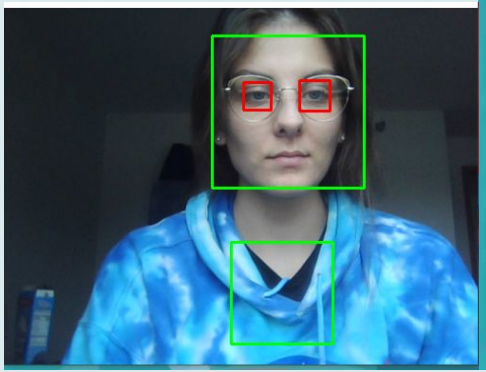
ROI PROTOTYPE

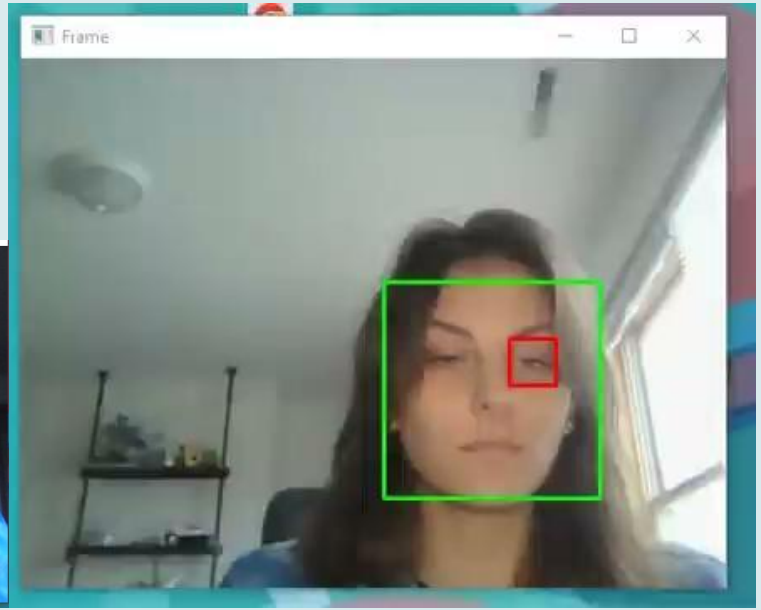
PURPOSE

- Identify benefits and downsides of each algorithm (find best fit)
- Learn how to improve accuracy and speed

REFLECTION

- Detect eyes with glasses
- Problems with glare over eye
- Problems with harsh backlight
- Lacks Accuracy
- Fast





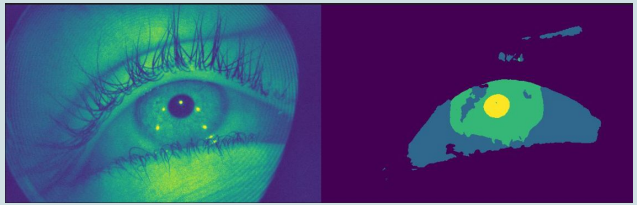
MODEL PROTOTYPE

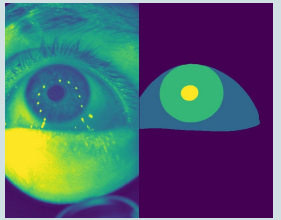
PURPOSE

- Familiarize with Open-Source Model

REFLECTION

- Accurate
- 4 channels (colors) is not needed

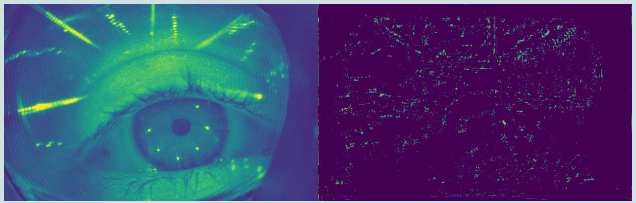




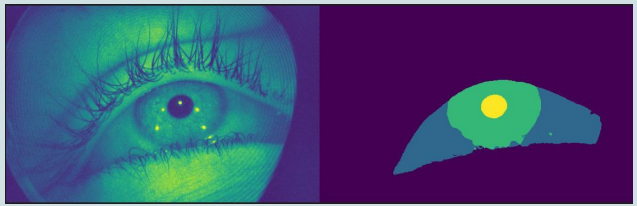
Epoch 2

Trained + Cropped

Epoch 0



Epoch 5



ULTRA96v2 PROTOTYPE

PURPOSE

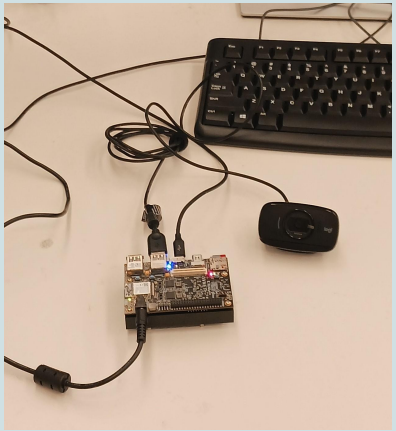
- Show the platform environment is able to run software from previous teams
- Show webcam video can be captured and displayed for our algorithms

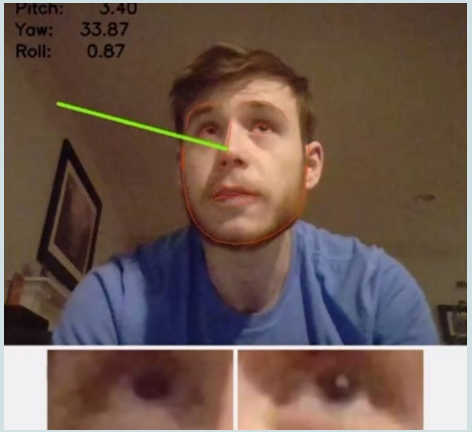
NOTE

- Ultra96v2 dev board includes the FPGA
- Camera, sitting to right of board

LEARNINGS

- Ultra96v2 dev board is tedious to set up – there are still remaining environment setup steps for the Pynq and Python





Used existing demo application that determines head position from a webcam

NEXT STEPS

ROI SELECTION

- Decide which algorithm(s) to use.
- Implement chosen algorithm(s).

PRUNING

- Use Vitis-AI Tooling to Optimize and retrain the model.

INTEGRATION

- Combine all subsystems onto Ultra96v2.

CONCLUSION

As a result

of our given problem and current components of our project

We will

Increase the performance of an existing FPGA system

To achieve

Throughput high enough to make real-time decisions.

Linking to Our Client's Problem

This increase in data throughput will supplement our client's system, unlocking the ability to predict when end-users might have health-affecting events such as a seizure.

Thanks!

Any questions?