EMBEDDED SOLUTIONS FOR DEEP NEURAL NETWORKS

Goal of the project

The goal of the project is to develop a technical solution that allows automatic transfer of Deep Neural Networks to dedicated embedded systems. Appropriate neural models need to be chosen in order to fit the specific requirements and limitations of an embedded system. At the same time, a suitable embedded platform needs to be chosen to accommodate all the necessary computational structures of a neural network and to satisfy the power constrains to the application.

Short description of the project

The project aims to insert Artificial Intelligence specific methods into the automotive applications.

Implementation period

01.02.2020 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

1. Identifying and studying the different types of deep neural networks: CNN-Convolutional Neural Networks, RNN-Recurrent Neural Netwoks, DBN-Deep Belief Networks
2. Choosing an appropriate development framework: Tensorflow (Keras), Caffe, Matlab
3. Developing and automotive specific application: traffic sign detection, pedestrian detection, drowsiness detection.
4. Studying the available embedded solutions and choosing the appropriate one.
5. Studying the computational limitations introduced by the hardware constrains.
6. Developing a deployment tool.
7. Testing and validating the results.

Results

1. Convolutional Neural Networks (CNN) and PointNet have been found to best fit automotive applications. These nets are also portable and can run on embedded systems.
2. Both Tensorflow and Keras are suitable for developing network architectures, training and testing the networks. MATLAB is also useful for preprocessing data.
3. Two automotive applications have been developed: traffic sign detection using CNN; driver hand gesture recognition using a 3D ToF (time of flight) camera and a 3D PointNet;
4. The best embedded system to run the applications was Google's Coral DevBoard, with TPU accelerator to efficiently run tensor operations.

Applicability and transferability of the results:

- The results are directly applicable in the automotive industry.
- Both the traffic sign recognition and hand gesture recognition applications improve driver-car interaction and so driving safety.

Research team

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