LEADING MACHINE VISION SOFTWARE
READY FOR LATEST INDUSTRY TRENDS

- Industry proven machine learning tools
- Support for embedded systems (ARM / Linux) and PCs
- Full 3D pointcloud support
- OPC UA machine vision support for Industry 4.0 integration

WWW.COMMONVISIONBLOX.COM
**Powerful programming libraries enable easy integration of imaging in your application**

The core of Common Vision Blox is image acquisition, providing direct support to advanced acquisition features and integrated control and monitoring of acquisition reliability. All validated by a company with over 30 years' experience in delivering both hardware and software solutions.

**Hardware independent**
- Choice of hardware with low level control
- Driver development kit to fully support all 3rd party specialist hardware
- Integration with the latest machine vision standards for maximum interoperability

**Platform independent**
- All current Windows versions under 32 bit and 64 bit, Linux 32 and 64 bit
- All current programming languages: C++, VB.NET, C#, Delphi XE2, Python
- x86 and ARM platforms

**Code independent**
- Combine multiple tools to create the best solution
- CVB algorithms, open source libraries, 3rd party packages and own code can be used together

**CVB acquisition engines**
CVB acquisition engines exist for Teledyne DALSA Sherlock and Cognex Vision Pro, enabling full GenICam and USB3 Vision compliance and access to every CVB compliant image acquisition device. Further information about these products is available on request.
Function overview

- Management console for configuration of system settings
- Management of licensing
- Support of different image file formats (including 16-bit formats)
- Camera emulator mode for simulation of image sequences
- Flickerfree live display with interactive zoom, ROI selector, labels and overlays
- Hardware control supports multiple boards/cameras with direct access to hardware features
- Flexible coordinate system to move and rotate the origin easily and access pixels in application specific units
- 3D image data acquisition, handling and display
- Direct digital I/O support
- Inbuilt GenICam, GigE Vision and USB3 Vision support

Ring buffer, line scan camera and secure acquisition

CVB applications acquire images into a ring buffer. This helps to decouple the acquisition rate and the processing rate to allow variations in acquisition and processing speeds without losing images.

A variation of the ring buffer acquisition allows continuous line scan images to be broken up into virtual buffers so that ‘edge effects’ can be handled where a defect might occur over the boundary between images. These two applications show that Common Vision Blox is designed from the start with image security in mind. Where the hardware supports it, CVB will also report acquisition errors and missed triggers.

Core 3D capabilities

CVB Image Manager includes core 3D capabilities, supported under Windows and Linux. The acquisition and handling of 3D data, including display, saving and loading of files (including numerous pointcloud formats) has been added.
CVB Foundation Package is a powerful entry package for developers that require general machine vision tools. The package includes the full functionality of CVB Image Manager complemented by a comprehensive set of general imaging algorithms.

**Functions for barcode reading**

CVB Foundation Package includes barcode reading functionality. ZXBarcode can read a variety of 1D and 2D symbologies and is particularly good at reading QR codes, even badly distorted codes.

For more demanding applications please refer to the CVB Barcode tool with enhanced performance and barcode grading included.

<table>
<thead>
<tr>
<th>1D code types</th>
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<tbody>
<tr>
<td>Codabar</td>
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<tr>
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<td>Code 93</td>
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<tr>
<td>UPC-E</td>
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<tr>
<td>UPC-EAN Extension</td>
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<th>2D code types</th>
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<tr>
<td>QR</td>
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<tr>
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<tr>
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**Functions for 3D calibration**

3D calibration is often a prerequisite before it is possible to perform any further analysis on 3D data. The Metric functionality in the CVB Foundation Package uses a calibration target to remove distortions and transforms image data from a pixel coordinate system to real-world units.

Metric allows a calibration result to be created, this can then be applied to incoming rangemap images using CVB Image Manager’s core 3D functions, enabling calibrated pointclouds that can be analysed directly, or transformed back into “rectified rangemaps” for processing by 2D image processing tools.
**Functions for optical flow**

Analysing movement is an important but complex task in machine vision. It is challenging to calculate optical flow at real-time frame rates, so this is rarely seen in imaging libraries. In CVB, optical flow is an efficient algorithm capable of detecting less than 2 degrees of angle and 1/10 pixel movement in determining the distance moved. The algorithm uses a block matching technique to determine the movement between images. By modifying the block size, it is possible to optimise an application for speed or resolution.

Applications for the optical flow algorithm include any type of movement analysis and the display of local motion vectors. Examples include the bulk flow of materials in a production environment, robot cell monitoring and particle imaging velocimetry (PIV).

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**Functions for the statistical evaluation of images**

Quick and easy analysis of an image using statistical calculations such as mean value, standard deviation, etc. Ideally suited for evaluation of object completeness and presence checks, surface inspection (homogeneity, scratches, print, etc.), or the supervision of a camera image in regard to integration time, illumination, etc.

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**Functions for blob analysis and segmentation of objects**

High-speed analysis of coherent objects in an image (blobs). The surface area, diameter or position, orientation and shape parameters of any object can be determined using this algorithm. Especially useful for verification of shape completeness (i.e. drilling, junking), also known as connectivity.

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**Functions for edge detection**

Optimised functions for subpixel edge detection and subsequent measurement of positions in an image. Regardless of whether single edges, edge pairs or multiple edges are concerned, the geometrical dimension of any object can be determined.
Functions for 2D calibration of image data

2D calibration allows conversion to real-world units, but also the removal of distortion due to lens effects or viewpoint perspective. In addition, a continuous plane, such as a part of a cylinder, can be ‘unwrapped’ using the calibration routines. Linear and non-linear transformations allow for complex distortions to be removed from an image.

Functions for colour processing

The red, green, blue (RGB) colourspace that is normally used in machine vision does not closely match human perception. By converting an image to other colourspaces such as HSV or CIE Lab it is easier to analyse an image for defects that are noticeable to a human.

Functions for superimposing destructive text overlays

This functionality allows the incorporation of user definable texts and numbers into any position within an image. The text replaces the original image data, making this function especially useful for adding permanent timestamps, markings or other information for error tracking or archival purposes.

Functions for image filtering

Comprehensive collection of highly optimised filter algorithms for fast image preprocessing. The use of these filters makes it possible to intensify or attenuate certain image details in order to simplify or accelerate the subsequent analysis. Examples include edge filtering and morphological filters.

Functions for binarisation using advanced thresholding

The use of dynamic thresholding simplifies the processing of image data in situations with illumination variations. Using binarisation, grey value images are translated into pure black & white images and the dynamic thresholding uses local thresholds that are automatically updated in case of local changes in illumination.

Functions for image arithmetic and logic

Functions for arithmetical and logical combination of images. These functions allow flat-field correction, image masking and image averaging to enable further processing.
Using Common Vision Blox on other operating systems and platforms

Since the first CVB Linux release in 2011 we have continuously expanded support and now offer support on Intel platforms and ARM processors including 32 bit (armv7l(hf)) and 64 bit (aarch64).

Development for Linux has traditionally meant using C++ and the gcc compiler that ships with Linux. The Mono compiler allows .NET-compatible C# code to be compiled for Linux. CVB’s support for Python adds another possibility as this can also be used under Linux. Qt is often used to create a cross-platform GUI-based application that runs on both Windows and Linux.

The term ‘embedded’ in relation to machine vision normally means a System-On-Chip (SoC) device, which typically means an ARM processor and associated interconnects, all provided on a single chip. This has both advantages and disadvantages of which users should be aware:

- Lack of flexibility compared to an Intel CISC platform – SoC means there is no opportunity for expansion
- A whole system-on-a-chip generally leads to much lower power consumption and heat production, making mobile and battery-powered applications feasible
- Custom SoCs are expensive to design, but cheap in volume and give a highly-specific hardware solution
- Off-the-shelf hardware is also available at relatively low prices, but often as bare boards without casing or CE marking
- Simple to duplicate – for multiple systems all that is needed is a disk image, there is no OS licensing or variation in hardware that affects Windows and motherboards. This makes Linux on an embedded platform an interesting choice for large volume users
- Some platforms combine SoC with a co-processor such as a GPU, DSP or FPGA to allow system acceleration. This can overcome the relative lack of processing power that these systems often exhibit

CVB functionality under Linux

Any CVB component that is supported under Linux is supported on all of the platforms that CVB supports: Intel 32 and 64 bit platforms as well as ARM armv7 (hf) and aarch64 architectures.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>X86/IA64</th>
<th>X64/X64_64</th>
<th>ARMV7L (HF)</th>
<th>AARCH64</th>
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</thead>
<tbody>
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Image Manager support for operating systems and platforms

- CVB Image Manager functionality includes support for GigE Vision and USB3 Vision cameras
- Python and C++ interfaces are also available (as is the .NET if using the Mono compiler)
- 3D image handling in CVB Image Manager is also available in Linux

CVB Foundation Package under Linux

To complement the 3D capabilities in CVB Image Manager, the 3D Metric functionality in the CVB Foundation Package is also available under Linux. The barcode reader in CVB Foundation Package is supported in Linux. In addition some of the existing tools have also been compiled for Linux:

- Arithmetic – for image arithmetic and image logic operations, such as AND for combining images or image division to perform flat-field correction
- Edge – to find an edge or a pair of edges for measurement or location
- BayerToRGB – an advanced de-Bayer tool allowing the user to choose between speed and accuracy
- Lightmeter – for detailed image statistics, as a way to check for defects on a homogeneous target
- TextOut – for destructive overlays such as timestamps for image archiving

Common Vision Blox tools under Linux

- CVB Minos – the highly-efficient OCR and pattern recognition tool brings speed to systems with low processing power
- CVB ShapeFinder – this allows object scales and positions to be returned to sub-pixel accuracy
- CVB GigE Vision Server – this has particular strengths for embedded systems, where it can allow an ‘edge’ device to work as part of a larger processing network
- CVB OPC-UA – the machine-to-machine communications tool for factory network systems
- CVB Match 3D – giving the ability to determine the misalignment of 3D pointclouds for positioning or subtraction to find 3D differences

More tools are possible, if you have a requirement, please discuss it with us.
Machine learning has become a hot topic in machine vision. Many available tools are based on convolutional neural networks and have intrinsic drawbacks such as a requirement for a large number of training images and a heavy processing load, especially during training.

- Typically CVB Polimago needs tens of images per class, compared to five hundred to a thousand for a neural network tool.
- Most neural networks rely on GPUs to be fast enough for industrial use, CVB Polimago runs on a standard CPU, and often runs faster than neural networks.

This makes it well-suited to many industrial environments, where training and execution time and the number of training images are constraints. In tests, CVB Polimago returns similar levels of accuracy to neural network applications.

CVB Polimago works as a classification tool and also as a search tool. This opens up the range of possible applications dramatically.

Another application of CVB Polimago is 3D pose estimation – by training targets and letting the learning process add perspective variation, CVB Polimago can learn about the orientation that an object is facing, for example for pick-and-place applications.
Machine learning OCR tool optimised for high-speed reading of printed text. By learning from multiple examples, CVB Minos detects which features are consistently needed and which ones are variable background features.

For object recognition CVB Minos uses discrete features in the grey value range that are automatically extracted from sample images during the training phase. CVB Minos not only detects features to differentiate between each trained object type, but also uses negative examples in the sample images to further secure correct detection and classification. This provides the ability to differentiate between two similar objects and also to deal with patterns that are mixed with varying backgrounds, for example in OCR or security print used in bank notes or credit cards.

- Character recognition (OCR/OCV) under difficult conditions
- Reads 100,000s of characters per second
- Can be trained to complex patterns (e.g. OCR) or easy patterns
- Outclasses traditional edge or blob tools regarding speed, accuracy and robustness
- Available for Windows and Linux platforms, including embedded ARM platforms.

**CVB SHAPEFINDER**

*High precision search tool using geometric information*

CVB ShapeFinder uses the contours of an object to provide highly-accurate position, scale and rotation information. The software is very resistant to partial occlusion – where an object is partly covered or subject to noise or dirt. This resilience extends to dealing with reflections and changes in illumination.

- Easy to use, fast recognition rates
- Inherently scale and rotation tolerant
- Very tolerant to changes in illumination
- Good recognition of partly hidden objects

CVB ShapeFinder uses a generalised form of the Hough transformation where patterns are located solely on the basis of localised contrast in the greyscales of an image. These contrasts correspond to pixels around which the greyscale values change significantly. In contrast the algorithm ignores image areas with only a low level of greyscale variation. Users can define an appropriate contrast threshold and thus control the computational demands and the quality of the results. Another interesting characteristic is its ability to search for more than one pattern type at the same time, with minimum increase in search time as the search window only needs to be scanned once when searching for multiple models.
CVB Barcode offers a powerful algorithm to accurately decode common barcode symbologies reliably and at high speed. The algorithm locates the codes automatically within the camera image, irrespective of position or rotation and can even read codes when they have poor contrast, are printed on uneven surfaces, or need to be viewed in a challenging environment or orientation.

CVB Barcode also allows grading of codes to determine the quality of printing or marking.

All 1D- and 2D-barcodes can be
- activated or deactivated individually
- located at any position in the image
- read at any angle of rotation or at different sizes
- read on a curved surface or if optically distorted
- read when mirrored
- read when printed black on white or white on black.

CVB MATCH 3D

Software for demanding 3D surface inspection

For 2D inspection it is not unusual to subtract a test image from a golden template to show the differences. The prerequisite for this is careful alignment, either of the camera and target or alignment in software. For 3D inspection a similar process is useful, but the alignment is much more complicated, as it must work in x, y, z and three rotation axes.

CVB Match 3D returns the difference in alignment which can either be used to align a test image to a template image and find the differences or it can be used to inform a robot vision system how it should align to a part.

- Alignment of an image to a template in 3D position and rotation
- 3D deviations can be used to find the differences after alignment
- Useful for robot alignment and 3D defect detection
CVB Movie allows video sequences to be streamed to disk as AVI files. Using modern PC hardware it is possible to achieve impressive data rates.

- Compressed or uncompressed recording
- Utilises CVB ring buffer to prevent dropped frames and smooth out the compression throughput
- Powerful application CVB Movie Interactive for RAM and/or disc recording included
- Parallel recording from multiple cameras
- Support of high-speed cameras
- Synchronised recording
- Supports text streams as metadata in the AVI container

As the core of our recording solutions, CVB Movie guarantees robust and secure image storage to RAM or disk and supports a variety of additional features such as adding a timestamp or user specific information such as GPS-data directly synchronised to the image data. This data is not visible on the image, but is clearly allocated to the individual image as meta data. Combined with our experience in building customer specific PC vision systems we have the expertise to work with customers to deliver image recording platforms with guaranteed performance.

CVB GIGE VISION SERVER

Flexible image server for data transfer to multiple PCs via multicast

By using the CVB GigE Vision Server a PC acts like a GigE Vision and GenICam compliant camera with freely definable features. Any acquisition hardware supported by Common Vision Blox, as well as processed images or saved images, can be delivered as a GigE Vision stream. CVB GigE Vision Server works with any standard compliant software interface from other suppliers.

With CVB GigE Vision Server you are able to:

- Freely define, create and control image data and GenICam features and commands
- Serve image data to single or multiple computing or monitoring devices simultaneously
- Create distributed processing networks

Available in two versions, the certified GigE Vision Server enables either point-to-point image transmission and system control, or full multicast ‘one to many’ for distributed processing and viewing applications.

Some typical applications include:

- Remote application monitoring and control
- Local preprocessing of image data on the GigE Vision Server
- Dynamic networked imaging systems
With CVB GPU Processing developers can take advantage of the immense power of the GPU to increase image processing speed. The GPU processing found in Common Vision Blox is based on Microsoft’s DirectX High Level Shader Language (HLSL), which means that it is fully hardware independent, allowing migration between different graphics cards and card vendors.

**Perfect combination of GPU and CPU**

CVB GPU Processing supports pipeline processing of several algorithms in a sequence on the image before it is transferred back to the host memory. Additional algorithms can be added and removed from the pipeline dynamically when processing.

- Frees the programmer from complex programming
- Handles the data transfer between host and graphics card
- Allows image access before and after GPU processing

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**Common Vision Blox**

Common Vision Blox grew out of two requirements for the industrial vision user: the free choice of hardware and the availability of advanced tools. 21 years later those founding principles still hold.

We have added comprehensive functionality to the CVB Foundation Package and were one of the first industrial software suppliers to add machine learning to our portfolio. This gives us a body of knowledge that has led our development and our advice to customers. The latest release of CVB Polimago works within the constraints of industrial use-cases to make machine learning practical for the real world.

We have allied ourselves closely to standards bodies. This allows us not only to conform to standards, but to help to build them. Acquisition standards such as the GenICam standard have allowed camera manufacturers to build self-describing cameras, while our efficient and secure acquisition methods are more important than ever. While camera pixelcount and framerate keep increasing and put increasing pressures on PC hardware, efficient acquisition is a must. The advent of embedded imaging brings low-power systems to the industrial vision world – these benefit just as much from our fast and efficient tools and acquisition.