

SILICONSOFTWARE

Graphical FPGA Programming Environment

VisualApplets



Awarded solution for realtime image processing on FPGAs


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Software Overview

- Offers a complete development environment
 - Abstractly working with image processing operators forming graphical data flows
 - More than 200 image processing functions (VisualApplets® operators) are structured in 11 libraries
 - More than 60 application examples (VA designs) point out the possibilities of usage
 - High-level simulation with real image data included
 - "One button click" synthesis
 - Software Development Kit (SDK) and microDisplay support
 - VisualApplets® is hardware-independent in first approximation
- ... and further ones

Software Features

- No knowledge required in circuitry, synchronization, timings and FPGA programming
 - No examination of side-effects
 - No VHDL compiler required
 - Supports microEnable III and IV series, PixelPlant subboard series
 - VisualApplets® applets are immediately usable in SDK and microDisplay
 - Supports Windows, Linux and QNX run-time environments
- ... and further ones

Compatibility / Certification



VisualApplets® certified 3rd party compliant



VisualApplets® is a graphic-oriented tool, which dramatically simplifies the programming of image processing on FPGA hardware. VisualApplets® is a high-level programming tool for image processing tasks on FPGAs. The self-explanatory graphical user interface is easy to use, fast to learn and inspirable for new solutions. Programs run on FPGA hardware in real-time. Image processing designs are arranged by the combination of operator modules, filter modules and transport links. The provided libraries include more than 200 hardware based operators for Machine Vision applications which cover standard as well as advanced image processing functions. The complete set of functions is implemented as hardware operators and guarantees an image processing in real-time. The complexity of the image processing designs is mainly limited by the available resources of the FPGA hardware.

There is no configuration necessary for synchronization, timing or avoiding problems with side-effects. Both a synthesis and a high level simulation are integrated and offer full control over the final visual result of a design at any time. The complete process of the hardware design creation lasts 10-15 minutes on an average. The hardware applet can immediately be used with the viewer and configuration software microDisplay or be integrated in applications by use of the SDK.

Targeting user groups for VisualApplets® are software programmers and application engineers in Machine Vision, and hardware programmers as well. Although knowledge of hardware programming is advantageous, the software solution VisualApplets® is addressed to application engineers in Machine Vision as a matter of priority. In first approximation VisualApplets® is hardware-independent. VisualApplets® runs under Windows XP, Vista and 7.

VisualApplets® was awarded in 2006 with the international VISION Award, a prize for outstanding solutions and contributions regarding applied machine vision..

Benefits using VisualApplets®

- Reduced time-to-market; development times are drastically reduced
- Economy of time and saving of development resources
- Know-how protection; development is done in-house
- Expert knowledge in FPGA programming is needless
- Protection of investment; re-use of applications and parts of applications
- Easy switching to different target architectures
- Automatic documentation on different levels
- Short education time of new employees

VisualApplets® Workflow

- Initial Steps
 - Analyzing the algorithm and mapping on VisualApplets® resources
 - Selection of the target hardware
 - Generation of requirements document
- Design Implementation
 - Selection and structuring the operators
 - Parameterization of the operators and the data-flow, considering the entire application setup
- Verification at Software Level
 - High-Level simulation based on real image data
 - Calculation of Bandwidth and performance
 - Estimation of consumption of FPGA resources
- microDisplay
 - The software tool microDisplay allows immediately a testing and adjusting of the settings of your generated Hardware Applet

Any information without obligation. Technical specifications and scope of delivery are liability-free and valid until revocation. Mistakes are excepted.



- Software Development Kit (SDK)
 - The automatically generated SDK example code can directly be executed and integrated in a certain software framework

Currently there are 14 libraries with more than 200 operators available (selection):



• Hardware Dependent Operators

- Camera interfaces: BASE, MEDIUM, FULL and FULL 10-tap in combination with
- Acquisition modules: Area and Line scan operator, Grayscale, RGB and Bayer color modes
- Digital interfaces: DigIOPort module
- Trigger interfaces: AreaPort, LinePort modules, native trigger modes
- Transfer interfaces: DMA read and DMA write module

• Operators for Memory Management

- Image memory interfaces: Image buffer, image FIFO, sequence buffers, dynamic and multiple ROI control, image buffers with internal spatial correction or tap sorting
- Frame and line memory
- Lookup tables and coefficient buffers

• Operators for Color Processing

- Bayer color reconstruction modules
- Color space modules: RGB2YUV, RGB2HSI, HSI2RGB, L*a*b, GRAY2RGB and GRAY2HSI
- Channel extraction operators: HSI channel splitting, RGB channel splitting
- White balancing RGB and Bayer

• Operators for Pixel Manipulation

- Processing modules: Increase and decrease of parallelity
- Extraction modules: Parallelity, components, pixel field, bitfield, images
- Module relations: Merge, split and branch
- Resolution: Down- and up-sampling
- Definition operator: Constant value, boxes
- Type conversion operator: Type cast, bit cast, change of pixel format
- Value conversion operator: Bitrange

• Image Filter Operators

- Filter matrix operators: 1- and 2-dimensional convolution and FIR filters
- Morphological operators: Erode and Dilate
- Statistical information: Determination of Minimum, Maximum and Median
- Comparison: Hit and miss, numbers of hits, sort

• Operators for Arithmetic Processing

- Mathematical operators 1: Addition, subtraction, multiplication, division, scaling, shifting, randomising, absolute value, sum
- Mathematical operators 2: sine, cosine, tangent, cotangent, arcos functions, square roots

• Logic Operators

- Causal operators: IF, CASE, logic NOT, logic AND and logic OR
- Boolean operators: comparison between two numbers or between number and constant
- Binary operators: Threshold

• Operators for Statistical Processing

- Statistical operators: Median, Minimum, Maximum, column, row and frame based
- Counter and memory models
- Register and histograms

• Operators for Synchronisation

- Image operator: Remove and insert pixels, lines or frames

• Operators for Signal Control

- Status information and control of delays, synchronization and events, signal waveform, polarity and format
- Shaft encoder
- Signal scaling and generating

• Operators for Compression (Extended VisualApplets® library)

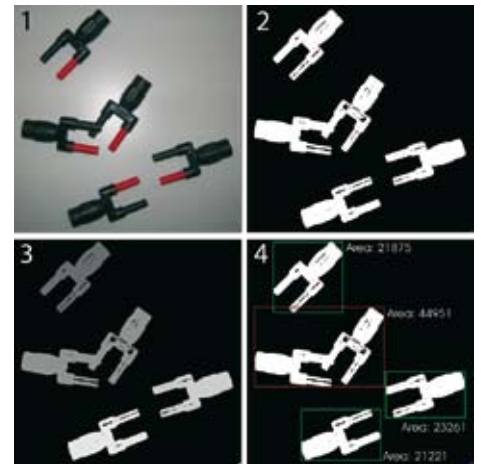
- JPEG image buffer and encoder

• Operators for Blob Analysis (Extended VisualApplets® library)

- Operators for 1D and 2D Blob analysis with object segmentation and classification

• Miscellaneous Operators

- Look-up table modules: Standard and knee look-up table for image enhancement
- Memory operator: Storing of coefficients
- Counter operators: Column counter, row counter



Blob Analysis - Detection and Feature Extraction of Objects in Binary Images

- the segmentation and mapping of neighbored foreground pixels to objects
- object description by geometrical and statistical shape parameters such as "area", "bounding box", "centre of gravity", and others
- used for classification

Advantages on using Blob Analysis

- Blob Analysis is the best established standard method for segmentation of objects
- Very robust method to describe objects
- applied in numerous machine vision applications
- used for detection, counting and sizing of objects such as in surface inspection, position detection and compensation.

Blob Analysis in VisualApplets®

- detects connected objects in binary images
- objects of any shape are detected
- supports 10-taps Full Configuration Camera-Link interface (850MByte/s)
- combinable with existing VisualApplets® pre-processing operators such as morphological filters and adaptive thresholds
- objects are determined in a single pass which reduces the latency to a minimum
- multiple object properties are determined such as area, bounding box, contour length, centre of gravity, circularity
- arbitrary number of concurrent objects may exist in the image
- processes images of any size
- highly efficient resource optimization by selection and parameterization of features
- included error handling system



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