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ANDANTE

AI for New Devices And Technologies at the Edge

D5.4 Specifications of the use cases of the domain “Society/Life”

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Description	This document provides the specification of the use cases of the domain “Digital Society/Life”.		
Work Package	WP5 – Application Integration and Evaluation.		

Abstract (Published Summary)

WP5, Task 5.5 “Digital Life” is devoted to design and produce applications for neuromorphic computing technology in the environment of consumer digital devices. Designed for direct interaction and sensing of the consumer, in portable, wearable and in-home IoT devices. Neuromorphic technology is ideal for implementing auditory and visual sensing applications for consumer devices, as it can satisfy the requirementsfor ultra-low-power real-time low-latency sensory processing. ANDANTE will build applications for auditory sensing in several domains and levels of complexity, from ambient sound detection to aged-care applications. ANDANTE will also build applications for vision processing, for user sensing and interaction. All these applications will be designed for implementation in edge computing devices.

Continuous auditory scene classification

Neuromorphic technology is ideal for compact, ultra-low-power applications such as hearing aids and battery-powered wearable headsets. These audio devices must provide the wearer with high-quality noise filtering over a wide range of background environments, from quiet office spaces, to busy cafés, and city streets. In order to tune and steer the noise filtering approach for the various environments, we will provide a low-power system to automatically classify the different noise backgrounds with neuromorphic technology. This will comprise a low-power system, deployed to digital or mixed-signal neuromorphic inference devices, which continually classifies the current noise environment based on single-channel microphone input.

Audio event detection

Smart home speakers provide the opportunity for continuous security monitoring of the home environment, detecting emergency situations or break-ins by listening for indicative audio events (e.g. smashed glass; screams). Traditional cloud-based approaches to accomplish this monitoring would entail recording of the audio environment, and transmission of these recordings over the internet for analysis. This dependence on remote processing raises privacy and reliability concerns. Neuromorphic technology provides the ability to perform auditory monitoring with low power consumption, and strictly local to the device. We will design a streaming-mode system, for which no audio recordings are required, which will raise transient “alarm” signals when an identified audio event is detected. The system will be deployed to a digital or mixed-signal inference device, suitable for integration into a smart home speaker.

Multi-microphone auditory processing

Smart home speakers must robustly detect and analyse spoken audio which is intended for direct interaction with the smart home device, which ignoring background sounds and noise including other spoken audio which is not intended for the smart home device. This challenging noise environment is compounded by the fact that most audio will be “far-field”, i.e. spoken some distance from the smart home device, and with possibly low SNR. Microphone arrays are often deployed within smart home speakers to assist with noise reduction. However, these devices oftern use DSP-based audio processing and algorithms such as reverse beam-forming to identify audio content of interest. DSPs can be relatively power-hungry. We will investigate multi-channel audio analysis with spiking neural networks which would be suitable for implementation on neuromorphic inference devices. We will attempt to minimize the need for DSP-based audio pre-processing and processing, such that the system will have reduced power consumption.

Vision-based interaction detection

Smartphones, watches, tables and other direct user interaction devices benefit from knowledge about when a user is intending to interact with the device, when the user is attending to the device, or when the user is not attending to the device. For example, a smartphone can pre-emptively wake its screen when a user looks directly at the phone. Since this can occur without touch and without movement of the device, detecting this attention is challenging. A vision-based approach can accomplish this goal, but requires continual monitoring which implies high power consumption for both the imager and the processor. We will use new low-power neuromorphic vision processing technology to implement a vision-based attention detection system. This will be deployed in a highly compact vision single-chip SOC, which is suitable for integration in compact battery-powered devices.

Neuromorphic processor technologies promise to bring computation to low-power devices, such as IoT and edge devices and wearables. The use cases defined in Task 5.5 and described here are commercial examples of where neuromorphic technology can show an advantage over traditional von-Neumann computing, and over vector processors such as GPUs and TPUs.

It will be important for future commercialisation to demonstrate these advantages in concrete, real-world use cases such as described here.