AUTOMOTIVE USE-CASE

VEDLIoT
Very Efficient Deep Learning in IoT

DISTRIBUTED PROCESSING OF MACHINE LEARNING IN IOT

OVERVIEW

Light vehicles contains an abundance of ECU's today, each responsible of a well-defined component in the overall architecture of the vehicle. One example is the camera ECU which serves as the interface towards the out facing camera which is observing the environment ahead of the vehicle. The ECU is tasked with interpreting the scenario ahead of the vehicle, such as detecting actors in the environment. The trend has shifted in the recent years where the premium segment moved towards centralized processing, implementing more powerful processing capabilities shared between multiple applications. The hardware resources for central compute is expensive which in turn results in lower end segments not being able to utilize some safety related applications. The aim for the automotive AI use case is to evaluate how the AI can be take advantage of multiple combinations of hardware's by distributing the machine learning model. Some of those resources may be outside of the vehicle, such as in the upcoming 5G NR base stations. The work includes an effort to understand the feasibility of distributing the model inside as well as outside the vehicle whilst maintaining the integrity of the function.
The automotive use-case is based on an existing vehicle safety feature known as Pedestrian Automatic Emergency braking (Pedestrian AEB). This functionality is described by, for example, the Euro NCAP organization in.

ACCELERATED MACHINE LEARNING

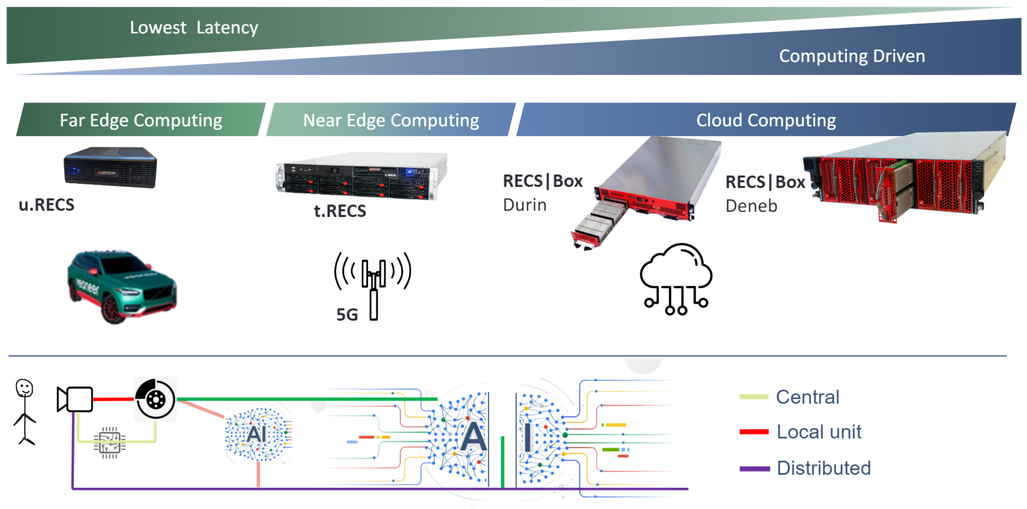
The automotive use-case for VEDLIoT assumes an open road with a pedestrian wand possibly other objects. The data has been collected and labelled for all the combinations as described above. Data for ten runs per combination results in a total of 290 data sets with continuous images. The images make up the learning, test and verification data.
The labelling strategy used to create labels for the data sets was to classify one of two conditions:
- Pedestrian on the road
- No pedestrian on the road

The classification will lead to an input to the AEB decision algorithm of stopping the vehicle to prevent a collision.

Data variations
- Target type
  Pedestrian, Other object (trash bin), No target
- Target longitudinal distance
  Every 1m over 1 to 100m (handled by continuous sampling of pictures duringeach drive)
- Target lateral distance
  1, 1.5, 2, 2.5, 3 m
- Target attitude
  Moving towards, Moving away, Crossing
- Background type
  Tarmac, Grass
- Illumination
  Sunlight, Cloudy, Rain

DISTRIBUTED PROCESSING

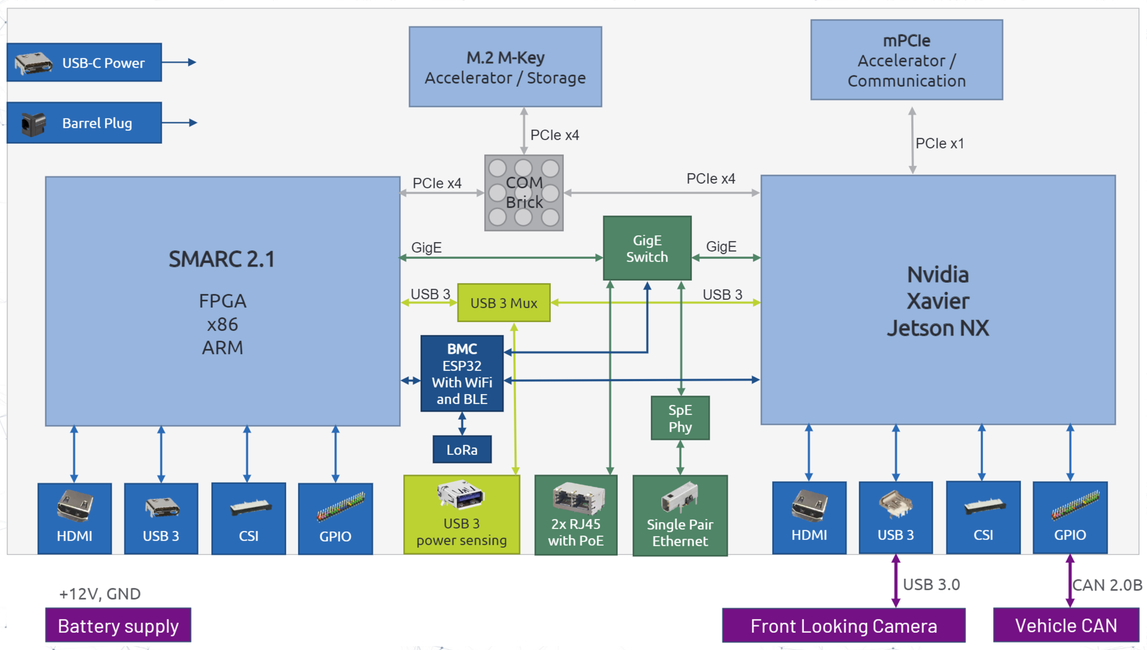
Sensor data will, in future systems, be used by multiple, physically separated applications. To ease the optimisation of data transfer and computational capability requirements, at each application node, we identified distributed processing of applications as a possible solution. This also applies to the learning of AI-based systems, where distributed processing resources are interconnected between far edge servers inside the car towards highly scalable cloud servers.



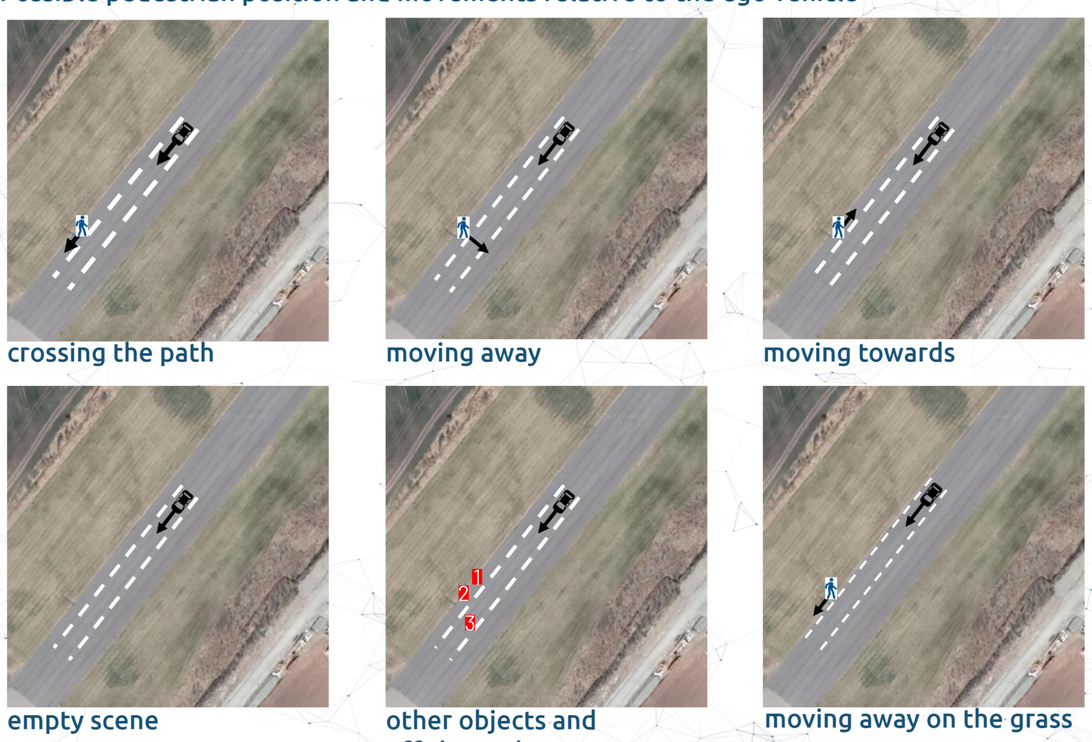
HARDWARE

In the VEDLIoT project, we have selected to use the RECS hardware platform: One u.RECS far edge server, placed in the car and one t.RECS placed in the base station. u.RECS contains a SMARC module, compatible with the existing camera processing device, and a Jetson NX, which equals the central computer (ECU) available in cars today. It also supports a 5G modem, for the communication to the base station, through the mPCIe interface.
The t.RECS hardware platform for far edge computing will be used as the back-end of the base station. It will receive and handle information from the agent in the proximate area. The information will be processed by the compute machine and the result will be transferred back to the agent.

u.RECS far edge server in test car environment



Possible pedestrian position and movements relative to the ego vehicle



CONTACT

Stefan Andersson, stefan.andersson@veoneer.com
Olof Eriksson, olof.eriksson@veoneer.com
VEONEER, Sweden
www.veoneer.com

@VEDLIoT
VEDLIoT Project
VEDLIoT EU Project

PARTNERS

Funded by the European Union Grant No 957197

www.vedliot.eu