Live Demonstration: Retinal ganglion cell software and FPGA implementation for object detection and tracking

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***Abstract*—This demonstration shows how object detection and tracking are possible thanks to a new implementation which takes inspiration from the visual processing of a particular type of ganglion cell in the retina.**

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I. Demonstration Setup

The demonstration shows the results of two systems running in parallel, one software-based (Java) and one FPGA-based. In both cases the front-end consists of an asynchronous temporal contrast silicon retina, otherwise known as a Dynamic Vision Sensor (DVS) [1], which outputs Address Event Representation (AER) coordinates.

In the first system, shown on the top part of Fig. 1, the word-serial AER data is read via USB2.0 by the Intel NUC embedded mini-PC with CPU i5-4250U at 1.3 GHz, 64-bit and 4 GB RAM. The NUC simply runs jAER (the software that processes and displays AER data [2]) real-time. The NUC performs, as a matter of fact, all the computations needed for the 15 x 15 Object Motion Cells (OMC) used for object tracking. The output can be viewed on a display connected to the NUC.

As regards the second system, shown in the lower part of Fig. 1, this receives word-parallel AER data from the DVS. The data is then processed inside the Xilinx Spartan6 FPGA of the AERNode board of [3]. The computed output is then passed to the OKAERTool, an Opal Kelly-based board, through a daughter board. The OKAERTool then forwards the AER data output of the AERNode board to a laptop running jAER, just for display purposes. The same board also passes configurable parameters to the FPGA via Serial Peripheral Interface (SPI).

In this second system, the FPGA runs an arrangement of 9 OMCs, each firing when detecting an object in their excitation center. The output of these OMCs can be visualized in jAER superimposed with the events causing it. The spikes of the OMCs can also be used to validate the guess of the object trackers of [4] which operate in parallel inside the same FPGA. The output of these trackers, with now increased accuracy, can also be displayed in jAER.

I. Visitors' Experience

Visitors can experience first-hand and understand the functioning of a single OMC by changing its biological parameters and exploring its behaviour. They can then observe the tracking of objects under different conditions either on real-time data, directly from the Silicon retina sensor they can interact with, or on pre-recorded data. The latter would be done to illustrate the high-speed capabilities in scenarios too fast for the human eye. Finally, the visitors can learn about event-based systems and sensors by observing the overall system at work from sensor to Graphic User Interface (GUI).

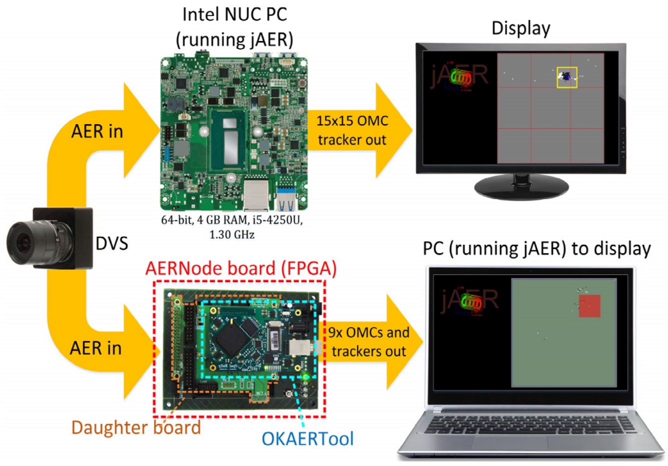

Fig. 1 Illustration of the two possible AER processing pathways of the demonstration: software-based (top) and FPGA-based (bottom).

References

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