CODESYS® Visualization

Creation of professional visualization interfaces fully integrated in the PLC development system – Display on PCs, target devices, and in web browsers
CODESYS Visualization

Integrated solutions for all application platforms

CODESYS is one of the standard tools in industrial automation. The IEC 61131-3 development system is an established name in factory automation, process automation, mobile automation, energy automation, building automation, and many more.

One reason for this is the innovative and proven programming characteristics of the development interface for industrial controllers. Another important reason is the seamless integration of a comprehensive visualization into the CODESYS Development System. More and more users benefit from the advantages not available in conventional systems. As a result, CODESYS Visualization is applied in hundreds of thousands of applications around the world. The close and efficient link to the controller has predestined CODESYS Visualization for machine-oriented operation. Many leading controller manufacturers have recognized this fact and equipped over 500,000 devices with CODESYS Visualization.

Integration into the CODESYS Development System and flexibility of use make it possible:

CODESYS Visualization can be used for simple machine operation as well as for remote maintenance, monitoring and diagnostics. It is employed in hundred thousands of applications, in the most different industries and on a wide range of display devices – such as tablets or smartphones or in a web browser.
Components of CODESYS Visualization

A visualization editor integrated in the CODESYS Development System allows users to create any number of complex operating interfaces based on available visualization elements.

Different combinable display variants (see graphic, pp. 8/9):

- Visualization for testing and commissioning – integrated in the CODESYS Development System
- CODESYS TargetVisu for control systems with integrated displays
- CODESYS WebVisu for display in standard HTML5 browsers (PCs, tablets, smartphones)
- CODESYS HMI for visualization on remote industrial PCs
What distinguishes CODESYS Visualization from other systems?

Integration into the PLC programming system

- Visualization and control application in one CODESYS project: Operating interfaces can be created at the same time as the development of the PLC program.
- Alternative: Project engineering of the visualization regardless of the control application – still in the CODESYS Development System, with switchable view for visualization specialists
- Multiple use of created operating interfaces – for example for application tests, commissioning, diagnostics, and application operation
- Direct access to the variables of the controller – Project engineering of the data exchange is superfluous.
- Use of the entire infrastructure of the CODESYS Development System for the visualization, for example library and source code management or find, replace, and refactoring
- Extended functionality thanks to integration: Function block instances of visualizations, array access from the visualization, real-time data recording, extensibility of the pool of visualization elements in the same interface, calls of PLC functions from the visualization, etc.

For device manufacturers: Unrestricted selection of device platforms

- Executable on almost all CODESYS-compatible platforms
- Easy implementation thanks to available adaptations for Windows, Windows CE, Linux, VxWorks, QNX, and operating systems without a graphic API
- Uniform operating interfaces from one project file for all display variants

CODESYS Visualization: Everything you need for commissioning complex motion, CNC or robotic applications.
Functions of CODESYS Visualization

Integrated graphical editor with intuitive operation

- Creation of operating interfaces
  - Fully integrated in the CODESYS Development System
  - As part of the whole project, if necessary simultaneously with the PLC program
  - By drag-and-drop actions from available elements of the toolbox or imported images
  - With many convenience functions, for example alignment, duplication of elements according to linked array variables, grouping, etc.
- Global functions, such as find, replace, print, compare, refactoring, or versioning with Apache Subversion® – also available in the visualization editor
- Support of all IEC 61131-3 data types

Data recording with Trace/Trend

**Trace**
- Real-time capable recording of the values of configured variables in the CODESYS runtime system (implementation required by device manufacturer)
- Display by visualization element "Trace" as a time chart
- Control of recording by trigger event or special logic function

**Trend**
- Real-time capable recording of variable values to a storage medium (implementation required by device manufacturer)
- Display by visualization element "Trend" as a time chart in any interval
- Automatically configured control elements for easy online operation of the trend display
- If necessary, further editing of trend data with external tools (for example, Microsoft Excel)
Recipe management

- Read/write variable blocks of the controller
- Typical application: Convenient transfer of machines and plants in specific states (for example, initialization, manual operation, slow production), backup/restore of different production data sets (recipes)
- Integrated editor for preparation and management of recipes in the CODESYS Development System
- Operation, creation, and management of recipes in the visualization during operation

Image switcher

- Management of image lists in the CODESYS Development System
- Image access by ID
- Image toggler depending on PLC data
- Typical application: Adapted display of visualization depending on machine status or configuration, show specific plant images for error messages
User management

- Creation and deletion of users and user groups with different permissions and properties
  - During project engineering in the CODESYS Development System
  - Directly in the visualization in runtime mode with customizable dialogs
- Configuration of user groups (display and user permission) per visualization element
- User change in runtime mode by means of buttons or image elements

Versatile communications concept

Display of data from multiple controllers on one display device (multi-PLC):

- For CODESYS HMI:
  Data collection with "Data source" object from any CODESYS-compatible controller – soon from any OPC UA server
- For all display variants:
  Data collection via network variables or I/Os

Display of data of one controller on multiple display devices (multi-client):

- Simultaneous display of variable values in CODESYS WebVisu, CODESYS TargetVisu, and CODESYS HMI
- Separate start visualization, user login, and adapted display depending on display size (responsive design) possible for each client

Alarm management

- Definition of error or critical plant states
- Registration and display of occurring error conditions
- Configurable reaction to alarm events
- Acknowledgment from users by means of predefined procedures
- Optional: Archiving of error conditions for documentation or reproduction of failures
- Triggering and processing of alarm events by the logic application (IEC program)
CODESYS Development System
- Development interface
- Creation of operating interfaces
- Diagnostics
- Commissioning/maintenance/service
- Optional: 3D visualization CODESYS Depictor
- Operating system: Windows

CODESYS HMI
- Data from one/multiple PLCs in one visualization
- Data connection to any CODESYS PLC (V2/V3)
- Multi-touch support
- Processing all visualization functions on the panel
- For MS Windows: available in the CODESYS Store (CODESYS HMI SL)
- For other operating systems: adaptable by device manufacturers

CODESYS TargetVisu
- Display variant on panel PLC
- Logic application and operating interface on a single device
- Platform-independent
- Multi-touch support
- Efficient data access without external communication
- Optional: remote operation

CODESYS WebVisu
- Display variant on standard browser
- Remote access with standard browser
- Based on HTML5 and JavaScript: runs on any common smartphone and tablet
- CODESYS WebServer locally on the controller
- Multi-touch support
- Optional: Encrypted communication to controller

CODESYS Control RTE
- PC-based SoftPLC with hard real-time properties
- For controller tasks
- Optional: CODESYS HMI, CODESYS TargetVisu, CODESYS WebVisu
- Operating system: Windows

CODESYS Control
- SoftPLC for different device platforms
- For controller tasks
- Optional: CODESYS HMI, CODESYS TargetVisu, CODESYS WebVisu
- Operating system: almost any

Optionally integrable CODESYS WebServer is prerequisite for the CODESYS WebVisu
**Visualization styles: Format templates for the visualization**

- Definition of a set of element properties (for example, colors, shapes, and images) in a style file in a separate style editor
- Design of operating interfaces by means of parameters in a style file
- Automatic change of all elements based on the style file when switching styles in the visualization manager
- Use of styles by all visualization elements in the scope of delivery
- Quick start using complete styles with attractive, up-to-date designs and a preview in the visualization manager

**Typical use case: Adaptation of operating interfaces to the corporate design of customers without changing the project**

- Convenient preview and selection of all elements in the toolbox
- Easy creation of appealing and high-quality operating interfaces

**Extensive selection of visualization elements**

- Basic elements and controls with many customization options
- Dynamic supplement to the element scope with optional products, such as CODESYS SoftMotion
- Symbol library with hundreds of elements in consistent styles

**Basis elements:**
Rectangles, ellipses, curves, polygons, polylines, pies, bitmaps, SVGs, buttons, frames, Bézier curves

**Common controls:**
Labels, buttons, tables, text fields, scrollbars, sliders, loading bars, radio buttons, check boxes, combo boxes (INT variables/arrays), group boxes, spin controls, progress bars

**Input options:**
Buttons, toggle, image/visualization switch, mouseover, function calls, open/close dialogs, keyboard shortcuts

**Special controls:**
Trace, trend, native control (ActiveX), text editors, web browsers, waiting elements, 3D path

**Graphical elements:**
Banner and tables for alarm management, extensive symbol library with standard symbols (arrows, file/folder symbols, clocks, etc.)

**Practice-oriented controls:**
Meters, lamps, switches, potentiometers, bar displays, histograms, date/time selection and display

**Animation options:**
Text display, toggle color, visible/hidden, transparency/semitransparency, gradient, operable/inactive, move, resize, rotation/inner rotation, font/character properties, color areas, unit conversion, event-triggered in visualization when value changes
**Individual visualization elements: Extension of the element pool**

**For end users:**
- Creation of visualization libraries for developers’ own applications, and possible sale of elements in the CODESYS Store
- Integration of visualization libraries from other manufacturers, for example from the CODESYS Store

**For device manufacturers:**
- Creation of functional visualization elements that are specific to plants, industries, or devices
- Development directly in the CODESYS Development System with the language possibilities of IEC 61131-3
- Required: CODESYS VisuElement Toolkit (optional add-on product)

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**Language switch**

- Management of displayed texts in text lists
- Consistent Unicode support: Display in all languages and characters, for example Chinese (logograms) and Russian (Cyrillic)
- Flexible assignment of fonts to languages; availability may depend on the device
- Translation of text lists regardless of the current project

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**Responsive design: Automatic adaptation to different display formats**

- Operating interfaces executable without changing to different displays
- For optimum display: Design of operating interfaces for different display formats (landscape 16:9/16:10/4:3 or portrait 9:16/10:16/3:4)
- Detection of format and resolution of the display device by code in the logic application
- Automatic override of the applicable visualization
- Dynamic adaptation: Change of window size, tilting the display

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Seamless integration of all visualization elements in the toolbox of the development environment
Gesture control with multi-touch operation

- Support depending on the capabilities of the display device
- Reaction to known gestures (swipe/scroll/zoom): Depending on the function of a complex visualization element, coded specifically to the use case
- Typical use case: Convenience functions, such as simultaneous operation of multiple sliders or virtual two-hand operation

Reusability by means of visualization objects with parameter interface

- Inclusion of complete visualizations in other visualization objects (image in image)
- Assignment of variables to visualization elements directly or by parameter interface

Parameter interface:

- Versatile assignment of visualization objects, for example to POU instances or I/O addresses, comparable to object-oriented programming of function blocks in IEC 61131-3
- Automatic update to all occurrence locations after changes
- Allows for storage of visualization objects (faceplates) with matching function blocks
Product variants of CODESYS Visualization

The operating interfaces created in the CODESYS Development System can be used in different display variants – depending on the applied controller.

Integrated in the CODESYS Development System

The integrated visualization in the development system is ideal for application tests, service and diagnostics, or commissioning a plant. As soon as the controller is connected, the interface editor switches in order to animate the displayed elements. This display variant is part of the free CODESYS Development System, and it can be used independently of the applied controller.

CODESYS HMI – Access to process values throughout the plant

With CODESYS HMI, the operating interfaces created in CODESYS can be viewed on a remote display. This eliminates the computational load on the controller. An industrial PC with Microsoft Windows is typically used. Device manufacturers can also port CODESYS HMI to other system platforms.

Properties

- Independent project engineering of visualizations and simultaneously with the logic application in the CODESYS Development System – optional with simplified interface (switchable)
- Tool-assisted configuration of required settings for communication with CODESYS V2.3 and CODESYS V3 controllers
- Data binding via CODESYS data source objects:
  - Simultaneous linking to different controllers via symbolic interface (multi-PLC)
  - With developers' own variable mapping, if required
  - Pending: Data binding as OPC UA client to any number of controllers
- Distributed visualization possible on multiple terminals
- If required: Processing of IEC 61131-3 program code in addition to the visualization, for example for data preprocessing, unit conversion, etc.
- Demo version included with the CODESYS Development System
- Available as Windows version for user licensing in the CODESYS Store (CODESYS HMI SL), as well as portable version for device manufacturers (CODESYS HMI)
- Typical application: Visualization, operation, and monitoring of a complete machine or plant with multiple controllers on one PC

CODESYS TargetVisu – Machine and plant operation on site

CODESYS TargetVisu displays operating interfaces directly on the PLC, or on an integrated or connected screen. This combines the controller and visualization in one device.

Properties

- Optional add-on product for device manufacturers and end users of SoftPLC systems available in the CODESYS Store: Requires an extension of the CODESYS runtime system
- Platform-independent product components: Portable on different system platforms (CPU, graphics processor, graphics library, operating system), reference implementations available for Windows, Windows CE/Embedded/Mobile, Linux, and QNX
- Variant for systems without their own display: CODESYS Remote TargetVisu for the remote operation on a display device without controller functionality
- Variant for systems without their own graphics library or with low system resources: CODESYS TargetVisu Embedded with reduced functionality
- Functional interface: Capability of calling functions, properties, and methods of the control application directly from the visualization elements
- Typical application: Control and visualization of modular machine units via panel PLC, savings of device costs by integration of both functions
CODSYS WebVisu – Service and diagnostics worldwide

The visualizations are downloaded with the logic application to the controller. Display is on standard web browsers by means of HTML5. Therefore, CODSYS WebVisu is ideal for teleaccess, telemonitoring, servicing, and diagnostics of a plant by internet.

Properties
- Optional add-on product for device manufacturers and SoftPLC systems available in the CODSYS Store: Requires an extension of the CODSYS runtime system
- Safe communication with the controller: JavaScript – optionally with TSL/SSL encryption and signing with X.509 certificate
- Integrated responsive design functionality: Optimized display of the information for different web-based terminals
- Visualization by means of HTML5 canvas element: Support of all current browsers, for example iOS and Android
- Typical application: Teleaccess, telemonitoring, as well as service and diagnostics of plants, machines, and automated buildings, for example by tablet or smartphone, or in distributed control systems

CODSYS Depictor – Integrated 3D visualization

Independent of the integrated visualization editor, end users can also create three-dimensional animations of their machines or factory operations: By means of CODSYS Depictor – directly in the PLC development system without any knowledge of 3D design.

Properties
- Seamlessly integrated add-on product for the CODSYS Development System – available as an option in the CODESYS Store
- Easy graphical design with standard elements and imported elements from CAD tools
- Animation of 3D scenes using variables of the control application without post-implementation of the function
- Display of scenes exclusively in the CODSYS Development System regardless of the applied controller
- Typical application: Feasibility and functional analyses without physical hardware (virtual laboratory), training and sales demonstrations

Example of a complete production process in CODSYS Depictor

Example of a motion kinematics in CODSYS Depictor

CODSYS Depictor

The CODSYS add-on tool when it comes to virtual function testing or the attractive display of 3D movements, for example when working with complex CNC or robotics tasks. CODSYS Depictor is available in the CODESYS Store and can be seamlessly integrated into the CODESYS Development System.
Integration by device manufacturers

Device manufacturers can implement CODESYS Visualization on almost any system platform to extend the functional scope of their products. Thanks to its scalability, the visualization runs on embedded controllers up to high-performance PC-based systems – regardless of the operating system.

Complete adaptation to the graphics interface is available for Windows, Windows Embedded CE, Linux, QNX, and VxWorks. Adaptation is required only for embedded controllers or other operating systems. Device manufacturers add specific runtime system components to activate the supported display variants in their devices according to the requirements.

**Advantage:**
Each display variant (see pp. 8/9) can be used individually or simultaneously. As a result, the display of operating interfaces is identical on each display device – for all display variants.

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**CODESYS Visualization – At a glance**

- Convenient creation of graphical operating interfaces in the PLC development system – parallel to or independent of the logic application
- Uniform display of designed operating interfaces in the development system, on the remote display devices, panel PLCs, and in web browsers
- Creation of developers’ own instantiable visualization objects and elements with parameter interface – easy reuse in all display variants
- Easy adaptation of visualizations to different designs thanks to visualization styles
- Reduced engineering and hardware expenses thanks to integration of PLC functionality and visualization in one device
CODESYS – the manufacturer-independent
IEC 61131-3 automation software.

CODESYS Product Families:

- Engineering
- Runtime
- Visualization
- Fieldbus
- Motion + CNC
- Safety
- Services

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