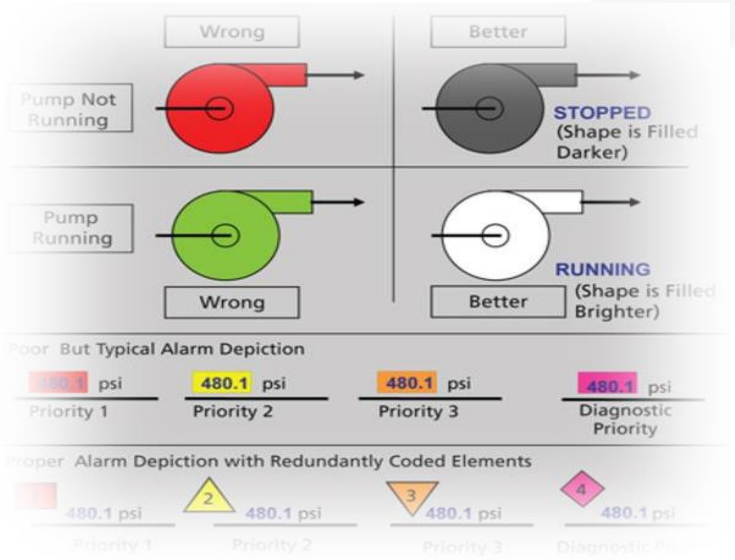
Situation Awareness:

Adroit ISA 101 High Performance HMI

Situation awareness (SA) is the perception of environmental elements with respect to time or space, the comprehension of their meaning, and the projection of their status after some variable has changed. It is also a field of study concerned with perception of the environment critical to decision-makers in complex, dynamic areas ranging from aviation, air traffic control, ship navigation, industrial plant operations, military command and control, etc. Having complete, accurate and up-to-the-minute SA is essential where technological and situational complexity on the human decision-maker are a concern.



Instrument Society of America (ISA) 101 Standard

The ISA 101 Standard embraces situation awareness by addressing the design, implementation, and maintenance of human machine interfaces (HMIs) for process automation systems. In so doing, it effectively…

- Provides guidance to design, build, operate, and maintain effective HMIs which result in safer, more effective and efficient control of the process, in both normal and abnormal situations
- Improves user abilities to detect, diagnose, and properly respond to abnormal situations
- Enables users to be more effective in achieving:
  - Improved safety
  - Quality
  - Production
  - Reliability
- Is applicable to continuous, batch, and discrete processes – in fact any process using an HMI for interfacing to a controlled system.

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Adroit High Performance ISA 101 HMI

The upcoming 8.4 release includes Adroit's implementation of ISA 101 in the form of a toolkit that contains controls, wizards, and examples of the necessary graphic symbols and elements to build an HMI application. In meeting the ISA 101 requirements, three primary principles have emerged:

Clarity

- Graphics are easy to read and intuitively understandable
- Graphics show the process state and conditions clearly
- Graphic elements used to manipulate the process are clearly distinguishable and consistently implemented
- Graphics do not contain unnecessary details and clutter
- Graphics convey relevant information, not just data
- Information has prominence based upon its relative importance
- Alarms and indications of abnormal situations are clear, prominent, and readily distinguishable

Consistency

- Graphics functions are standardised, intuitive, straightforward, and involve minimum keystrokes or pointer manipulations
- The HMI is set up for navigation in a logical, hierarchical and performance-orientated manner

Feedback

- Graphic elements and objects (wizards/controls) behave and function consistently in all graphics and all situations
- Important actions with significant consequences have confirmation mechanisms to avoid inadvertent activation
- Design principles are used to minimize user fatigue, since operators use the HMI constantly

ISA 101 conventions and stipulations

- Grey backgrounds are used to minimize glare, along with generally low-contrast graphic elements. The best RGB colours for backgrounds are:

  221, 221, 221

  192, 192, 192

- Process lines and outlines of vessels and equipment are dark grey or black. Emphasis is provided by differences in line thickness, not colour
- No gratuitous animation, such as spinning agitators or pumps, moving conveyors, splashing liquids or sprayers. Animation is only used to highlight abnormal situations
- Depiction of process values is done in the context of information presented and not just simple numbers on a screen
- Important information and key performance indicators have small, in loco trends
- Colour is used only to indicate alarm conditions

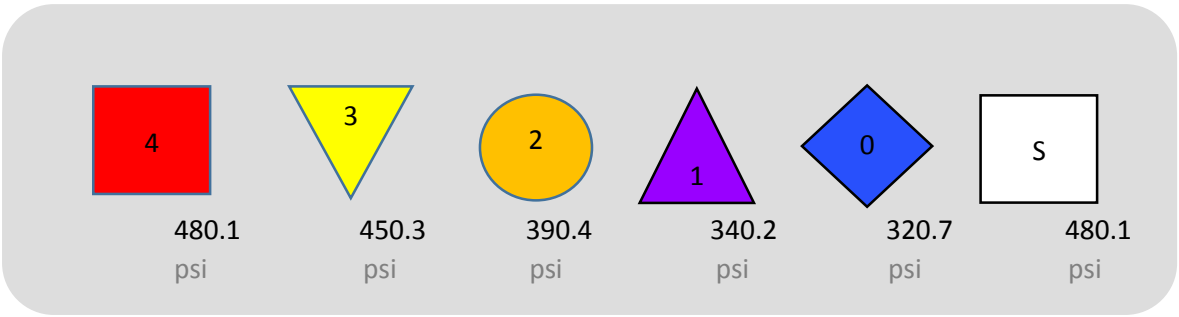
- Equipment is depicted in simple 2-D low contrast, not brightly coloured 3-D with shadowing, etc.
- Layout is consistent with the accepted mental model of the process which is often not the same as the P&ID layout
- Navigation methods are logical and consistent
- Graphics are hierarchically structured, supporting progressive exposure of detailed information
- Access to displays requires the minimum number of keystrokes or clicks
- Techniques are used that minimize the possibility of operator mistakes
- Validation and security measures are implemented
- Graphics are layed out such that wherever possible process flows from left to right. Gases flow upwards and liquids flow downwards
- Measurement units are shown in low contrast lettering if shown at all

Depicting Alarms

Alarms are divided into 5 priorities, each with an associated colour and geometric shapes:

- Priority 4 – Highest: Red
- Priority 3 – High: Yellow
- Priority 2 – Normal: Orange
- Priority 1 – Low: Magenta
- Priority 0 – Lowest: Blue

Priority 0 (Blue) is reserved for diagnostic events. Alarms for process variables that have been suppressed (alarm inhibited) are shown with a unique suppressed symbol using a white background:



With regard to audible alarm annunciation, where used, each one of the different alarm priorities should have its own unique alarm sound. For example – Priority 4 Highest – railway crossing bell. The sounds chosen must not be used by any other process or interface in the control room.

Contents of the Adroit ISA 101 toolkit

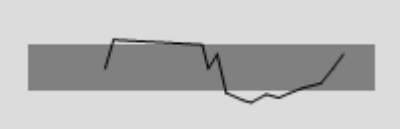
The toolkit essentially consists of a number of graphic form controls and wizards that implement the various elements and artefacts recommended by the ISA 101 standard.

Trends

The information content of trends is far more valuable than the mere display of many P&ID elements on a graphic page. Trends are implemented with the following capabilities and characteristics:

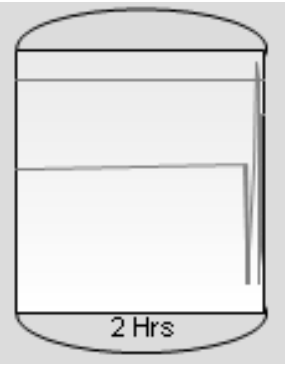
- The Y-axis span automatically ranges itself to a predetermined scale or predetermined amount relative to the current value, which is rarely the full range of the value being trended
- The time base of the trend is appropriate to process conditions. The slower the scan rate of value trended, the longer the trended period
- Normal bounds, quality limits, or desirable operating ranges are shown on the trend
- Manual alteration of the range and time base are possible and persist to subsequent invocations of the display. A “re-trend” mechanism exists whereby the trend is reset to its default configuration

Spark Line



When precision is not essential, and simple direction, magnitude, and amount of change is sufficient, a small unlabelled trend is placed next to a process value. The shaded area of a spark line trend represents the normal operating range. Clicking on the spark line brings up the normal range and time, e.g. +- 2° C / 1h

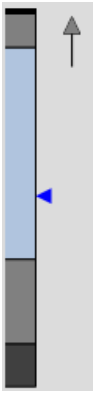
Process Vessel Trend



There are several methods to display the analog value of a vessel. The goal is to depict the level without undue emphasis or distraction. A trend line is used to display the value:

- Vessel is shown as 2-dimensional
- Outline is thin (1-pixel) black line
- Trend timespan is configurable
- 3 different sizes are available (small, medium, large)
- With either 2 or 4 alarm set points
- Vertical orientation only

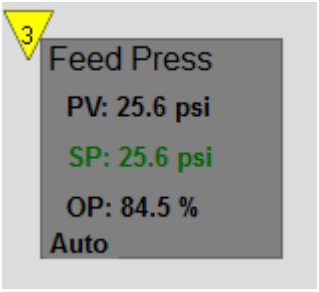
Analog Indicator



The purpose is to represent the operating state of an analog value graphically so as to be assimilated at a glance:

- 3 different sizes (small, medium, large)
- 2 different orientations (vertical, horizontal)
- Normal operating range is pale blue
- Inner alarm limits are light grey
- Outer alarm limits are dark grey
- Current value shown as dark blue index
- Trending direction show as directional grey arrow

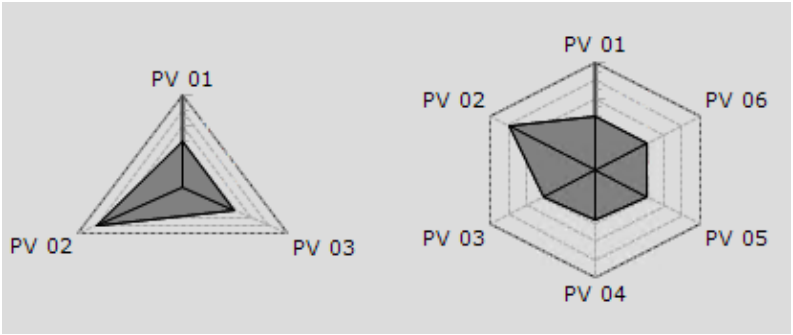
Controller



A controller is thought of and depicted as a physical entity. This way, proper information about its operational status can clearly be shown:

- Process value – expressed in engineering units
- Set point value – expressed in engineering units
- Output value – expressed as a percentage
- Mode – digital value showing Auto or Manual

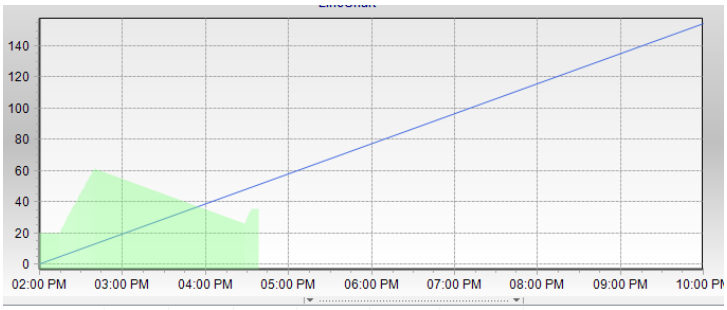
Radar Plot



A radar plot is used to create a PRO (Pattern Recognition Object) display element. It produces a polygon shape by plotting each process variable's current value on a separate plane. It is based on the premise that the retention and recognition power of the human brain is far greater for shapes than it is for a set on numbers:

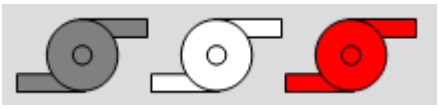
- Minimum of 3 and a maximum of 17 process variables
- Captures and saves process variable values for future reference
- Recalls pre-captured patterns and superimposes them under real-time pattern
- Indicates alarms. When any of the process variables goes into alarm, the shape changes colour based on the highest priority in force. The reading(s) in alarm are highlighted
- The name of each variable and its value can be seen as a tool-tip when the mouse hovers over the relevant axis

Production Target Trend

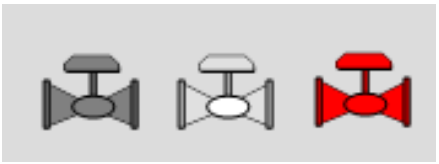


This trend is used to give operators an indication of how they are performing against a set target. It is also dynamic in that it can be reset with new target value after a process change so that operators are then able to see performance relative to the new target.

Standard ISA Shapes



Different sizes of various standard ISA shapes are provided, once again making use of pattern recognition so that objects can be recognized at a glance.



Labelling is not intrusive or of high visibility. In fact, not every item needs a label identification. In particular, tag names are not routinely displayed as they only add unnecessary visual clutter.

Call to Action

So keep monitoring the Adroit news feed at http://adroit-europe.com to download Adroit 8.4 and its ISA 101 High Performance HMI toolkit as soon as these become available. Remember, you can download and install Adroit in a couple of minutes, there is no such thing as a development licence – development is free, you only need to licence your application when you deploy it – you can even rent your licences annually if required. So get started as soon as possible developing high performance HMIs that foster enhanced situation awareness for your operators and other end-users.