

## Embedded real-time video processing with FFmpeg and CUDA

FFmpeg is a very powerful tool that allows any user to perform video processing. It is capable of muxing, transcoding applying filters and it tries to do all that by exploiting available accelerators whenever possible. It is largely utilized within many open-source video projects, and it has a very large developer community while also receives contributions from companies such as Google.

Having such a versatile software is extremely useful as it allows to save quite a lot of time from manually implementing matrix algorithms for each pixel format. In the case of a fairly new platform such as the Nvidia Tegra, the support is often not perfect as the software may need to be updated to be able to utilize the capabilities offered by the platform.

The conducted study was mainly split in 3 phases, analyze the available features on the platform, provide a framework to extend the currently supported features and finally analyze the effective performance of a video processing stack.

The developed framework allows to transparently bind the FFmpeg processing functions with custom functions. This results in a very flexible way of customizing the video processing, the GPU acceleration can be manually added even when is not yet officially supported, without the need of altering FFmpeg's source code.

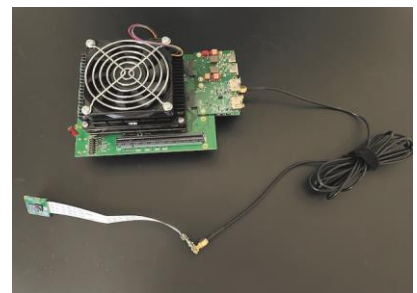
Other challenges such as zero-copy and support for the Tegra bayer 10 raw pixel format were tackled during the research and the framework resulted to be a very important key to successfully test new functionalities. The zero copy technique has shown to be able to save a significant amount of time during the workflow of the program as it allows to access the video input buffer without the need of copying its content.

Finally, the final experiments have shown that it's possible to concatenate a video input stream with GPU processing (CUDA) and H264 hardware or CPU encoder while maintaining the input frame up to 60 FPS. By using the dedicated H264 hardware video accelerator the CPU can further exploited for other parallel processing.

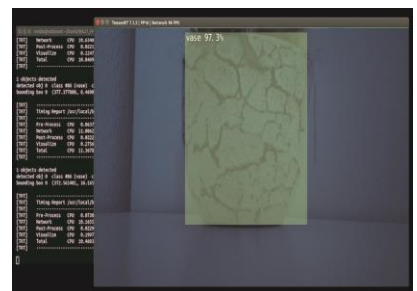


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Custom Nvidia Tegra Xavier  
developed at InES



Real-time video processing with AI  
object detection