Performance and Application of the NVIDIA NVENC H.264 Encoder

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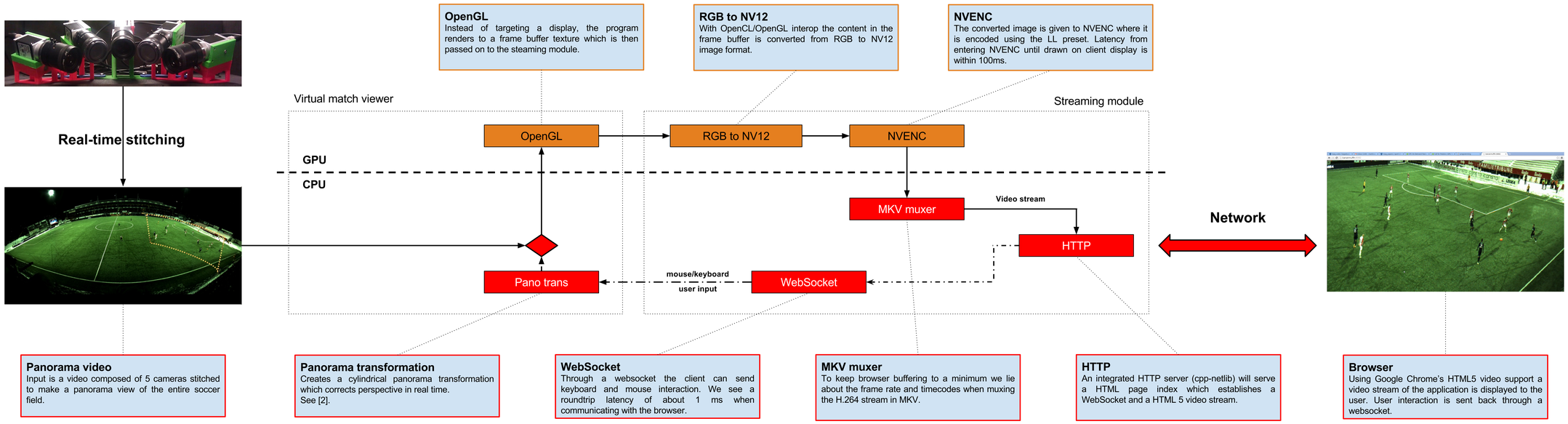
Abstract

This poster describes the delivery pipeline in the Bagadus soccer analysis system. The delivery pipeline takes a real-time stitched panorama video, and generates a personal virtual camera that can be controlled by the clients (end-users). An important component in this pipeline is the H.264 encoding of the personalized virtual view before delivery. By using Nvidia's NVENC hardware encoder, we are able to maintain the same visual quality as the software x264 encoder with a reduction in both CPU utilization and encode latency.

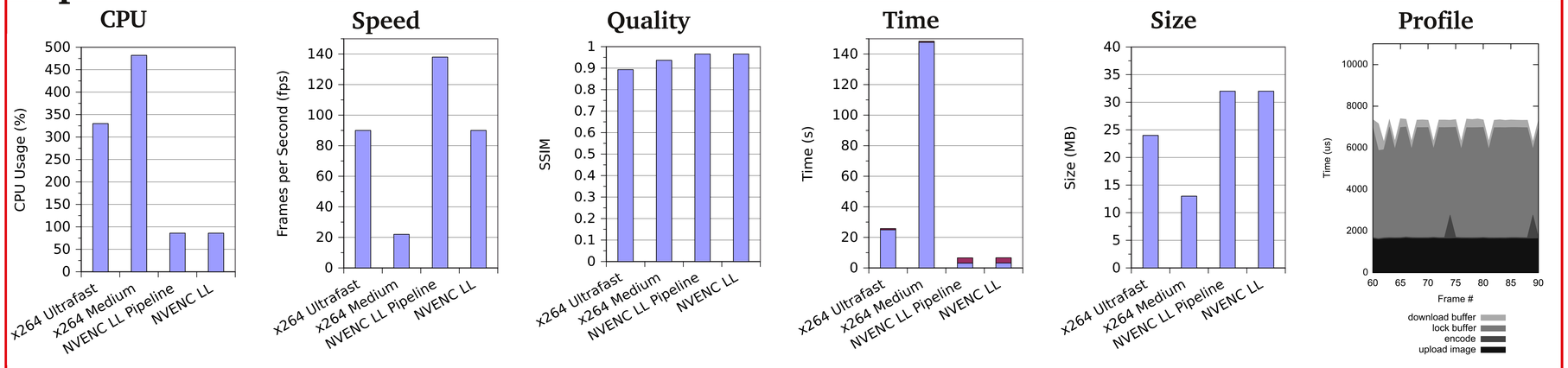
Bagadus

Bagadus is a soccer analysis system, which is described in [1]. On this poster we will focus on the panorama video pipeline. It consists of five 1080p cameras in a matrix recording the matches while a positioning system tracks the individual players. The videos from the cameras are then stitched into a 4450x2000 panorama video, which in turn is used to create a virtual camera. Using calculated transformation matrices we are able to highlight players by their position in the frame. By using player positions we are able to create advanced queries such as showing every time a given player is within 30 meters from the opponent's goal line, and measure speed/acceleration etc.

HTTP Application Streaming



Experimental Results



- NVENC gives better video quality compared to x264 Ultrafast and Medium presets
- The framerate produced by NVENC is 90 frames per second, and 138 frames per second when used in a pipeline setup.

Experimental results from encoding 690 frames of the "tractor" 1080p test sequence with an Intel Core i7-2600 and NVENC on a NVIDIA Quadro K2000 GPU

- NVENC uses much less CPU resources which can be used for other tasks.
- The files produced by NVENC LL in variable bitrate are a bit larger when comparing with x264 Ultrafast.
- Profiling shows that most of the time is spent on output buffer locking.

Summary

We were able to render a 1080p stream at 60 fps within 100ms in the client browser. On the server side, NVENC allows us to maintain the same visual quality as the software x264 encoder with a reduction in both CPU utilization and encode latency.

We are also experimenting with using NVENC for other stages of the Bagadus panorama creation pipeline, such as storage for both the panorama and the single camera streams.

Further work will include studies on how many clients we can serve using multiple GPUs running NVENC, and also the possibility of using GPUDirect with PCI Express interconnect Cards from Dolphin Interconnect Solutions to multicast the panorama video into multiple machines for endowing and streaming.

References

[1] H. K. Stensland, V. R. Gaddam, M. Tennøe, E. Helgedagsrud, M. Næss, H. K. Alstad, A. Mortensen, R. Langseth, S. Ljødal, Ø. Landsverk, M. Stenhaug, P Halvorsen, C. Griwodz and D. Johansen. Bagadus: An Integrated Real-Time System for Soccer Analytics, In: ACM Transactions on Multimedia Computing, Communications and Applications (TOMCCAP) 10(1s), 2014

[2] V R. Gaddam, R. Langseth, H. K. Stensland, P Gurdjos, V Charvillat, C. Griwodz, D. Johansen, P Halvorsen. Be Your Own Cameraman: Real-Time Support for Zooming and Panning into Stored and Live Panoramic Video, To appear in Proceedings of the 5th annual ACM conference on Multimedia Systems (MMSys), 2014