

Proposal for a Master Thesis at the
Chair of Robotic and Embedded system

Multi-Target Tracking with PHD Filters in a Heterogeneous Platform

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Project Description

In the context of TU9 project, research at the Institute of Robotics and Embedded Systems is dealing with the challenge of providing high-performance ECUs as an enabling technology applicable in the automotive field, which will be a heterogeneous system with multi-core CPU, FPGA, and GPU.

A typical application of ECUs in car is to avoid driving accidents. Pedestrian detection and tracking is an essential and significant task in any intelligent video surveillance system, as it provides the fundamental information for semantic understanding of the video footages. It has an obvious extension to automotive applications due to the potential for improving the safety systems. This can help in developing warning systems to alert a driver of an impending accident. This is particularly a challenging problem due to multi-target detection, complex traffic on the road that obstructs the lane markings, the shadows cast by buildings or trees. A possible solution is that we use FPGA or GPU to accelerate the computing of pedestrian detection, thus reducing the computing burden on main processor, which is the same as the lane detection and tracking in [1, 2].

The heterogeneous platform composing of CPU, GPU, FPGA was tested by a road lane detection and tracking application to be a promising platform that can greatly accelerate the execution of usual program. The tests revealed a processing frame rate of up to 627 Hz on the GPU, 478 Hz on the Stratix V FPGA and 38 Hz on the Cyclone V SOC.

On the next step, we plan to apply the multi-target tracking, like pedestrian tracking shown in Fig. 1, in such a heterogeneous platform. The multi-target tracking is high computing demanding, which is expected to be greatly accelerated by the heterogenous platform.

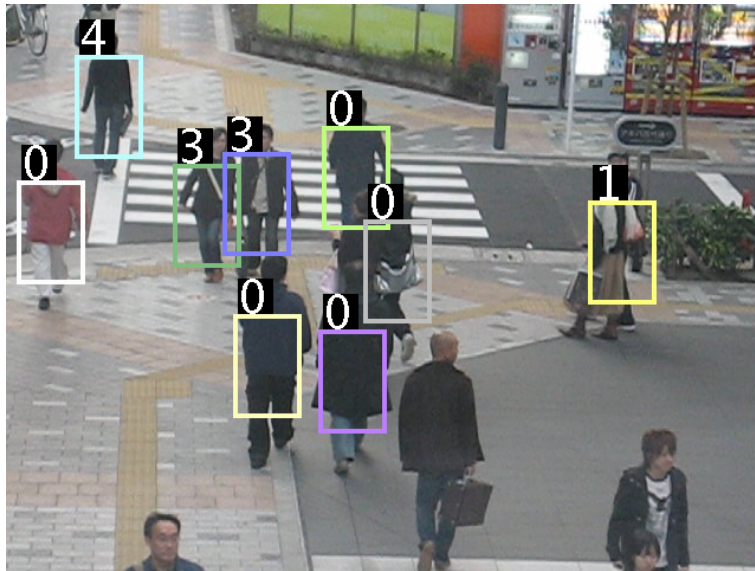


Figure 1: Pedestrian Tracking

Requirements

The basic requirements will be that

1. Implement the multi-target tracking with PHD filter, like pedestrian tracking, in the heterogeneous platform composing of CPU, FPGA, and GPU devices.
2. Evaluate the effectiveness of this application.

Arrangement

The project will include the following phases:

- Learn the state-of-art multi-target tracking with PHD filter.
- Learn the OpenCL programming skill.
- Implement the state-of-art multi-target tracking with PHD filter in OpenCL code. Run it in the heterogenous platform.
- Testing the effectiveness by running some benchmarks.

Kind of Work

- 25% theory
- 45% implementation
- 20% evaluation
- 10% documentation

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References

- [1] N. Madduri, "Hardware Accelerated Particle Filter for Lane Detection and Tracking in OpenCL," 2014.
- [2] J. Botsch, "Real-time lane detection and tracking on high performance computing devices," 2015.