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Institut für Technische Informatik
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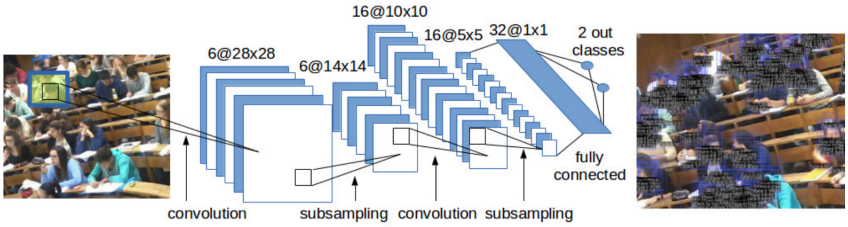
Semester / Master Thesis:

Energy-Efficient Vision on Batteryless Platforms

In recent years, computer vision has become more accessible to performance constrained, low power platforms. This is mostly due to the development of novel brain-inspired computer vision algorithms. Convolutional neural networks (CNN), for example, are designed to imitate the deep, layered structure of the brain's visual cortex and its capability to link low-level features and derive higher level concepts in each new layer. In this way, they can often achieve better efficiency and generality than traditional computer vision techniques.



With that in mind, we want to explore their effectiveness on batteryless (e.g. solar-powered) platforms. These systems must be designed with tight energy constraints, and usually contain only memory-constrained, ultra-low power microcontrollers. An example for such a platform can be the NXP LPC54000. It features two cores: a slow but low-energy ARM Cortex M0 and a faster but more energy-consuming ARM Cortex M4. We have developed an energy burst scheme can execute different tasks using only a small energy storage (e.g. SMD capacitor), and can tolerate volatile harvesting conditions.

Your Project: During this project, which is a collaboration between TIK and IIS, you will learn about convolutional neural networks, multi-core programming frameworks, and energy harvesting. Your task will be to specify a CNN using a high-level multi-core parallel programming framework that was developed at our group. The goal is to have a functional, batteryless prototype based on the NXP LPC54000. Depending on your interests and type of the thesis, this might consist of the following steps:

1. Get acquainted with the concepts of CNN and parallel programming.
2. Write a first CNN implementation for a PC.
3. Adapt the implementation to the LPC54000, paying attention to the severe memory constraints.
4. Evaluate the performance of your LPC54000 implementation and optimize it.

Requirements: You should have experience with embedded system programming in C. Knowledge on neural networks would be an asset, but is not required.

Interested? Please have a look at `http://www.tec.ethz.ch/research.html` and contact us for more details!

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Further reading

- Brain-Inspired Classroom Occupancy Monitoring on a Low-Power Mobile Platform. Conti, F. et al. *(Accessible from ETH network)*
- Dynamic Energy Burst Scaling for Transiently Powered Systems. Gomez, A. et al.