ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

Centro Ricerche Fiat/DET - Micro Tiny Machine Learning for Automotive Applications

Funded By	CENTRO RICERCHE FIAT [P.iva/CF:07084560015] Dipartimento DET
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Context of the research activity	AI in the automotive sector requires significant computational resources, limiting energy-efficient implementation. This project leverages TinyML to enhance AI efficiency, creating compact models for resource-limited hardware. The PhD focuses on using TinyML for always-active services like cabin monitoring and occupant detection through sensors. It aims to develop hardware/software solutions to reduce vehicle energy consumption and assess hardware needs for MCU or FPGA execution, enabling shared hardware usage.
Objectives	Artificial intelligence (AI) can be leveraged for many applications in the automotive sector; however, AI models require significant computational resources, making large-scale implementation difficult in contexts where it is important to limit energy consumption. This project aims to apply TinyML (Tiny Machine Learning) technology to enhance AI efficiency by developing compact models that can be run on hardware with limited resources. The PhD aims to apply TinyML to provide services that need to remain active even when the vehicle is off (e.g., for cabin monitoring, occupant detection, intrusion, etc.), using combinations of sensors. Hardware/software solutions will be developed to reduce the vehicle's energy consumption. Among the objectives is the development of a framework to explore different solutions and evaluate their performance with floating-point models and assess the hardware requirements of the models developed for execution on MCU or FPGA, with the aim of sharing hardware for the execution of multiple models. The main PhD Thesis focus is on the In-Cabin vehicle environment to support target situations with very limited resources and application fields when the ignition is off, and the available energy and power are limited or when the internal HPC device is in critical situations (overload, damage, …). Some critical services that need to be active (totally or partially) can be related to Occupant Monitoring Systems and Safety Features. (Anti-Intrusion features, Vital sign on Post Crash, …). The PhD Thesis aims to develop a methodology for designing and deploying networks on hardware with limited resources.

	Evaluating the needs of the coprocessing unit. The activity will exploit the use of dynamic networks (e.g. slimmable networks), which are a family of neural networks that can instantly adjust the runtime width.

Skills and competencies for the development of the activity	Python, Digital Architecture, RTL Design, HDL Language, Microcontroller architecture, C programming, Machine Learning