EE/CprE/SE 491 WEEKLY REPORT 10

Video Pipeline for Machine Computer Vision

11/15/24 – 11/21/24
Group number: sdmay25-01
Advisors: Dr. Zambreno and Dr. Jones
Client: JR Spidell

Team Members:

Lindsey Wessel — ML Face & Eye Detection

James Minardi — Hardware

Eli Ripperda — Embedded Systems

Mason Inman — Semantic Segmentation Optimization

Table of Contents:

This week we continued testing algorithms, optimizing the model, and alignin environments. Most importantly, we worked with the existing VPIPE team to discuss their progress and the details of their code. This will set us up nicely for when we begin to take parts of their code. We also obtained GitHub access to view the previous teams work and add our own.

Past Week Accomplishments

- ❖ Lindsey's Accomplishments
  - ➢ Worked on getting more algorithms running to start testing
  - ➢ Worked on creating a file to feed images into each algorithm
    - ■ Times how long each algorithm works
    - ■ Tracks the success rate of each algorithm
  - ➢ and timing how long they take and the success rate of tracking the eyes
  - ➢ Gathered a database of diverse faces with different settings and challenges (lots of freckles, classes, major lightning contrasts, and new lighting colors and patterns.)
- ❖ James' Accomplishments
  - ➢ Meet with VPIPE team to review their code and ask questions.
  - ➢ Run through the code in person on their board
  - ➢ Obtain their pip freeze to make sure we have the same environment setup
- ❖ Eli's Accomplishments
  - ➢ Met with VPIPE Team to better understand their progress, environment, and technical system that we will receive from them
  - ➢ Attempted to compile a new .onnx file that Mason developed with opset [NDA] (the previous one had opset [NDA]).
- ❖ Mason's Accomplishments
  - ➢ Profiled the open-source model with Vitis-AI tools. This allows us to see where the model is spending the most time computing (doing local scalar operations).

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                    Name    Self CPU %     Self CPU   CPU total %    CPU total  CPU time avg   # of Calls
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              aten::item        0.89%      5.747ms       69.22%    448.271ms    184.322us         2432
 aten::_local_scalar_dense       68.76%    445.253ms       68.76%    445.253ms    183.081us         2432
         aten::is_nonzero        2.38%     15.445ms       28.46%    184.329ms    232.739us          792
                aten::to        0.83%      5.377ms        8.39%     54.341ms     27.725us         1960
           aten::_to_copy        0.56%      3.597ms        8.24%     53.383ms     49.065us         1088
             aten::copy_        7.09%     45.893ms        7.09%     45.893ms     39.158us         1172
               aten::sum        3.65%     23.620ms        4.89%     31.678ms     29.801us         1063
               aten::pow        2.59%     16.784ms        2.59%     16.795ms     10.670us         1574
            aten::conv2d        0.18%      1.185ms        1.57%     10.183ms    121.226us           84
        aten::convolution        0.04%    268.000us        1.55%     10.038ms    119.500us           84
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Self CPU time total: 647.592ms
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➢ Gained access to Semantic-Segmentation Repo and reviewed the depthwise-convolution model.

❖ Team Accomplishments
➢ Gained access to GitHub for future use.
➢ Setup practice presentation time with advisors.

Pending Issues
❖ Lindsey's Issues
➢ Difficulties measuring the level of computation expense with certain algorithms.
➢ Lack of time
➢ Waiting to test algorithms on the Ultra96
❖ James' Issues
➢ Issues running some demos on the board but I'm using it primarily headless, so I'd have to adapt the code to just output still frames into jupyter notebook for now.
❖ Eli's Issues
➢ Understand where the Tensil shell is relative to my file directory – How do I get the files that the compilation generated?
➢ I am not able to find the new .onnx file within the container
❖ Mason's Issues
➢ None.
❖ Team Issues
➢ No issues.

Individual Contributions

Name	Cumulative Hours	Week 4
Lindsey	114	12
James	92	8
Eli	92	8
Mason	116	8
Team	414	36

Forward Plan
❖ Lindsey's Plan
➢ Continue comparing algorithms to each other to find the most relevant algorithm for our project.

- - - Finish up slide show & "present" my findings to the team.
    - Create a file feeder to track algorithm locating time, and accuracy
    - Set up Development Environments for each algorithm
  - ❖ James' Plan
    - Confirm board environment is the same as the VPIPE team.
    - Figure out MVP for webcam -> display port on the board. It might require an RTL overlay, unsure.
  - ❖ Eli's Plan
    - Figure out how to retrieve generated files from compiling the ML model.
    - Compile Mason's ML model.
    - Analyze verilog code
    - Analyze other outputs from compiling ML model
  - ❖ Mason's Plan
    - Research depthwise convolution methods and Vitis-AI tooling. Make a presentation for the team to share the knowledge with clients as well.
  - ❖ Team Plan
    - Begin making design decisions and implementation

Advisor Meeting Notes

We discussed with Dr. Zambreno about the ethical responsibilities of using other teams' optimizations. Specifically with the client requesting to use other teams optimizations and building off of that as SDMay25-01 moves forward. After the discussion, we ultimately decided it is best to continue to use the open-source model as our baseline because that is where the research efforts have been spent this semester, however we will be able to bring forward several metrics of different optimization strategies, some of which will include optimizations from other teams. After that topic, we briefly discussed setting up a final presentation practice time for our next meeting.

Client Meeting Notes - 11/17

Team members shared weekly status reports with the client and set up meetings with other teams. Mason shared progress on Vitis-AI, with the client highlighting depth-wise convolutional work for parameter reduction. Mason will meet with Jack, a University of Iowa team member also working with the client, who experienced in depth-wise convolutions. James is setting up the PYNQ environment and collaborating with other teams to replicate dependencies. Lindsey's video demonstrating the ROI Haar-like algorithm with various glasses and glares received praise from the client. Further discussion was held about ethnicity bias for certain ROI Algorithms. The team also discussed setting up a GitHub repository for code sharing with the client and received access to their respective GitHub repositories.