EE/CprE/SE 491 WEEKLY REPORT 03

Video Pipeline for Machine Computer Vision

09/26/24 – 10/3/24
Group number: sdmay25-01
Advisors: Dr. Jones and Dr. Zambreno
Client: JR Spidell

Team Members:

Lindsey Wessel — *ML Face & Eye Detection*
James Minardi — *Hardware*
Eli Ripperda — *Embedded Systems*
Mason Inman — *Semantic Segmentation Optimization*

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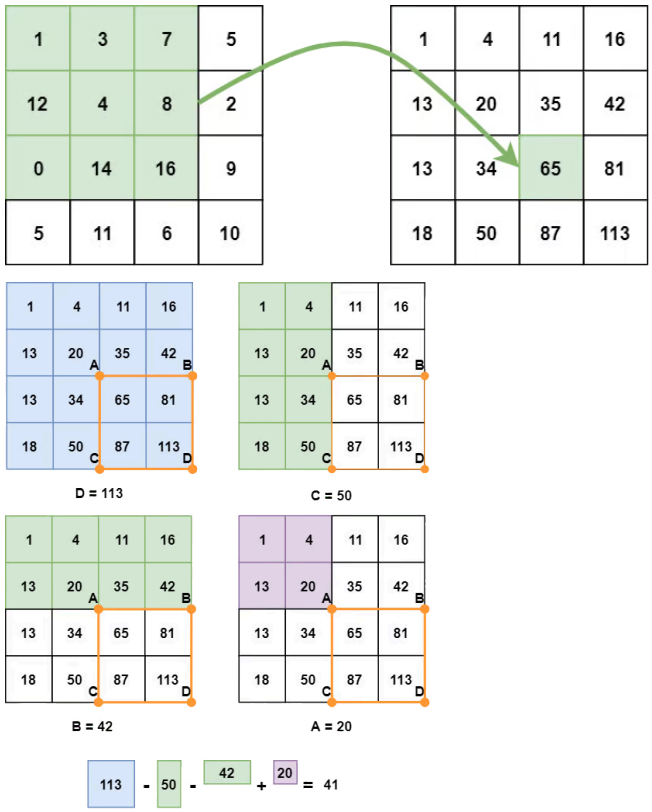
Weekly Summary:

This week, sdmay25-01 made significant initial progress. Lindsey was able to get a local environment working. Mason was able to share knowledge about CNNs with the team. James and Eli looked into a thesis paper providing useful information about our Ultra96 board and Pynq environment. Additionally, as a team, we were able to discuss a high-level block diagram with the client about the system to be implemented.

Past Week Accomplishments

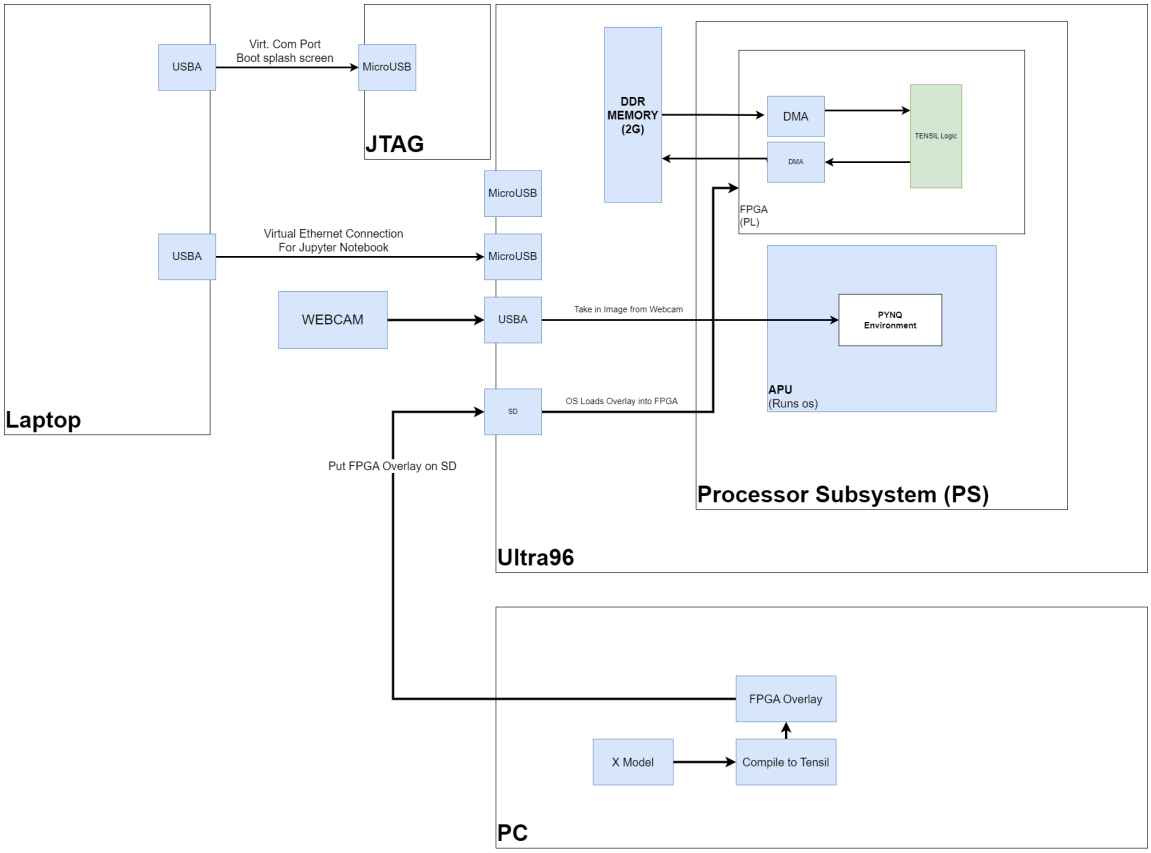
- ❖ Lindsey's Accomplishments
  - ➢ Acquire understanding of how Computers Detect Human Faces
    - ■ Haar-like Features
    - ■ Internal Images



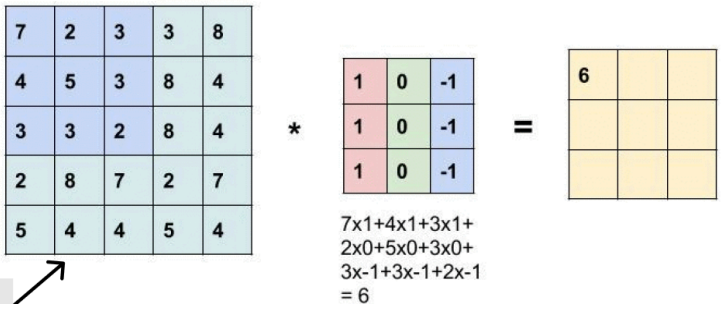
      - Summed Area Table is used to calculate the difference betwene to rectuangular pixel sums
    - ■ Adaptive Boost Training
      - Using weak data sets the computer create to create stronger data sets (Test what data sets should have the most and least weight with Ada (adaptive) Boost)

- ❖ James' Accomplishments

- ➢ Gain basic understanding of Tensil
- ➢ Work on system diagram



- ❖ Eli's Accomplishments
  - ➢ Studied a "Bachelor Thesis" from two students who study at the University of Applied Sciences and Arts Northwestern Switzerland. This thesis is titled "AI High-Performance Solution on FPGA."
- ❖ Mason's Accomplishments
  - ➢ $$(f * g)(t) := \int_{-\infty}^{\infty} f(\tau) g(t - \tau)\, d\tau.$$
    - ■ Studied the following equations. It denotes the calculus based definition of convolutions. The product of two functions as a function "slides" over time across the other.
  - ➢ However, we will be primarily using the piecewise, linear algebra, based definition depicted below.



- ➢ Researched and divided the UNET architecture into three parts
  - Encoder
    - Captures Contextual Information and "Encodes" it into additional Channels
    - The Convolutions decrease image resolution, but increase channels
    - Think of channels like the Z-Dimension
  - Bottle-neck
    - Serves as the bottom of the "U"
    - Feeds Encoder and Decoder
  - Decoder
    - Works to locate features
    - Increase image resolution, decrease channels
    - The skip channels are able to fill the decoder in on previously lost data from the encoder at each layer, tremendously helping with accuracy
- ➢ Solved dependency issues with local model

❖ Team Accomplishments

- ➢ Worked as a team and with the client to build a high-level system diagram.

Pending Issues

❖ Lindsey's Issues

- ➢ Finding time in the week to sit down and work on the project. Working in small segments is causing learning/development delays.

❖ James' Issues

- ➢ No issues

❖ Eli's Issues

- ➢ See team issues.
- ➢ No additional issues

❖ Mason's Issues

- ➢ Setting up a development environment is taking some additional time. There are many dependency issues when using the environment.yml file.

❖ Team Issues

- ➢ Waiting on NDA from client.

Individual Contributions

Name	Cumulative Hours	Week 3
Lindsey	40	16
James	32	8
Eli	32	8
Mason	40	8
Team	144	40

Forward Plan

❖ Lindsey's Plan

- ➢ Continue development by learning about eye detection

❖ James' Plan

- ➢ Look over CPRE 488 MP-2 lab.
- ➢ Set up board environment, remote access, etc.

❖ Eli's Plan

- ➢ Begin researching Tensil.ai
- ➢ Stretch goal: Begin working with Ultra96 to run linux on it.

❖ Mason's Plan

- ➢ Train the base RITnet model to gain an understanding of the process and how it works.

❖ Team Plan

- ➢ Continue research in individual areas. Consolidate information for future meetings and begin breaking down the design.

Advisor Meeting Notes

- We initially were going to work on the CPRE 488 MP-2 lab, but with how our project has developed our advisor suggested we just read through it and try to understand what is going on.
- Our advisors found a project from another university that uses the same board and PYNQ environment.
- Showed advisors our package we received with our hardware.

Client Meeting Notes - 9/29

- Client is working on NDA
- We will be looking inside the model to find areas of improvement
    - Can retrain specific filters
- After getting the board set up we should work on getting it connected to the internet to be able to remotely connect and update packages.
    - Directly connect the board to a workstation through JuPYter Notebook
    - A current ISU team is familiar with this and may be useful
- Connect the webcam to the board and get work on getting an image output
- Client helped us with our questions about the board and the JTAG card