

Computer Vision on Different CPU Architectures

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Project Overview

- Object Detection for Raspberry Pi 4 vs Raspberry Pi 5
- Controlled (to the best of our ability) Conditions
 - 4 GB RAM, ARM v8 4 core CPU, Neon Instruction set, GNU/Linux 12 OS
- Characteristics being tested
 - CPU Architecture: RISC (Pi 4) vs CISC (Pi 5)



VS.



Testing Methods

Geekbench

- Standardized benchmarking software
- Collect general performance scores and object detection data points
- Used to orient our expectations

Computer Vision

- Utilize a facial recognition model
- Train the model on our faces via photos captured in real time
- Run a live facial recognition test with the same camera
- Collected Data Points:
 - CPU Temperature
 - CPU Clock Speed
 - Frame rate

System Information with Geekbench

Raspberry Pi 5 Model B Rev 1.0 Raspberry Pi 4 Model B Rev 1.5

884
Single-Core Score
2090
Multi-Core Score
Geekbench 6.4.0 Preview for Linux AArch64

System Information

Operating System Debian GNU/Linux 12 (bookworm)
Model Raspberry Pi 5 Model B Rev 1.0
Motherboard N/A

CPU Information

Name ARM ARMv8
Topology 1 Processor, 4 Cores
Identifier ARM implementer 65 architecture 8 variant 4 part 3339 revision 1
Base Frequency 2.40 GHz
Cluster 1 0 Cores
Instruction Sets neon aes sha1 sha2 neon-fp16 neon-dotprod

Memory Information

Size 3.95 GB

294
Single-Core Score
681
Multi-Core Score
Geekbench 6.4.0 Preview for Linux AArch64

System Information

Operating System Debian GNU/Linux 12 (bookworm)
Model Raspberry Pi 4 Model B Rev 1.5
Motherboard N/A

CPU Information

Name ARM ARMv8
Topology 1 Processor, 4 Cores
Identifier ARM implementer 65 architecture 8 variant 0 part 3336 revision 3
Base Frequency 1.80 GHz
Cluster 1 0 Cores
Instruction Sets neon

Memory Information

Size 3.70 GB

General Geekbench Benchmarks

Raspberry Pi 5

Object Detection:

Single-Core: 20.6 images/sec

Multi-Core: 34.3 images/sec

Photo library:

Single-Core: 11.9 images/sec

Multi-Core: 30.5 images/sec

Background Blur:

Single-Core: 3.45 images/sec

Multi-Core: 9.93 images/sec

Raspberry Pi 4

Object Detection:

Single-Core: 2.77 images/sec

Multi-Core: 7.99 images/sec

Photo library:

Single-Core: 3.32 images/sec

Multi-Core: 10.5 images/sec

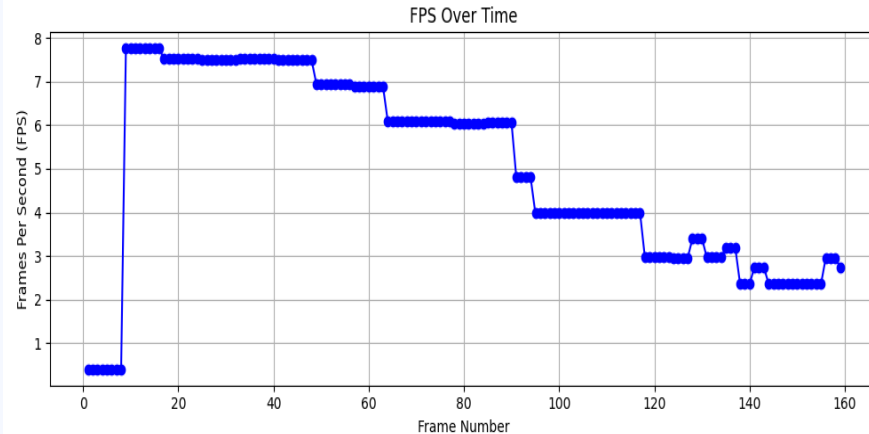
Background Blur:

Single-Core: 0.75 images/sec

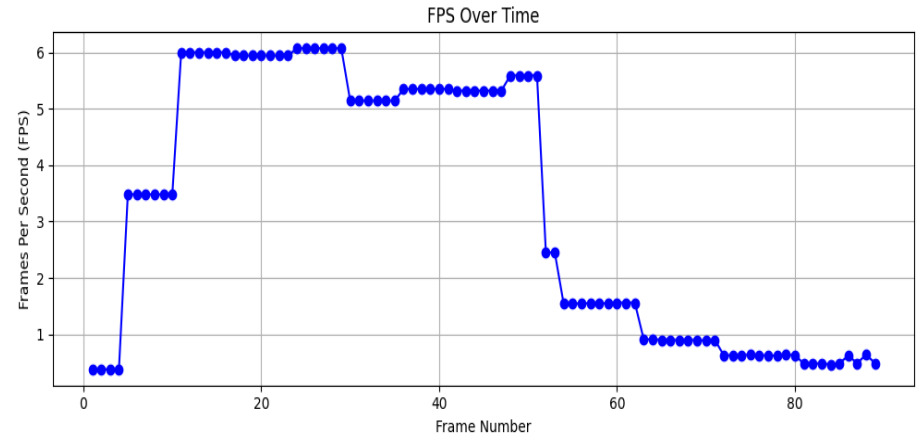
Multi-Core: 0.78 images/sec

Computer Vision Benchmark

Raspberry Pi 5

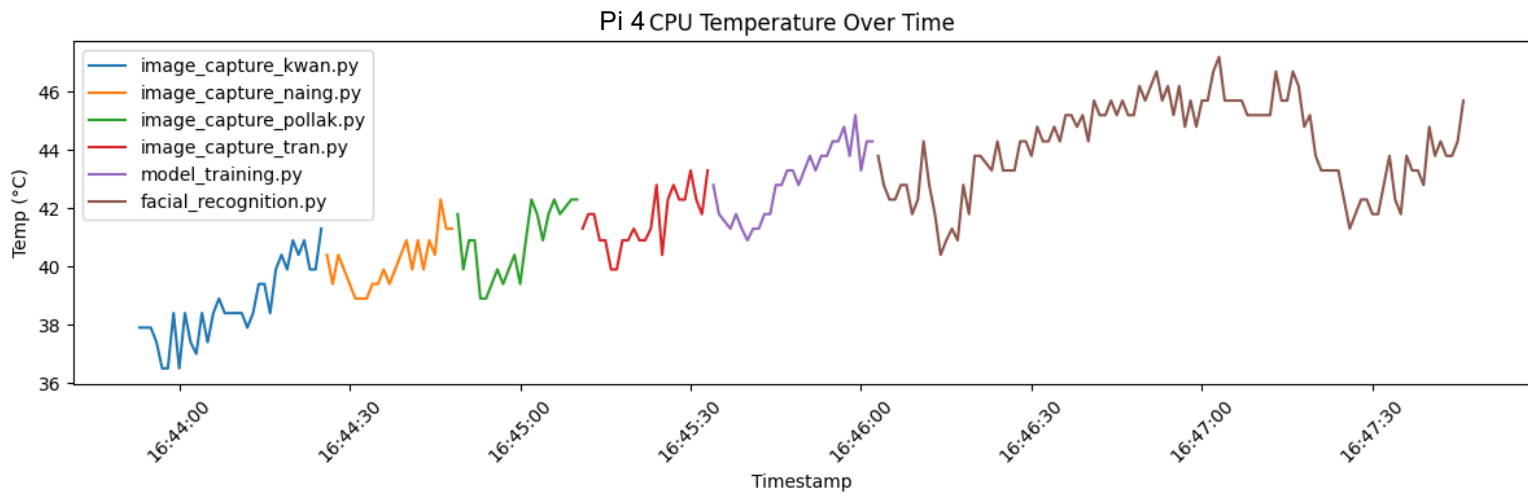
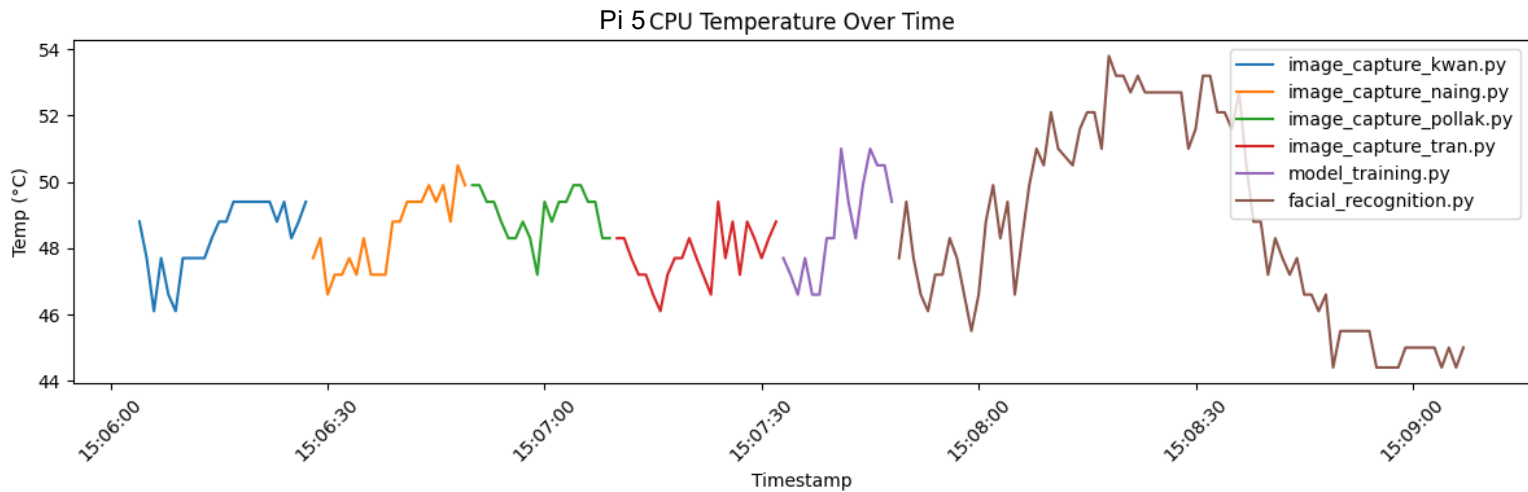


Raspberry Pi 4

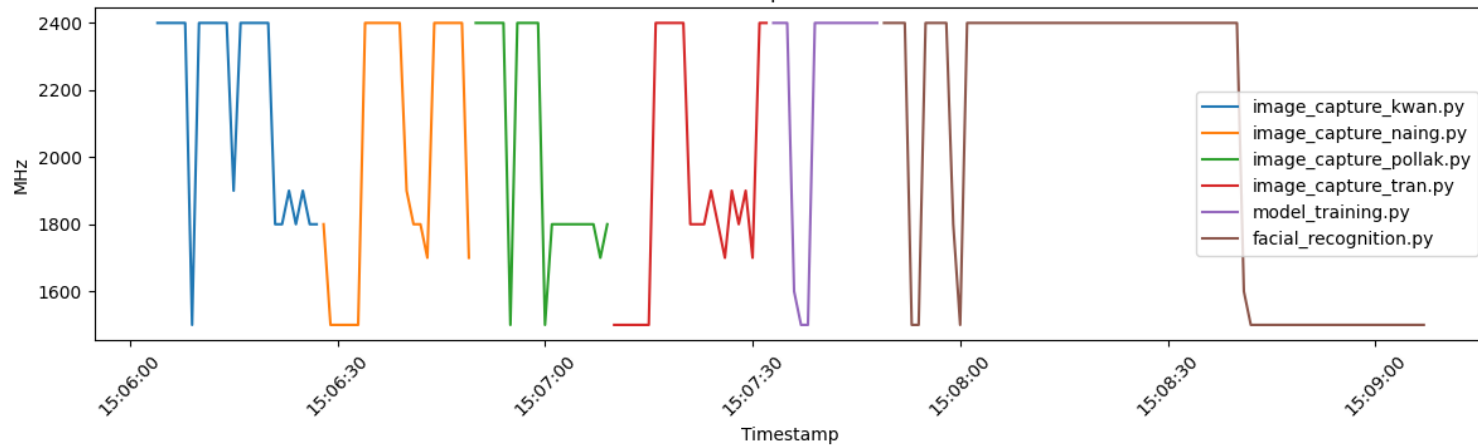


Note:

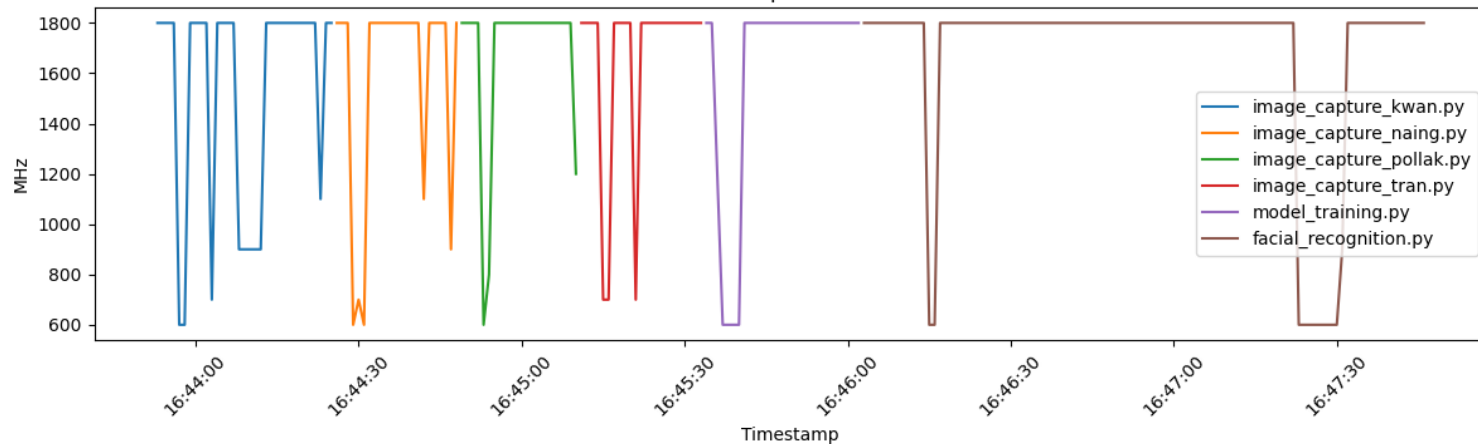
As we increase the workload by introducing more faces into the camera frame, the fps of both Pi 5 and 4 dropped significantly. This drop also created a lag effect where the facial detection software is many seconds behind what the actual camera is seeing.



Pi 5 CPU Clock Speed Over Time



Pi 4 CPU Clock Speed Over Time



Data Analysis

Raspberry Pi 5

Max FPS (no face in frame): **7.76**

Min FPS (4 faces in frame): **2.36**

Pi 5 consistently had higher FPS than Pi 4, and had less lag effect when fully loaded.

CPU Temp change: **9.4 °C**

Although Pi 5 started with a higher CPU temp, it had less CPU temp change compared to Pi 4.

CPU Clock maxed %: **55.5% @ 2400Hz**

Throughout the test period, Pi 4 run at max clock rate for more time than the Pi 5 did.

Raspberry Pi 4

Max FPS (no face in frame): **6.07**

Min FPS (4 faces in frame): **0.47**

CPU Temp change: **10.7 °C**

CPU Clock maxed %: **84.6 % @ 1800Hz**

Conclusion and Results

Although the Pi 5 had some small advantages over the Pi 4, (such as a slightly larger memory and slightly faster max CPU frequency) the Pi 5 outperformed the Pi 4 in most of our tests by a large margin. Thus, we can conclude that for AI applications such as facial recognition, the CISC architecture is better than the RISC architecture since it provide better FPS allowing the algorithm to better detect faces. We can also conclude that higher cost of the Pi 5 is worth the performance increase when comparing to the Pi 4.



Thank You!

Geekbench: [website link](#), [Raspberry Pi 4](#),
[Raspberry Pi 5](#)

Facial Recognition model: [Face Recognition](#)
[With Raspberry Pi and OpenCV](#)

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