

Collective research (CORNET) project

EmbedML

Accelerate the integration of **Machine Learning** in products with **Embedded hardware**

Industrial relevance

Until recently, the deployment of machine learning on microcontrollers has been the sole playing field of tech giants and their well-known voice assistant applications. Thanks to the latest advancements in hardware and machine learning frameworks the breakthrough combination of machine learning and low-end microcontrollers is now coming within reach of the broader industry, opening up numerous possibilities for new and powerful applications.

Digital technologies are shaping the development of innovative products and services. By adding more intelligence to products, more value can be created in a myriad of ways: for instance by increasing performance, autonomy and resource efficiency. Companies bringing such products to the market can capture more value by covering a larger part of the overall solution. **Machine learning** - allowing a system to make decisions based on models learnt from data - is a key enabling technology for the transition to smarter products. Not only can it bring entirely **new smart capabilities**, it also has the potential to **reduce the development effort** for solving complex reasoning tasks. Today machine learning algorithms can start being deployed on low-end microcontrollers and do not need to be confined to high-end processors in the cloud. The combination of machine learning and embedded hardware is disruptive for the way low-cost, low-power embedded devices could process sensory information in the future across a vast variety of products and application domains.

Manufacturing:	add-on sensor solutions for condition monitoring of equipment
Agriculture:	wearables monitoring vital parameters in livestock
Retail:	monitor shelves in stores and update stock levels automatically
Mobility:	sensors at strategic locations helping traffic routing
Healthcare:	patient monitoring, wearables monitoring well-being
Living:	appliances acting based on context sensing

Key advantages of embedded machine learning (embedded ML) on a product level are: **lower hardware costs, reduced power consumption** thanks to low-power hardware and limited cloud communication, and **reduced latency** when no data needs to be sent to the edge/cloud. On a system level this approach requires less network, server and storage resources, has a smaller ecological footprint and can improve security and privacy.



Innovation target

Recently, embedded ML components have become in reach of early adopters and first demonstrators are showing technological feasibility. Nonetheless, the successful adoption by SMEs is tied closely to their central question: “**Can we integrate embedded machine learning in the development of our new products in the right way and at the right cost?**”

How can embedded ML solve my problem and at what effort and cost?

What are essential requirements for my embedded ML solution?

Which building blocks can I use for fast proof-of-concept development?

How should I develop, deploy and maintain my embedded ML solution?

Therefore, Sirris (Flanders) and Hahn-Schickard (Germany) are setting up a collective research (CORNET) project to address these key questions and support SME companies in achieving a better understanding how embedded machine learning can be integrated in their products and product development. To this end **embedded system expertise, machine learning expertise** and **application domain knowledge** need to be brought together. The target group of this project includes both the problem owners and solution providers in the solution development value chain.

Product builders: smart solution builders & sensor manufacturers developing a smart (add-on) solution in which “smart” is core to their offering.

System builders/integrators: developing a product in which “smart” is a value-adding feature

Development service providers: providing the aforementioned companies with electronics, software, algorithm development and combinations thereof.

Project results

The project will build **SME-oriented supporting tools** in order to lower barriers to adoption of embedded ML, accelerate concept validation and stepwise development, and enable the successful implementation of new value adding solutions by the target group. In a variety of **industry-driven cases** the different development stages of embedded ML solutions will be investigated through a combination of desk study and proof-of-concept validation. The learnings from this case-based approach will be translated into a **case book**, a **toolset** for **proof-of-concept** development, and **development guidelines**.

Case book - Online collection of best practice examples of embedded ML applications. Assists SMEs in the identification and evaluation of opportunities in embedded ML.

Toolset – Set of tools accelerating **proof-of-concept** development by SMEs. System design calculator and practical guidelines on existing development platforms for embedded ML.

Development guidelines – Guidelines on the required steps and engineering methods in an integrated development approach from initial feasibility to product follow-up in the field.



Provides SMEs with a better understanding of the product requirements, required activities and expertise for in-house/external solution development.

User committee

By joining the user committee, your company will have direct access to the project results and stay informed about the opportunities in embedded ML. Via 6-monthly meetings your company will be actively involved to guide and validate the project results and to exchange ideas and experiences.

The planned starting date of this collective two-year project, if approved, is May 2022.

Are you interested? Interested companies are encouraged to sign a letter of intent (see template in annex) and to take contact with us to discuss their concrete involvement in the project.

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