FRACTAL PROJECT RESULTS AND CONTRIBUTIONS

ABSTRACT

FRACTAL - A Cognitive Fractal and Secure EDGE based on a unique Open-Safe-Reliable-Low Power Hardware Platform Node

The motivation to initiate the project FRACTAL was to satisfy challenging requirements such as time-predictability, dependability, energy-efficiency, and security on modern industrial edge computing devices (visit https://fractal-project.eu/ for further information).

The aim of FRACTAL was to create a **reliable computing platform node**, realizing a so-called Cognitive Edge under industry standards. This computing platform node is a building block of **scalable decentralized Internet of Things**. FRACTAL makes smart edge systems able to learn from the surrounding context and adapt to changes in extremely dynamic environments. This allows edge systems to become Cognitive Systems that will gain capabilities and efficiency in a fully autonomous manner as required for the most demanding industrial applications.

As an overall result of the project, the FRACTAL System was produced, which is a Modular Open Reference Architecture, that includes the set of components developed along the project. The FRACTAL System and the Building Process are published in our website (https://fractal-project.eu/about/fractal-system/), the objective is to provide to the developers community a guideline on the FRACTAL components that are available for the development of edge computing applications. The FRACTAL System constitutes a first milestone, and it is the consortium´s intention to continue its evolution in future projects.

Low Latency Object Detection with Cognitive Awareness for Reliable Computing Platforms

A major contribution to FRACTAL's project objectives by Siemens was a use case in which a reference node for object detection with cognitive awareness was prototyped. More concretely, the uses case targets electronic product lines where visualizations of printed circuit boards with electronic components are analyzed for faults and their correct placement – which required a sufficient degree of object detection accuracy enabled by AI algorithms (CNN – Convolutional Neural Nets). Within the use case, the capability of the FRACTAL platform for recognizing the surrounding and with that demonstrating a cognitive awareness feature of the platform was evaluated. The resulting FRACTAL node is based on a RISC-V processor implementation and the Darknet framework with the YOLO (You Only Look Once) algorithm for object recognition.
The interaction between the edge node and the cloud node was shown by training the neural net in the cloud, while running inference directly on the local node. Hardware accelerators for fast inference were designed by leveraging High-Level Synthesis Technology (the Siemens EDA tool Catapult HLS) to efficiently model and optimize generated hardware descriptions for FPGAs (Field-Programmable Gate Array) based on high-level object recognition algorithms. The outcomes of this use case support future RISC-V based products with object recognition building up on High-Level Synthesis for AI hardware accelerators and corresponding AI software layers.
Siemens was also responsible for the work package for exploitation, dissemination, standardization and training, where more than 20 papers were published, and several events organized in a common effort between the partners.