

QRTECH is an independent company specialized in product development, industrialization and supply of automotive electronics and software. Our organization and competence masters all phases of development including requirement engineering, electronics and software development, environmental and EMC qualification and manufacturing. Today QRTECH electronics can be found in vehicles made by AB Volvo (Volvo Truck, Volvo Bus, and Volvo CE), BMW, Daimler, Ford, Mack, Renault, Volvo Cars, Jaguar, Land Rover, Mazda, etc. QRTECH facilities are located in Gothenburg with high capability electronics and vehicle labs. Today a large focus in the automotive industry is autonomous cars and machine learning. New powerful methods and solutions including deep learning neural networks are rapidly being developed. There is a large potential to apply these new emerging technologies also in other application areas than automotive, such as autonomous aircraft and in medical technologies.

## Master Thesis: Combining Artificial Neural Networks with FPGA in Autonomous Vehicles

There is extensive enthusiasm regarding autonomous vehicles and how they could contribute to society in the future. By combining different technologies and state-of-the-art methods, autonomous driving could provide a safer environment for motorists, cyclists and pedestrians, and avoid traffic accidents from occurring. One common tool used for autonomous driving is machine learning or more specifically, artificial neural networks. By detecting other cars and road restrictions a neural network can analyze the road as a human and, in some cases, even perform better when detecting unpredictable objects/events. In order to ensure this it is of most importance to have a reliable system, machine learning has been proven to be effective for object detection and classification. However, the deep neural networks are on GPUs, which not only have a high power consumption but it also is expensive. There is, however, a possibility to use a Field Programmable Gate Array or FPGA instead of the GPU. They have approximately the same price but are more optimized for these applications.

This thesis aims to develop a neural network that may identify simple objects and implement this ready trained network into an FPGA (Field Programmable Gate Array).

The thesis work will allow QRTECH to expand knowledge inside the field of autonomous driving and help create more opportunities for cross-industry projects.

The thesis will consists of:

- Implementation of a deep neural network.
- Studies on how FPGA can be applied in an autonomous society.
- Present and evaluate a FPGA solution in combination with neural networks.

Possible extension of the scope:

- Verification methodology for neural networks in terms of functional safety.
- Implementation within other fields, such as the medical field.

It would be good if at least one in the pair have completed any course concerning any field listed below.

- At least one of the following three:
  - Machine Learning
  - Neural Networks
  - Image Analysis
- Basic programming skills
- FPGA
- Basic Ubuntu (Preferred)

## How to apply

The thesis is on Master thesis level and shall be performed by two students. The thesis will be carried out at QRTECH premises in Mölndal during the spring of 2019.

Please send your application including CV and report card to:

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