Energy efficient object detection and tracking through adaptive operation on heterogeneous multi-core systems

Student: Yubo Zhi (yz39g13@soton.ac.uk)
Supervisor: Dr. Geoff Merrett (gvm@soton.ac.uk)

Because of environmental issues and rapid growing mobile computation requirement, power consumption on electronic devices become critical, especially on platforms that are running on battery or harvesting energy from environment. As battery technology development is not as fast as electronic technology development, lower power consumption implies longer battery life for mobile devices e.g. laptops and smart phones, also lower environmental impact. This project is purposed to reduce power consumption on object detection and tracking applications.

Object detection and tracking has played an important role in robotic and automatic systems, but video processing algorithms consumes a significant amount of energy. The objective of this project is to dynamically control camera configurations, active time and the execution of video processing algorithm to achieve an overall saving in energy consumption. The methodologies will be investigated are automatic frame rate and resolution reduction when no objects are in the view and when velocities of objects moving are slow. In order to achieve this, automatic feedback control need to be developed based on previously tracked objects' positions and velocities. GPU accelerated computer vision algorithm will also be deployed to minimise power consumption and computation time. For easier power consumption analysis, the Jetson embedded development platform featuring a quad-core ARM CPU and a CUDA-enabled Tegra GPU, introduced by NVIDIA, will be used in this project.

In technical aspect, OpenCV API for Tegra with CPU optimisation and CUDA GPU acceleration developed by NVIDIA for the embedded platform will be used to implement the video processing algorithms. The widely used background subtraction algorithm together with blob detection will be applied to detect foreground moving objects and get their coordinates. Afterwards, Continuously Adaptive Meanshift (CAMshift) algorithm will be used to track movements of objects. A camera will be interfaced with the platform to do capturing and detecting objects in real-time, by a Linux kernel module driver. Afterwards, automatic feedback frame rate and resolution control will be implemented, then power consumption with different operation modes will be investigated and the energy saved by applying the proposed method will be analysed.

If time allows, energy-efficient object identification may also be implemented.