"FPGA implementation of neutral networks for scene segmentation with a Time Of Flight camera on AGVs"

Abstract:
Autonomous Guided Vehicles (AGV) are used in many different ways in industry. In order to control these and make predictions about the environment, there are various computer vision-based approaches. One task can be to recognize and avoid obstacles. But for this they need a reliable prediction about the environment on the basis of which decisions can be made. Prediction about the environment can be implemented in AGVs with cameras and intelligent evaluation algorithms such as scene segmentation. In this work, the images of a Time-Of-Flight camera are segmented with the help of neural networks, which currently represent the most modern methods of segmentation. Since an AGV does not have much computing power, a key requirement for the neural network is its suitability for use on small hardware. Based on the architecture of U-Net, a neural network is adapted to account for hardware requirements, is then trained in TensorFlow and finally implemented in VHDL. The quantization process is considered and its effect on the results are analyzed. The operations in VHDL are implemented exactly like in TensorFlow, which means that the generic blocks can be used to implement other neural network architectures in hardware. The entire toolchain from data acquisition to implementation in hardware is considered and the comparison of hardware to software verifies the successful implementation. At the end, a first look at the synthesizability in an FPGA is taken to draw conclusions about further optimizations.

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