Environmental Assessment of AV1, VP9, H264 and HEVC codecs for video streaming

Elyas Khorasani (77264206)

ICT and Environment

by Dr. Ah-Lian Kor

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Introduction

Increase in video streaming:

- CPU usage
- network usage
- Storage usage

AV1 VP9 H.264 MPEG-4/AVC H.265 HEVC High Efficiency Video Coding

AIM

The aim is to investigate the energy consumption and environmental impacts of AV1, VP9, H.264 and HEVC codecs video streaming and determine the most sustainable and green video coding for online streaming.

Objectives

RQ1: Is there a difference between the power consumption of different video codecs?

RO1: To conduct Descriptive analysis on the power usage of different video codecs

RO2: To conduct Inferential analysis on the power usage of different video codecs

RQ2: Does a better compression rate means less energy consumption while streaming?

RO3: To compare the file sizes with the energy consumption values

RQ3: What is the greenest video codec for streaming?

RO4: To examine the greenhouse gas emission of different video codecs

Methodology

Macro

ICT Services

USE stage

Micro

- Data Collection
- Data mining
- Assessing the Environmental Impact

Findings

File Size change after converting experiment sample video

Codecs	/H264	/HEVC	/VP9	/AV1
H264/	0%	7%	119%	113%
HEVC/	-7%	0%	104%	98%
VP9/	-119%	-104%	0%	-2%
AV1/	-113%	-98%	2%	0%

Descriptive Analysis for the application power usage

count	1532
mean	5.09
std	2.28

count	1470
mean	0.15
std	0.10

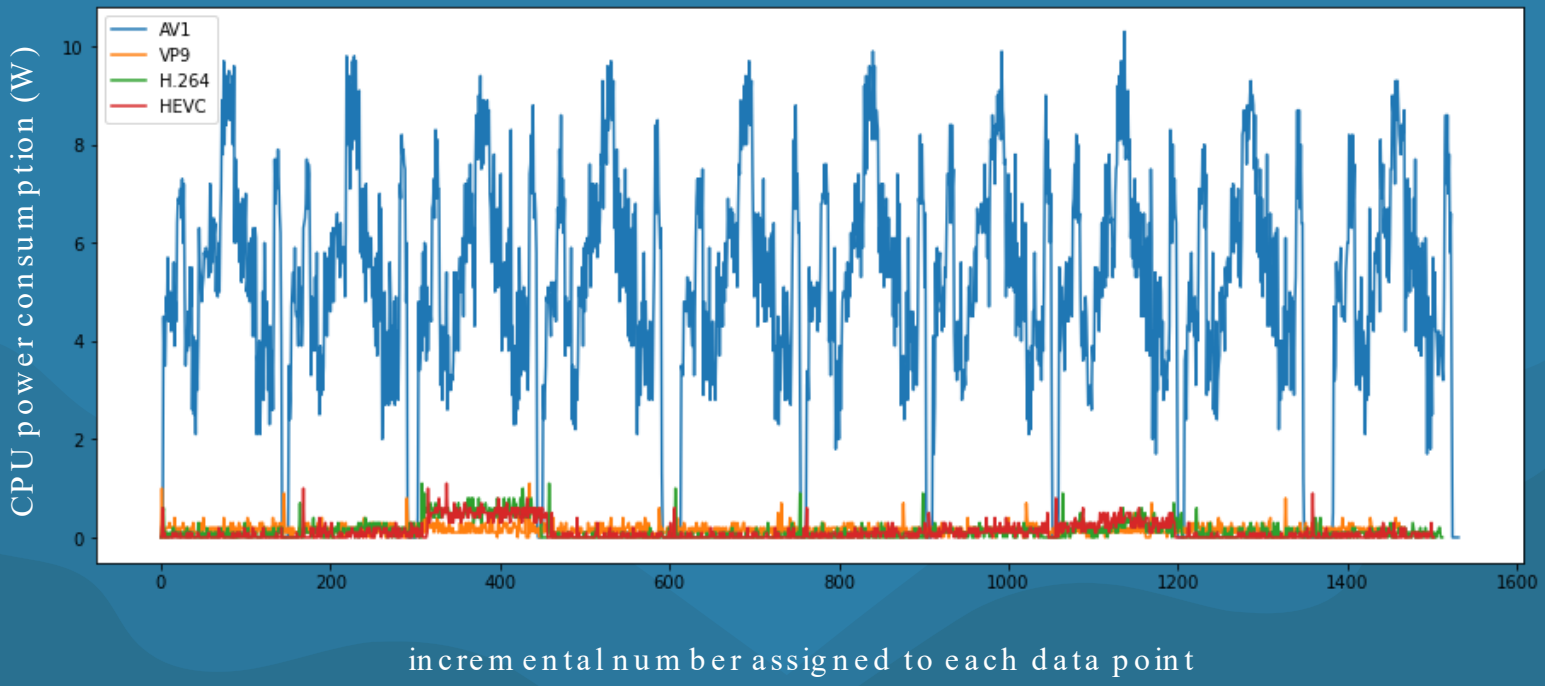
count	1513
mean	0.12
std	0.17

count	1503
mean	0.11
std	0.17

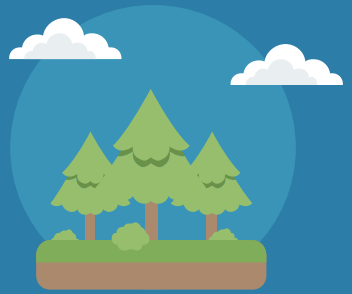
Entire video Average

AV1	VP9	H264	HEVC
4297.15 W	128.74 W	118.57 W	110.85 W

Comparing Application Power Usage for Different Codecs



Inferential Statistics



ANOVA test for all the codecs

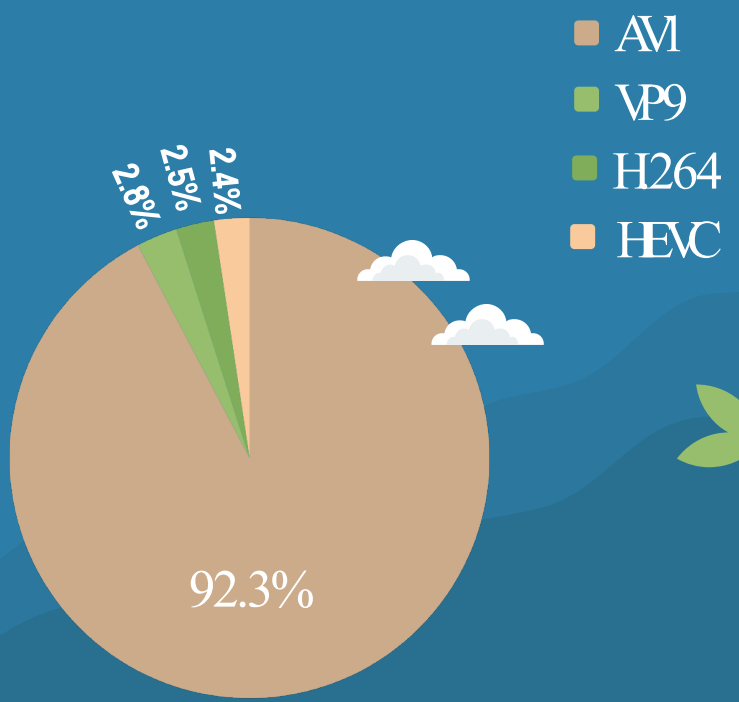
F Value (x) = 6958.14
P Value (x) = 0
The null hypothesis can be rejected

ANOVA test for VP9, H264 and HEVC

F Value (x) = 22.881
P Value (x) = 1.29805e -10
The null hypothesis can be rejected

Emission Comparison

Codecs	CO_2e (kg)	CO_2	CH_4	N_2O
AV1	1	0.99	119%	113%
VP9	0.03	0.029	104%	98%
H264	0.027	0.027	0%	-2%
HEVC	0.025	0.025	2%	0%



CONCLUSION

HEVC

Greenest for Streaming

VP9

Greenest for Storing

Future Work

MPEG-5 LCEVC

THANKS!

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