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NeuroCorgi

An application-specific integrated circuit (ASIC) for embedded AI that cuts power consumption 1,000-fold

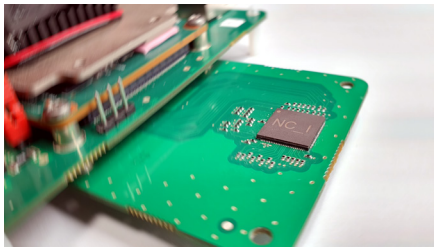
? WHAT IS NeuroCorgi?

The advent of smart devices and systems with their own local AI capabilities is one of today's broader technology trends and a sign of major digital transformation. Not only is processing data near or at the source **faster**, but it also **reduces data movement** and protects **data privacy and security.**
On-chip AI creates a new set of challenges. The expectations for performance are high, yet the chip has to be small, lightweight, and low-power.
CEA-List developed a brain-inspired solution called NeuroCorgi to respond to these challenges. In the human visual cortex, the first layers of neurons are fixed fairly early on in childhood. Despite this, humans can still "learn" new objects and faces for the rest of their lives. NeuroCorgi is similar in that the feature extraction backbone is fixed at the circuit design stage, much like those childhood neurons. In the circuit, this does away with energy-intensive memory access and data movement. Transfer learning is then used to configure and optimize the output layers for a given application.
NeuroCorgi, which can address multi-object classification, segmentation, and detection tasks, is built on a MobileNetV1 architecture optimized for mobile applications and uses less power than the sensor itself.

Demo@CES 2024

The NeuroCorgi demo will include:

- A physical demonstrator in the form of an integrated circuit
- A display with additional information about the technology



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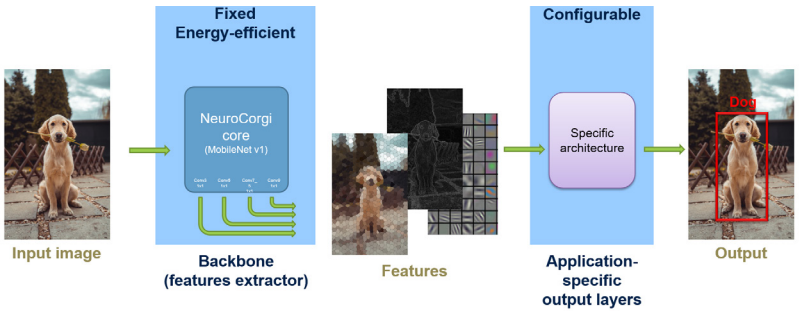
! WHAT'S NEW?

"Fixing" a large part of the neural network is the key concept behind this very-low-power circuit. The first layers, used for feature extraction, are fixed in their entirety when the circuit is designed. Transfer learning is then used to optimize the output layers for each new application.
This brain-inspired concept echoes how the human visual cortex learns.



The circuit is built on the MobileNetV1 neural network with fixed feature extraction, optimized for on-chip AI.
Its design has been assisted by an in house learning framework, which handled parameters quantization and ASIC code generation.
Compared to the current state of the art, this is a novel—and effective—approach.

- Power consumption 1,000 times lower than conventional solutions.
- Near-sensor AI processing now uses less power than the sensor itself.

NeuroCorgi comes with its own set of tradeoffs, of course.

- It implements a network topology that is fixed at design time, here a MobileNetV1.
- The first layers cannot be relearned, resulting in a very slight loss of accuracy (~1%).

SCIENCE FOR A BETTER FUTURE

This one-of-a-kind circuit makes it possible to address previously inaccessible applications. It enables AI processing at the edge, with a lower energy footprint than data acquisition.
All that remains is to invent the future that goes with it. We anticipate applications leading to a reduction in the use of weedkillers and pesticides in agriculture, better area monitoring and widespread obstacle detection. What else?

APPLICATIONS

Transportation

- Obstacle avoidance (urban drones, industrial robots, etc.)

Agriculture

- Plant detection for mechanical weeding
- Insect detection in hydroponic systems
- Grape disease detection for wine growing

Surveillance

- Intrusion detection on construction sites
- Sound classification

Defense

- Radio spectrum sensing for jammer detection
- Multispectral cameras

KEY FIGURES

- **Uses 1,000 times less power than commercial circuits**

>> WHAT'S NEXT?

Application performance will be evaluated with partners, with regard to:

- Insect detection
- Image segmentation for the automotive industry
- Grape disease detection for wine growing
- Classification of sounds by underwater drone

INTERESTED IN THIS TECHNOLOGY?

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