VkCoreVX™ SC

Safe AI and Computer Vision

FEATURES AND BENEFITS

- CoreAVI's safety critical implementation of Khronos' OpenVX™ 1.3 industry standard API provides a feature set for implementing and deploying neural networks in safety critical environments.
    - APIs capable of deploying and designing convolutional neural networks, supporting vector machines, Gaussian filtering, optical flow, and much more.
    - Library built on top of CoreAVI's safety critical Vulkan® SC implementation, providing both graphics and compute capabilities within the same safety critical framework.
    - Leverages the power of CoreAVI's safety critical BLAS (Basic Linear Algebra Subprograms) implementation for accelerated vector and matrix manipulation.

INTRODUCTION

CoreAVI's VkCoreVX SC is based on Khronos' safety critical OpenVX 1.3 API, an industry standard providing safety critical computer vision and artificial intelligence functions. The backbone of CoreAVI's artificial intelligence and computer vision platform (Safe AI), VkCoreVX SC provides algorithms for performing crucial pre-processing and post-processing tasks on the sensory data streams being analyzed. This collection of computer vision algorithms—edge detection, Sobel filters, FFTs (Fast Fourier Transform), optical flow, etc.—and neural network inferencing engines provides a true safety certifiable software stack that facilitates powerful computer vision executing on modern GPUs.

The VkCoreVX SC computer vision subset includes the following capabilities:

- Gaussian Filtering
- Laplacian Pyramids
- Convolution Filters
- Median Filters
- Box Filter
- Non-Linear Filter
- Histogram Analysis
- Optical Flow
- Canny Edge Detectors
- …and more. Please contact CoreAVI for a full list.

SAFEAICORE™ STACK

Designed to ensure deterministic runtime behaviour, CoreAVI's SafeAICore Stack provides a flexible framework for computer vision and neural network inferencing, while achieving the most stringent levels of safety certification.

The SafeAICORE Stack enables GPU compute capabilities, which are the application of a modern GPU's data-level parallelism through many-core SIMD engines, to solve high volume computations. It is the basis for modern data processing, machine learning, and computer vision systems.
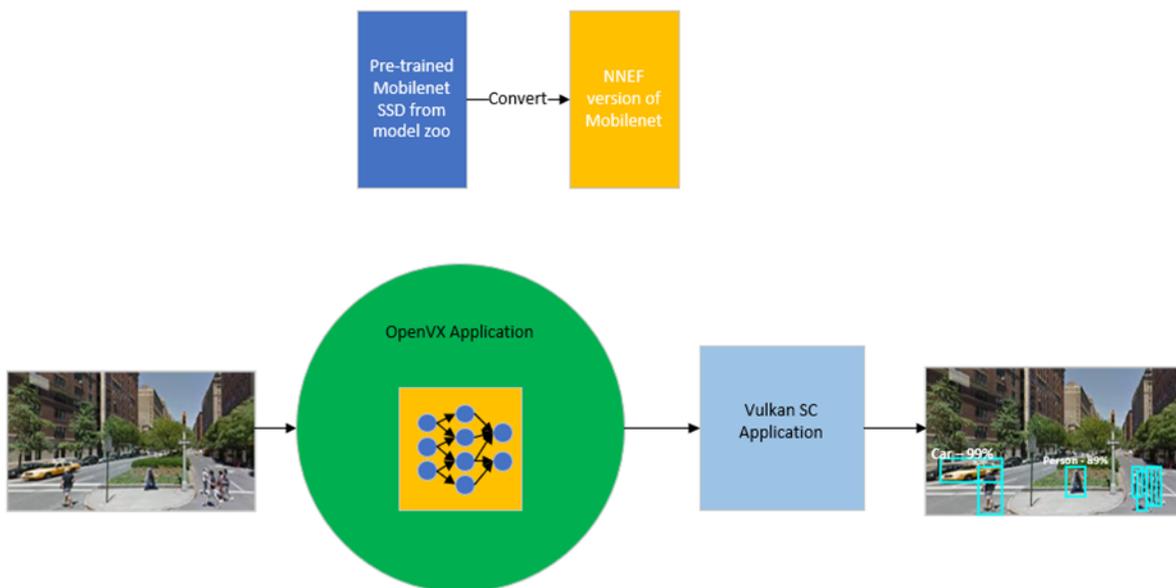

Figure 1: Neural Network Inferencing and Visualization

CoreAVI's SafeAICore Stack offers the platform building blocks—including Commercial Off the Shelf safety critical hardware designs (COTS-D), software drivers, GPU compute libraries, and tools—that enable AI system manufacturers to deploy mission-critical pre-trained neural networks as well as implement discreet machine learning algorithms (support vector machines, random forests, etc.) on real time operating systems. These software building blocks are based on flexible GPU compute capabilities and written against a safety critical Vulkan compute API. The benefit of which is deterministic runtime-state-management with no undefined behavior is present at the API level. The system conforms to formal safety critical standards, including RTCA DO-178C, EUROCAE ED-12C, ISO 26262, and other functional safety standards.
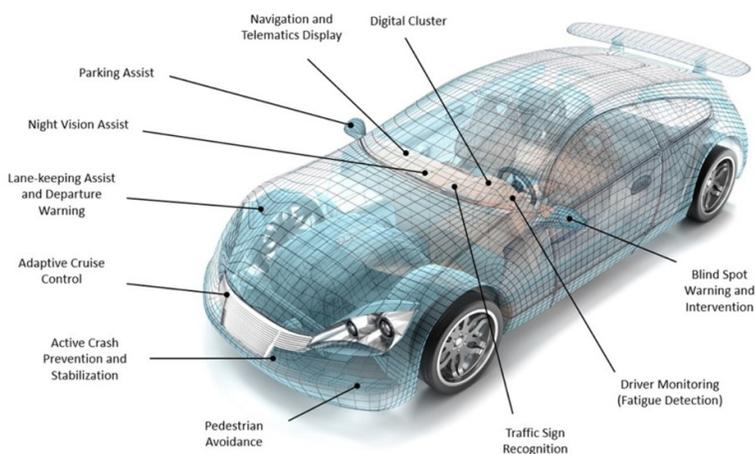

Figure 2: ADAS Functions that Benefit from GPU Compute Capabilities

The SafeAICore Stack is ideal for a wide range of AI and compute-centric applications, such as augmented vision systems, object detection and tracking via neural network inferencing, signal processing, image processing for degraded visual environments, security monitoring, encryption, ADAS, autonomous systems, and more. It integrates with CoreAVI's safety critical Vulkan SC driver—VkCore® SC—which provides the foundation for safety critical GPU Compute.

In addition to the VkCoreVX SC implementation, CoreAVI's SafeAICore Stack includes ComputeCore™, CoreAVI's safety critical implementation of BLAS (and FFTs, and the mathematical foundation of our Safe AI and computer vision platform. ComputeCore provides safety critical accelerated vector and matrix math operations by implementing the industry standard BLAS functions, and provides a safety critical implementation of FFT.

The SafeAICore Stack offers VkCoreGL® SC1 and VkCoreGL® SC2 OpenGL application libraries, enabling customer using OpenGL SC 1.0.1 or OpenGL SC 2.0 to continue to do so while taking full advantage of the modern capabilities Vulkan has to offer. It also includes TrueCore™, CoreAVI's patented safety manager, which predicts worst case execution time of compute tasks, ensuring processes execute within the required time envelope. TrueCore enables a system integrator to predict the worst-case execution time of executing compute processes in the system.
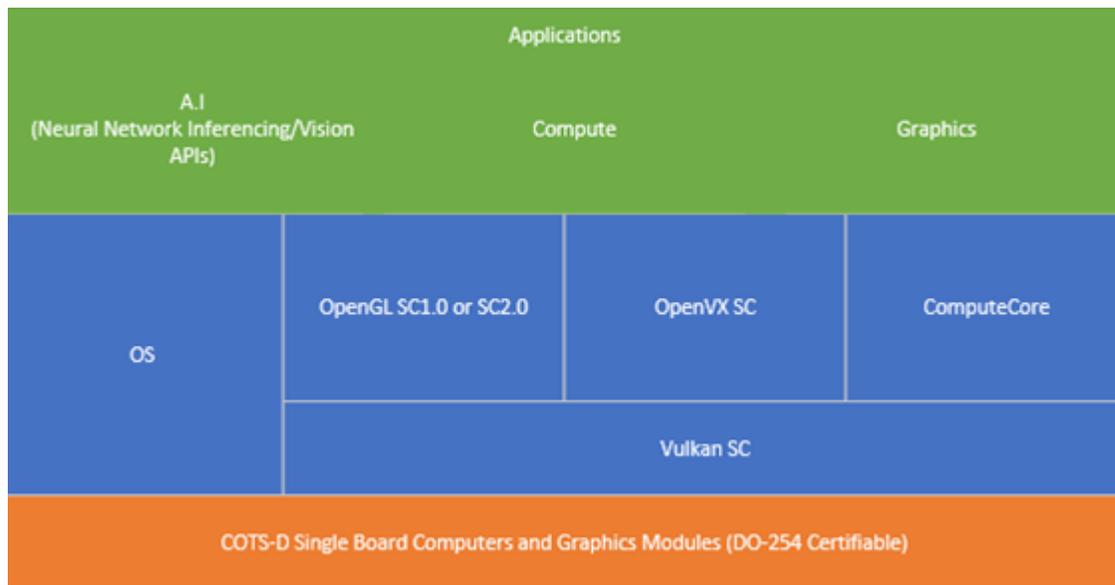

Figure 3: SafeAICore Stack Architecture

Please consult individual product briefs for ComputeCore, VkCore SC, VkCoreGL SC1 and SC2, and TrueCore for more information.

The SafeAICore Stack facilitates the transition to safety certifiable Vulkan Compute from commercial OpenCL®/CUDA®, and OpenCV. It is designed from the ground up for real time and safety certification; it contains no open source components and no third party software. It is available with CertCore™26262 ISO 26262 Accredited Safety Assessment Certificate ASIL D and CertCore™178 (DO-178C / ED-12C Avionics) DAL A safety certification package.

DEVELOPMENT INTERFACE AGREEMENT

The intent of a Development Interface Agreement (DIA) is to define the responsibilities of the customer and supplier in facilitating the development of a functional safety system. In custom developments, the DIA is a key document executed between customers and suppliers early in the process of developing the system and the CoreAVI drivers and libraries.

As the CoreAVI software is a Commercial-Off-The-Shelf (COTS) Safety Element out of Context (SEooC) product, an ISO 26262 DIA is not required. Please refer requests for custom DIAs to CoreAVI Sales.

The following sections highlight key points of the standard DIA.

Requirements Transfer

The SafeAICore Stack is developed as an SEooC. Detailed safety requirements were not available from lead customers during development; therefore, the safety requirements used were based on CoreAVI analysis of target safety applications and industry standard safety critical APIs. CoreAVI is willing to discuss acceptance of new customer safety requirements for future designs. Please contact CoreAVI Sales for further information.

Availability of Safety Documentation

The following table lists the safety documentation for the library.

DELIVERABLE	CONTENTS	AVAILABILITY	DELIVERY
Safety Manual	Document usage, assumptions, issues, etc. of SEooC to put the SEooC into a safety context (application)	NDA material	TBD

Table 1: Safety Documentation

Support

CoreAVI provides integration, performance optimization, and design consulting services.

External Product Audits

CoreAVI works with TUV Rheinland® for an external audit of functional safety suite software to ISO 26262 standards.

Contact Sales@CoreAVI.com for more information.