Human Machine Interface

Chapter 9

Table of Content

Human Machine Interface (HMI)

- HMI is the user interface, in the industrial design field of human–machine interaction, where interactions between humans and machines occur.
- The goal of this interaction is to allow effective operation and control of the machine from the human end, whilst the machine simultaneously feeds back information that aids the operators' decision making process. Other term for HMI is man–machine interface (MMI)

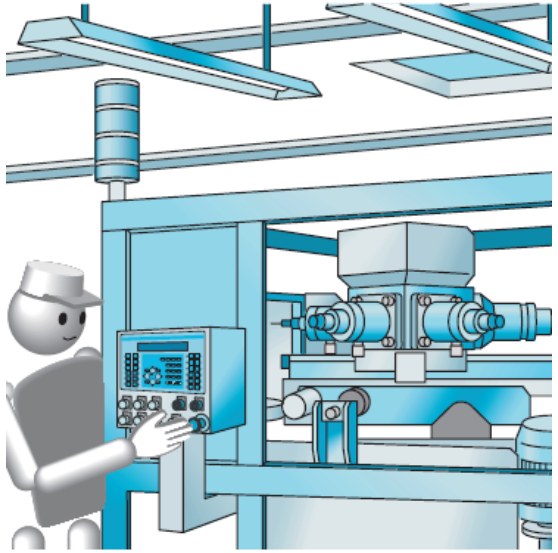
Introduction

- Why to use Human Machine Interface (HMI) systems?

  Problems of fitting machines and their uses for humans.

- Human characteristics: *To understand how humans communicate, and people's physical and psychological requirements.*
- Human-machine fit and adaptation
  - Improve the fit between the designed object and its use
    - how systems are selected and adopted; how users create routine systems; how systems adapt to the user (customization); how users adapt to the system (training, ease of learning); user guidance (help, documentation, error-handling)
- HMI system and interface architecture must have:
  - Input and output devices
  - Dialogue techniques
  - Machine Graphics

Introduction



- A human-machine interface uses two information flows in two directions:
  - Machine –> Human
  - Human –> Machine
- **Role of the operator**
  - **Perform regular process run tasks**
    - Stop and start the process.
    - Operate the controls and make the adjustments required for regular process run and monitor its progress.
  - **Deal with unexpected events**
    - Detect abnormal situations and undertake corrective action before the situation disturbs the process further (e.g. for early warning of motor overload,…)
    - Deal with system failure by stopping production or implementing downgraded operation using manual controls instead of automatic ones to keep production running.
    - Ensure safety of people and property by operating safety devices if necessary.
- The scope of these tasks shows how important the operator's role is.
- Depending on the information he has, he may have to take decisions and perform actions that fall outside the framework of the regular procedures and directly influence the safety and availability of the installation.
- This means the dialogue system should not be confined to mere exchange of information between human and machine but should be designed to facilitate the task of the operator and ensure that the safety of the system in all circumstances.
- The quality of the operating interface design and using the standards can be measured by the ease with which an operator can **detect and understand** an event and how efficiently he can **respond**.

History

- The design of an operator panel requires much coordination with the programming of the PLC and the design of the machine being controlled. Before the computer-designed systems, there were individual component systems that were hard-wired to the control devices inside the panel.

- Printers are used for alarms for a process. Each alarm was recorded at the time of occurrence and printed as a single line of data to be analyzed by a process engineer or controls engineer.

History

This panel shows many discrete devices as well as mimic panels showing process lines.

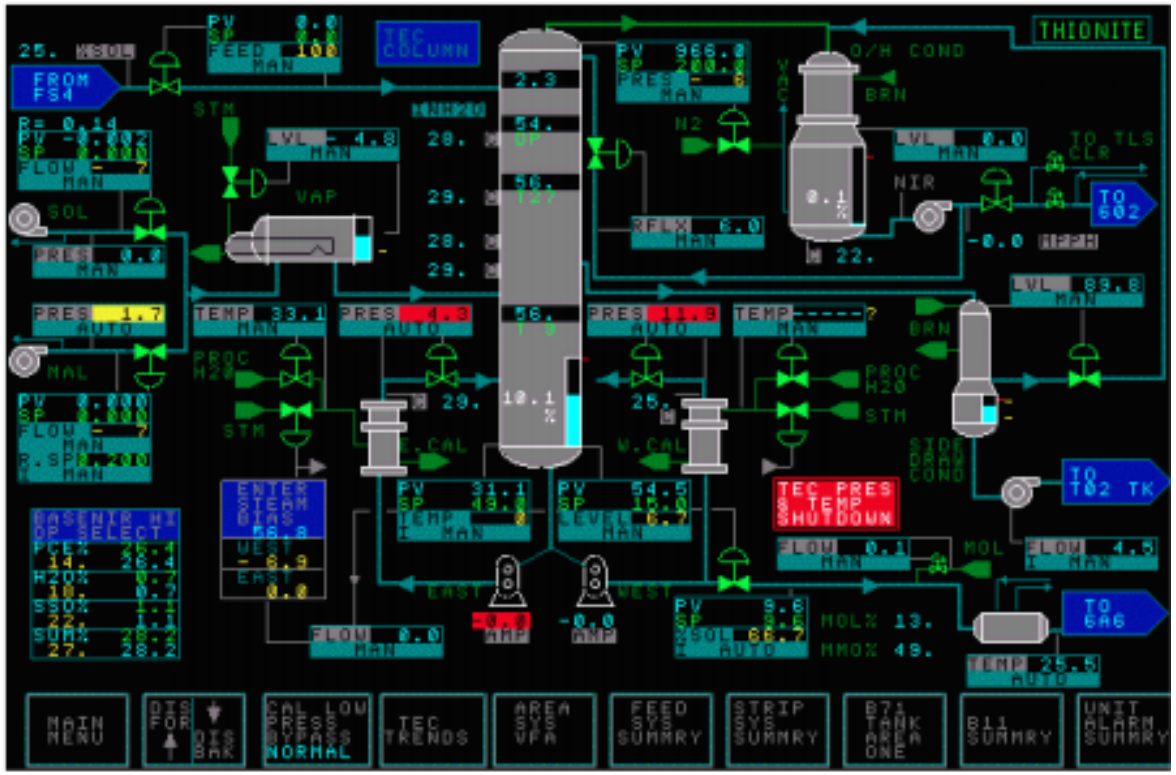
Meters show levels or flows of various devices.

Alarms are shown in grids of illuminated push buttons.

Alarm panels were designed with discrete panels that lit or blinked with each alarm. Buttons were used to acknowledge each alarm point

Data was collected with recording devices. Multiple points were individually recorded and studied

History



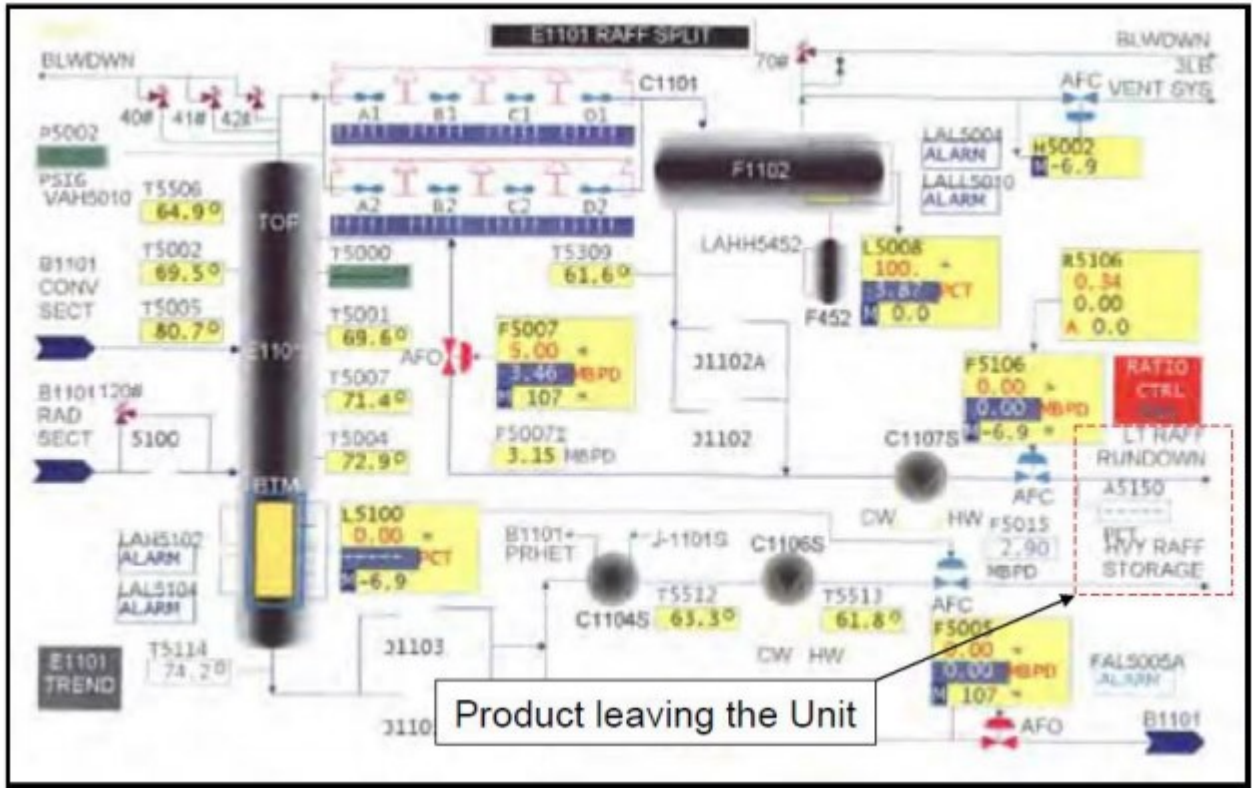
Graphics were developed over 20 years ago and remain common throughout the industry. Indeed, inertia, not cost, is the primary obstacle to the improvement of HMIs. Engineers and operators become familiar to this style of graphic and are resistant to change

Modern HMI design:
Show Information Instead of Raw Data
Proper Use of 3d graphics
Proper Use of Colors

HMI Design

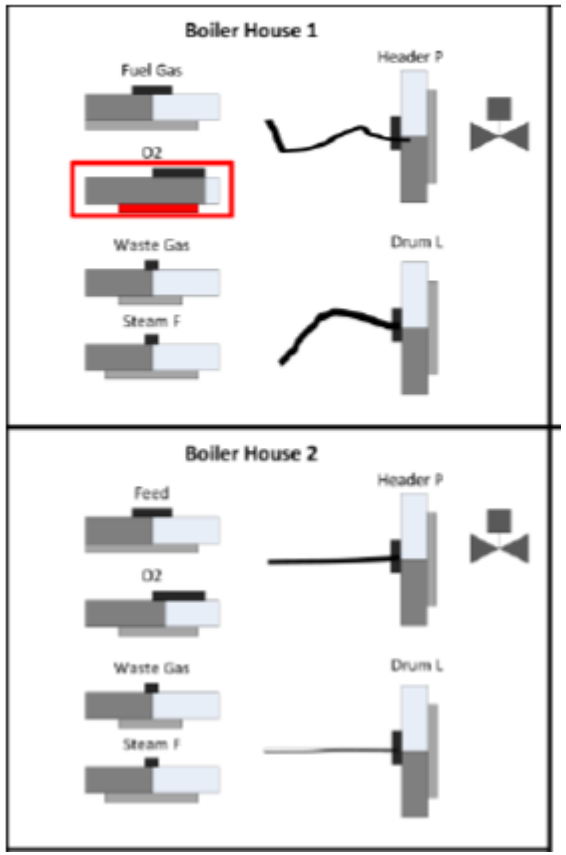
Four areas are primary in the successful design of a good HMI screen system. They are:

- Situation Awareness
  - Relates to the goals and objectives of a specific job or function.
  - Without understanding the user's goals the information that is presented has no meaning.
- Using Color Effectively
- Interpreting the data
- HMI Display Organization



HMI Standards

- The API-1165 Recommended Practice and the ISA-101 HMI Standard released in August 2015.
- ISA-101 (officially ANSI/ISA-101.01-2015) was begun in October 2008, very close to the time that the first edition of *The High Performance HMI Handbook* was published.
- In June 2014, a “final” draft of ISA-101 was sent out to the overall committee for final comment and vote.
- The draft was approved by vote but 1,163 comments were returned and had to be resolved.
- In March 2015, the version reflecting those modifications was sent out for a revote, which passed and the document was released in August 2015.
- It contains basic (and well known) recommendations such as these:
  - The HMI should be consistent.
  - The information shown should be relevant to the operator.
  - Color should not be the only indicator of an important condition.
  - Colors chosen should be distinguishable by the operators.
  - Auditory warnings should be clear and unambiguous.



HMI Standards

- The most important job of an operator is to detect and successfully respond to an abnormal situation. The HMI is the means by which the operator accomplishes this task. Existing HMIs are sadly insufficient for this purpose. They were generally designed in an era when proper practices were unknown, and the resistance to change has kept those graphics in commission for two or more decades.
- The principles of High Performance HMI are specifically developed to deal with the needs of today's operators and the complex systems they manage. A High Performance HMI is designed to be the best tool for operator interaction with the process control system.
- The benefits of such an HMI are more than just reducing human error and avoiding abnormal and unsafe operations. The HMI becomes an effective operational tool for maximizing production, reliability, efficiency, quality, and profitability.
- Industry is now recognizing the need and benefits of improved HMIs. Dozens of major companies are in the process of HMI modernization and see it as not only a safety initiative, but a cost-saving and productivity-enhancing one as well.
- The functionality and effectiveness of our process automation systems can be greatly enhanced if redesigned in accordance with proper HMI principles. A High Performance HMI is both practical and achievable.

HMI Hardware

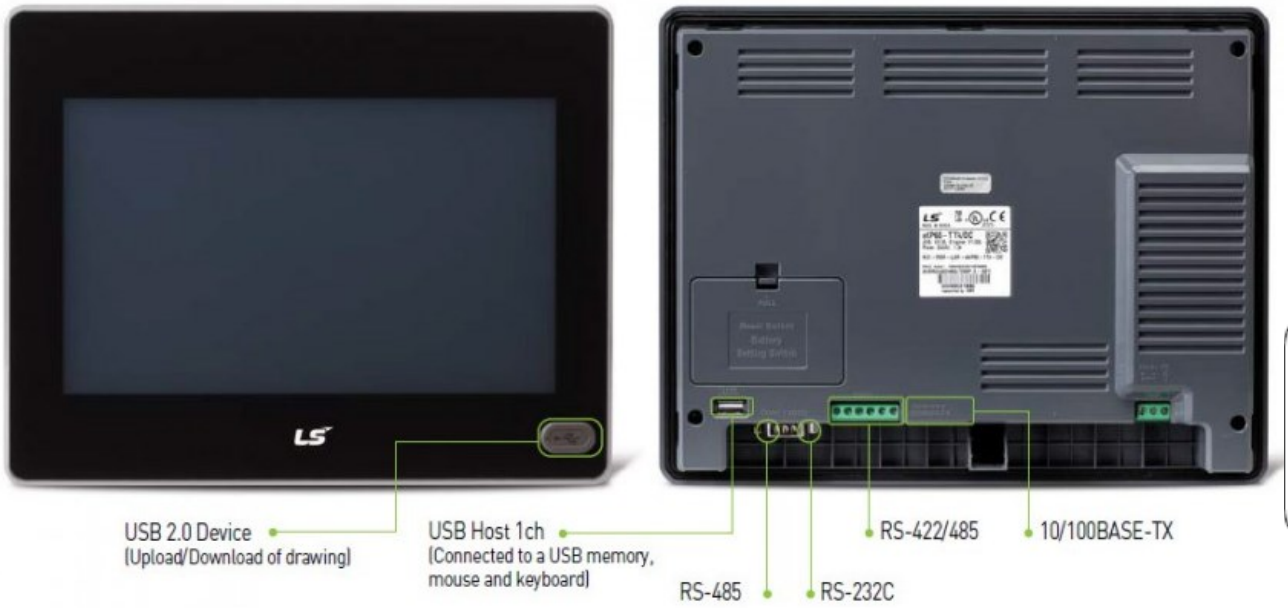
The following is a listing of one of the hardware vendors, LSIS, which provides a complete offering of hardware operator interface units to complement the software designs.

Item			XP30-BTE/DC	XP30-BTA/DC	XP30-TTE/DC	XP30-TTA/DC	XP50-TTE/DC	XP50-TTA/DC	XP70-TTA/AC XP70-TTA/DC	XP80-TTA/AC XP80-TTA/DC	XP90-TTA/AC
			Mono		Color						
Display description			Mono Blue LCD		TFT Color LCD						
Display Size (inch)			14cm (5.7")				21cm (8.4")	21cm (8.4")	26cm (10.4")	31cm (12.1")	38cm (15")
Resolution			320×240				640×480			800×600	1024×768
Color			8-bit Gray Scale		256 color	65,536 color	256 color	65,536 color			
Backlight			LED			CCFL(whole LCD), auto On/Off	CCFL (Replaceable LCD), Auto on/off				
			50,000Hours			60,000Hours	50,000Hours				
Contrast			Adjustable		Fixed						
Luminance			230cd/㎡		210cd/㎡	400cd/㎡	200cd/㎡	480cd/㎡	430cd/㎡	**400cd/㎡**	450cd/㎡
Viewing angle	Up/Down(Degree)		20/40		80/80	70/50	20/20	50/60	45/65	**45/75**	50/60
	Left/Right(Degree)		45/45		80/80	70/70	45/45	65/65	65/65	**65/65**	75/75
Touch panel			4-wire system analog					8-wire system analog			
Movement LED			Green : Run (Monitoring, download drawing data) Red : Error (Communication error, drawing data error)								
Memory	Display data		4MB	10MB	4MB	10MB	4MB	10MB			20MB
	Backup data		128kB	512kB	124kB	512KB (Logging, alarm data saving)	128kB	512KB (Logging, alarm data saving)			
Ethernet			–	1ch, IEEE802.3, 10/100Base-T	–	1ch, IEEE802.3, 10/100Base-T	–	1ch, IEEE802.3, 10/100Base-T			
USB interface			USB Host ×1	USB Host ×2	USB Host ×1	USB Host ×2	USB Host ×1	USB Host×2			
Serial	RS-232C		2ch (1 port for PC Communication)								
	RS-422/485		1ch, 422/485 optional mode								
CF memory card interface			–	CF card (TYPE-I) ×1	–	CF card (TYPE-I) ×1	–	CF card (TYPE-I) ×1			
AUX interface			–	Optional	–	Optional	–	Optional			
Certification			CE, UL, KCC								
Protection			IP65F (Front Water Proof Structure)								
Size (W×H×D)mm			181×140×56.5	181×140×66.5	181×140×56.5	181×140×66.5	240×174×63	240×174×73	317×243×73		395×249×73
Panel Cut (W×H)mm			155.5×123				228×158		294×227		383×282
Weight (kg)			0.62	0.75	0.62	0.75	1.2	1.4	2.2	2.4	3.9
Power	Rated voltage		DC 24V						AC100–220V, DC24V		AC100 – 220V
	Permitted voltage	AC	–						MIN 85 VAC, MAX 264 VAC		
		DC	MIN 19.2 VDC, MAX 28.8 VDC								–
	Watt	AC	–						37	40	46
		DC	5	8.5	5	8.5	13	20	27	30	–

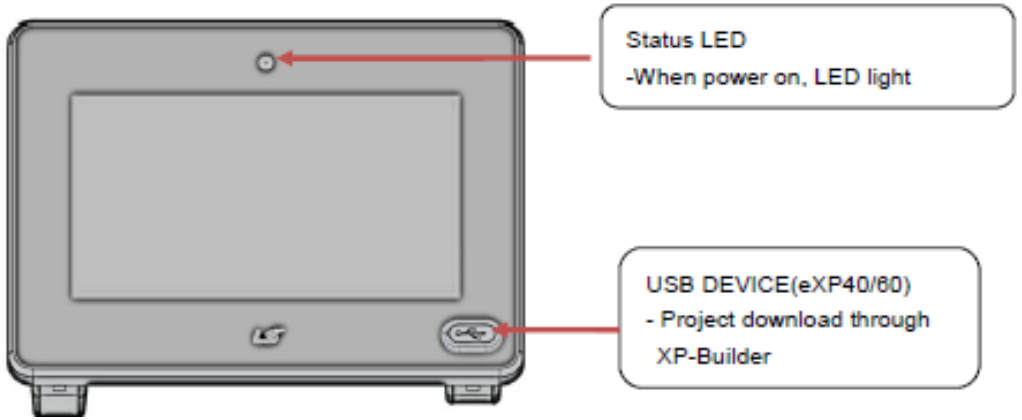
Graphic type XP30/XP50/XP70/XP80/XP90

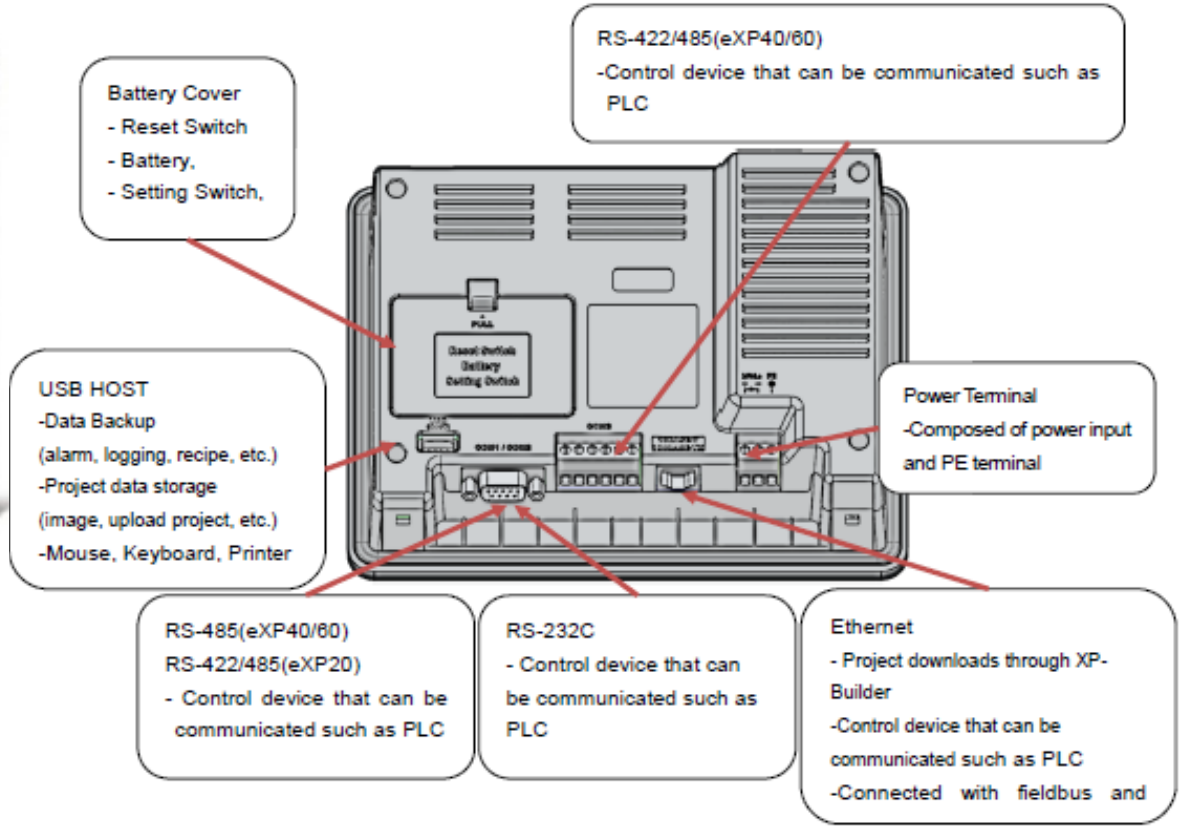
- High and vivid distinction with 65,536 colors
- High quality raster and vector symbols
- Various BMP JPG GIF graphic file support: BMP, JPG, GIF, WMF,
- Simple animation effects: animated GIF
- 10/100BASE-T Ethernet interface
- Convenient and easy screen editing
- Strengthened data management: Logging, Recipe, and Alarm
- Read function of a controller's state information: Monitoring and maintenance
- Multi-lingual display: up to 8 languages
- Offline and concurrent simulation with XG5000
- Easy to change the address of the graphic objects: Tag function with XP-Builder
- USB host for peripheral devices: USB Drive, Mouse, keyboard, printer, etc
- Sufficient memory for screen data: 10MB

XGT PANEL



(a) Supporting various device of USB, Ethernet, it maximizes the customer's usability.

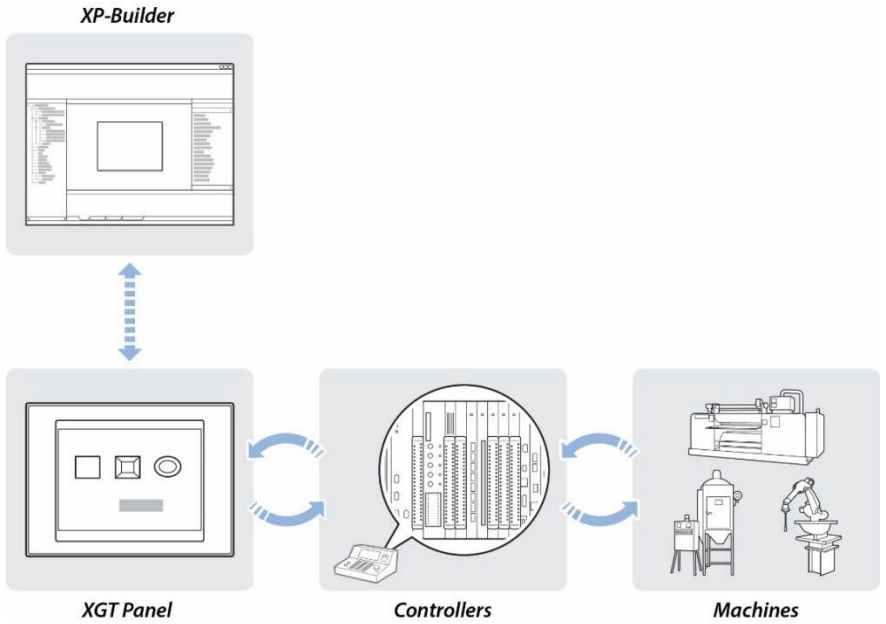




HMI Software

XP-Builder is software that allows you to create and manage projects for machine control devices. You can use XP-Builder to create projects for the XGT Panel. XP-Builder includes multiple features that allow you to design and edit projects conveniently, such as:

- Customizable toolbars and hotkeys
- Customizable tool, project, and editing panes
- Functions to import and export common data
- Tabs for viewing multiple screens easily
- Previews of project screens
- Customizable image and object libraries
- Scripts and advanced functions, such as alarms, logs, schedules, and recipes
- Support for multiple languages



XP-Builder is the starting point for creating human-machine interfaces (HMIs) for industrial applications. With XP-Builder, you can design user-friendly interfaces for XGT Panels that allow end users to control machine functions through configurable controllers, such as programmable logic controllers (PLCs), inverters, or servos.

XP-Builder Software