Object Detection on GPU

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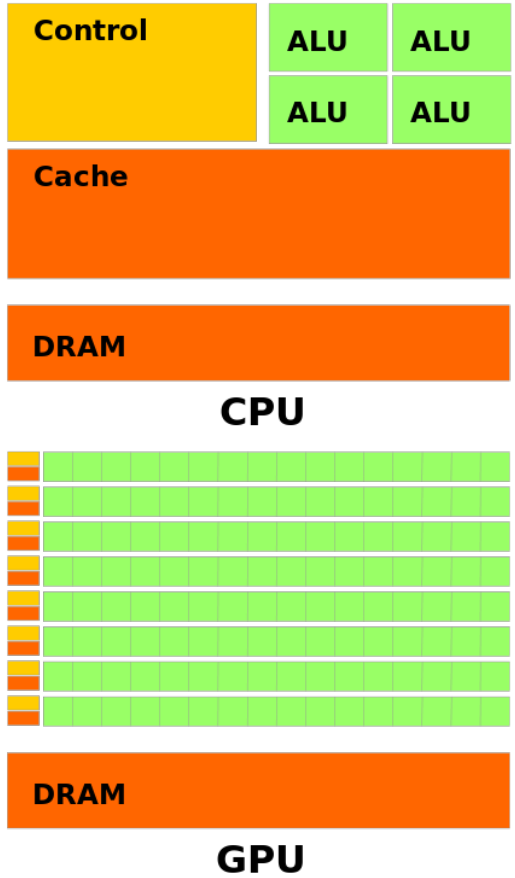
Goals and contributions of the thesis

- CUDA implementation of an object detector (waldboost+lbp) working real-time on videos (25fps 1080p)
- Comparative measurements of GPU and CPU versions, GPU optimization research, measurements and discussion

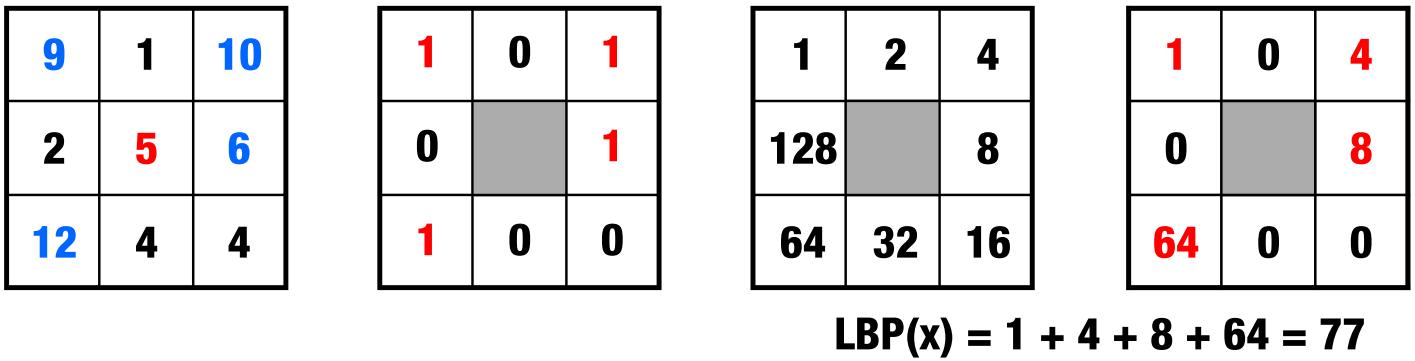
NVIDIA CUDA

- GPGPU *(General-purpose computing on graphics processor units)* technology
- similar to: OpenCL, C++ AMP, OpenGL compute shaders, DirectCompute
- extension to C/C++ (CUDA C) - uses its own compiler NVCC
- massive parallelism
- scientific calculations (chemistry, bioinformatics, . . .), computer vision & imaging, medical imaging, weather, numerical analytics

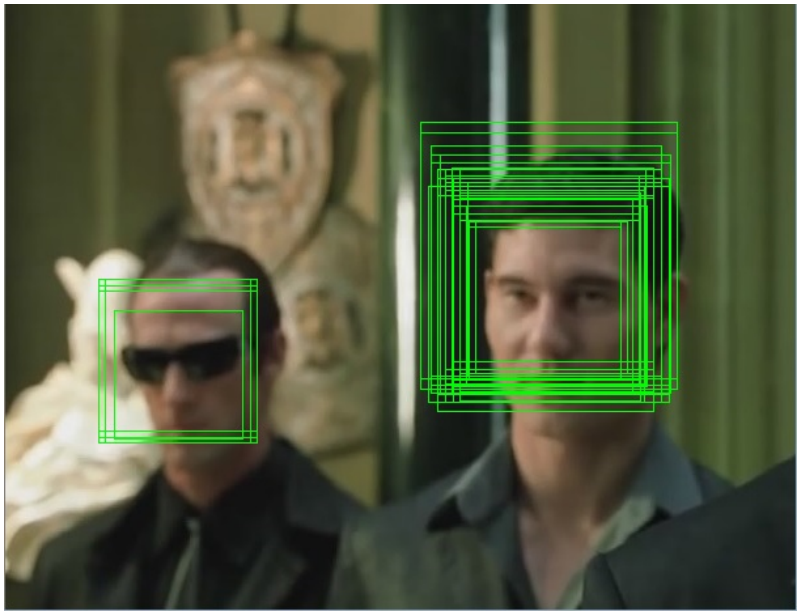


Object detection

- detecting specific objects of a certain class in digital images or videos
- **WaldBoost** - meta-algorithm, which sequentially processes a sample and discards when accumulated response reaches certain threshold
- **LBP** *(Local Binary Pattern)* - feature to describe properties of an image



Implementation

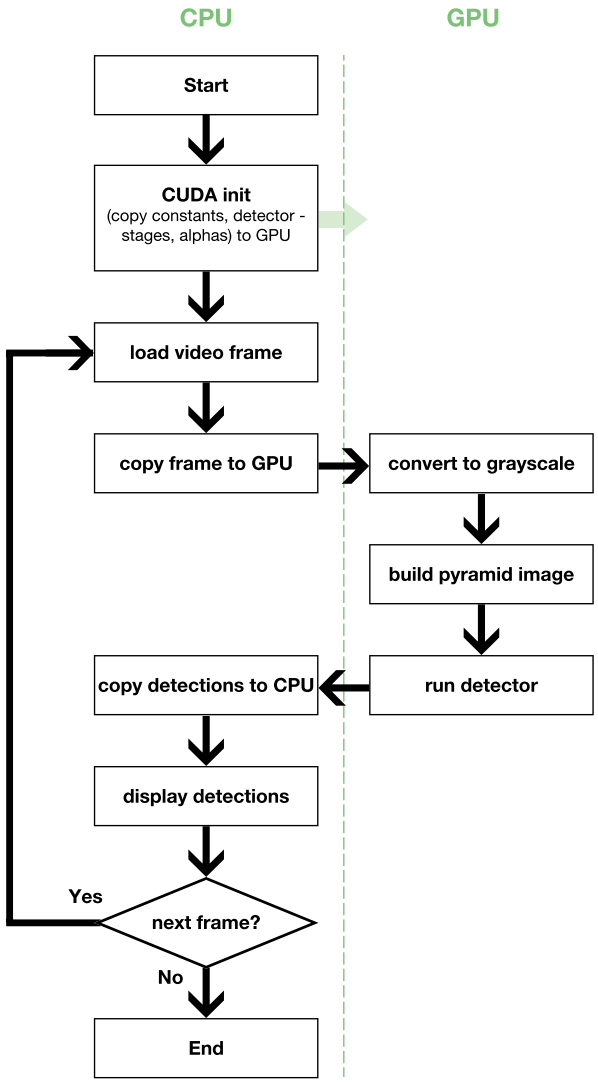


- GPU and CPU implementation
- GPU version (NVIDIA Quadro K1000M):
  25 ms (pyramidal image)
  60-100 ms (detection)
  10 FPS (HD video)

`https://github.com/mmaci/vutbr-fit-object-detection`

Optimizations

- Bilinear interpolation using texture memory used for pyramidal image
- LBP features are 2x1, 1x2 and 2x2 - pyramidal image stored in texture memory and LBP computed using bilinear interpolation



Future work

- thread rearrangement
- Lanczos interpolation
- pyramidal build optimization + mipmaps
- CPU and GPU measurements

Thank you for attention.