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Kneron and Cadence

Reducing Edge AI Processor Development Cycle Time

The Customer

Kneron is a leading provider of on-device edge artificial intelligence (AI) solutions whose mission is to enable the access of edge AI everywhere and for everyone. Toward this end, the San Diego-based startup designs and develops integrated software and hardware solutions that enhance smart devices for AI of things (AIoT), smart home, smart surveillance, security, mobile, robotics, and industrial control applications. Based on its early successes, Kneron has received a variety of industry accolades, including earning an honorable mention in Gartner's Cool Vendors in AI Semiconductors 2020 report and being named a winner in the Business Intelligence Group's 2020 Artificial Intelligence Excellence Awards program. CB Insights also named Kneron in their 2020 AI 100 ranking of the 100 most promising AI startups in the world while EE Times named them in their 2020 Silicon 100 list.

The Challenge

On-device AI inferencing requires striking a difficult, but vital balance of performance, power and size. Kneron's next-generation 1.4TOPS edge AI processor, the KL720, is targeted at AIoT, smart home, security, and smart surveil-lance including network video recorder (NVR), digital video recorder (DVR), robotics, and industrial control applications (Figure 1). It features higher power efficiency, a higher compression rate with lower accuracy loss compared to its predecessor, the KL520. Additionally, Kneron's software

Key Challenges
▶ Pre- and post-processing functions are compute intensive and not optimal for NPU
▶ Need future-proof solution capable of offloading fast-growing future AI workload

Cadence Solutions
▶ Tensilica Vision P6 DSP
▶ Xtensa Imaging Library
▶ Xtensa Neural Network Compiler
▶ VIP for DSP Integration

Results
▶ Vision P6 DSP provides up to 2X performance gains
▶ Development cycle time reduced by 10 percent

development kit (SDK) has evolved, allowing for easy adoption of popular frameworks, including TensorFlow and PyTorch, and mainstream AI models that enable natural language processing (NLP) and 3D image sensing among other applications.

When designing the KL720, Kneron needed to accelerate mathematical computing functions while also minimizing power and maintaining a small size. Computer vision pre- and post- processing are very compute intensive, and finding a solution capable of co-processing these complex

computer vision algorithms alongside their proprietary neural processing unit (NPU) was critical (Figure 2). Kneron also needed a programmable, future-proof solution capable of offloading their fast-growing future AI workload.

The Solution

Kneron turned to Cadence for assistance in developing the KL720. The Cadence® Tensilica® Vision P6 DSP is an established, industry-leading, high-performance and low-power processor specialized for the computer vision and AI market.

> "
> *Removing hurdles and making AI algorithm deployment on our platform easy is key for us and our customers' success as our mission is to enable AI everywhere, for everyone. The Tensilica Vision P6 DSP packs a lot of compute capacity to tackle the latest AI challenges."*
>
> Albert Liu, founder and CEO of Kneron

The Vision P6 DSP provides Kneron with up to 2X faster performance for computer vision and neural network pre- and post-processing compared to its prior-generation SoC, while delivering crucial power efficiency for edge AI applications.

In addition to its high performance, a key selling point of the Tensilica Vision P6 DSP is its design flexibility, which enabled Kneron to customize and select the features necessary to achieve an optimal balance of performance and cost for the KL720 while meeting the stringent requirements of its target applications. Tensilica DSPs offer every customer a variety of configuration options so they can create a tailored solution

optimized for their specific requirements. The Vision P6 DSP supports an N-way programming model, allowing users to write source code that is portable across the family of Vision DSPs, promoting both backward compatibility and future readiness.
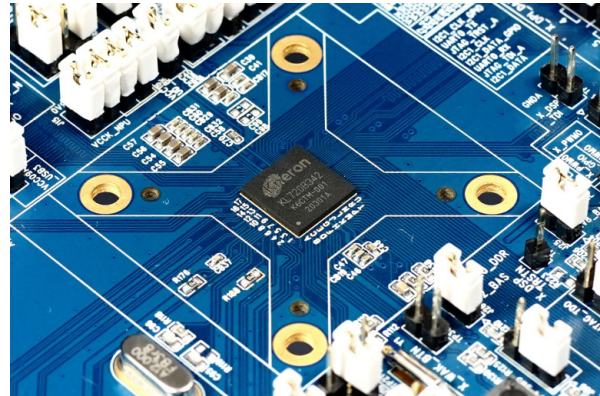

Figure 1: KL720 is targeted at AIoT, smart home, security, and smart surveillance including network video recorder (NVR), digital video recorder (DVR), robotics, and industrial control applications

In addition, the Vision P6 DSP leverages the optimized Xtensa® Imaging Library for optimized computer vision functions and the Xtensa Neural Network Compiler for efficient deployment of neural networks, which now supports the GLOW (Graph LOWering) Compiler and the ONNX framework. Lastly, the Vision P6 DSP supports the Tensilica Instruction Extension (TIE) language, which allow users to create customized instructions with a fully supported toolchain to achieve maximum performance.

Cadence development tools feature a powerful embedded debugger that delivers a consistent user experience for both simulation and on-chip debug. In addition, the cycle-accurate instruction set simulator (ISS) allowed Kneron to fine-tune and characterize algorithm performance without the need for silicon.
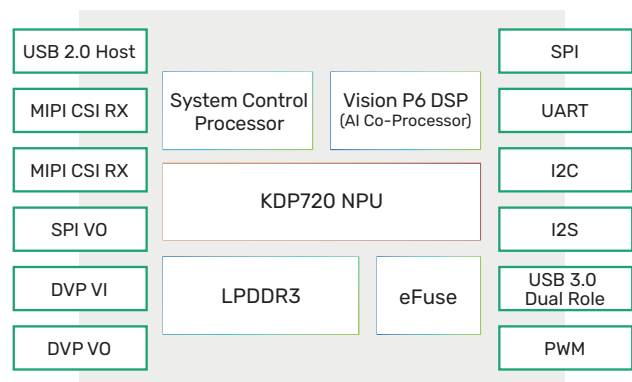

Figure 2: Kneron's KL720 AI SoC features the company's NPU IP alongside the Vision P6 DSP as an AI co-processor

Tensilica DSPs' strong industry reputation was another factor in the selection process. Many Kneron engineers have experience designing with Tensilica DSPs, reducing their learning curve when designing the complex KL720. Additionally, all Cadence DSPs come with comprehensive documentation and a wide range of examples, application notes, and high-quality technical support, which makes it easy to learn about the available features and integrate them into a design.

The design flexibility afforded by the Tensilica Vision P6 DSP proved critical. Competitive licensing for the tool chain lowers the barrier of entry for Kneron's customers, making the KL 720 processor a more attractive solution for companies looking to integrate on-device edge AI capability.

With all these benefits, the Vision P6 DSP pairs perfectly with Kneron's NPU as a co-processor. By performing pre- and post-processing operation as well as handling new or unsupported layers for neural networks, the Vision P6 DSP allows the KL720 to be truly future-proof.

Results

Cadence's detailed documentation, tools, and Verification IP (VIP) for DSP integration and verification, as well as its extensive onsite support, easy learning curve, and design flexibility eased integration into Kneron's complex development environment—effectively reducing the development cycle time by 10%.

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