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TECHNICAL NEWS

INDUSTRIAL SWITCHGEAR & AUTOMATION SPECIALISTS

AUTOMATION IN A TECHNOLOGICAL WORLD

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Wes' expertise in automation come from an international automation career spanning more than 15 years and as many countries. This paper forms the introduction to an educational series on automation. If interested in attending please email your interest with your contact details to: automation@nhp.com.au.

We live in a technological world with many facets of our lives automated. It can all seem quite daunting. This issue of Technical News covers the parts of an automation system, providing descriptions of what they are and where they fit, and concludes with an example of how it's all applied. The principals of automation are covered to give the reader a basic understanding of how to get the best out of automation in our technological world.

GLANCE BACKWARDS

Understanding where we've come from gives understanding on where we're going. We've been living with electricity for just over 100 years even though experiments in electricity started in earnest in the 1700's. In the 1830's the electric relay was invented and it was originally used with the telegraph. Relays and their variations were the basic building blocks of early automation systems such that assembly lines in the 1960's were controlled by large, complex panels of relays.

THE IMPETUS TO MOVE FORWARD

The problem with relays is that they are either on or off, they require hard wiring, and they contain moving parts that eventually fail. Control systems incorporating relays require a lot of pre-planning to make sure it is right the first time, a lot of time for wiring and a lot of space for components. Unfortunately, design requirements change along the way often resulting in extensive re-wiring and hardware changes. Precise operations require high resolution and hard wired systems can be difficult to commission.

THE PLC

In order to overcome these limitations, the Programmable Logic Controller (PLC) was born in the late 1960's. The PLC is essentially a computer that simulates the functions of relays and replaces wiring with programming. Further, utilising the processing power of computers, advanced control algorithms

FEATURES

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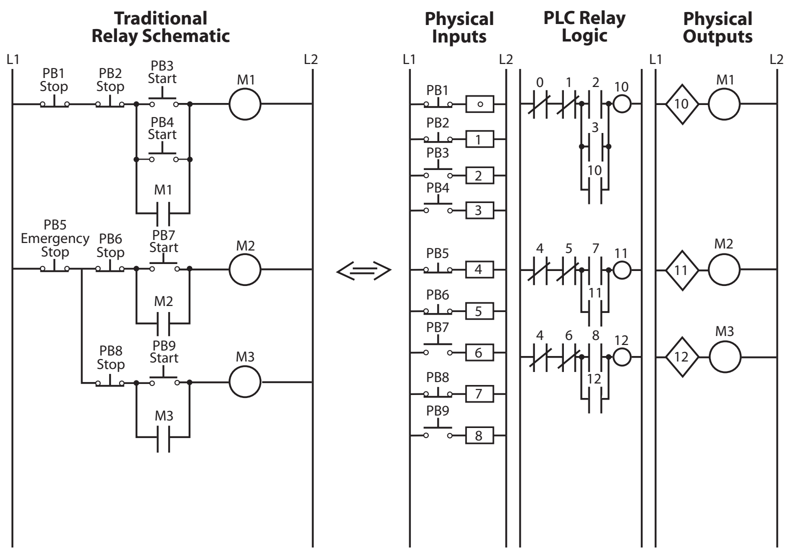
can be employed and the processing of analogue data is possible. The PLC is the basic building block of the modern automation system.

I/O: INPUTS AND OUTPUTS

The PLC needs inputs to process and outputs to control. Today, PLC's come with onboard I/O and remote input and output clusters called remote I/O modules. The beauty of remote (also called distributed) I/O is the reduction of field wiring.

LADDER LOGIC

Ladder logic is one of the ways PLC's are programmed. Relay based control systems were drawn as ladder diagrams. Ladder Logic programming is just the relay ladder diagram converted into software (see below) - an obvious connection to the history of PLC's.



ALL ENCOMPASSING AUTOMATION

The PLC still remains the brains of the modern automation system however with the advancements in computer processing power, the internet, telecommunications, silicon and applied materials, all encompassing automation is available today. Today's automation systems provide not just control but monitoring, event notification (alarms) and reporting functionality.

FIELD DEVICES

A field device is a piece of equipment (e.g. switch, sensor) that does something in the process. They measure, monitor, sense, push, pull, or rotate. It is not unusual for these items to have a means of connection to an automation system. The simplest method is a dry contact and the most complex is a communication port. Some field devices have their own smarts which gives processing capability right at the "coal face". The dry contact (also known as a volt-free contact or auxiliary contact) is connected to the automation system via the PLC's input and output modules and is a means of either monitoring and/or controlling the device e.g. start/stop the device, monitor its status. The communication port allows a multitude of data to be transferred to and from the device and also to and from other parts of the automation system.

HMI'S

At the other end of the automation spectrum is the need to collate the myriad quantity of data into useful, clear and concise information. Enter the Human Machine Interface (HMI). HMI's include: computer screens with text and graphical displays (GUI), touch screens, LEDs, LCDs, mobile phones, sirens and flashing lights. In the "old days" (cc1960/70), mimic panels were used. These have been replaced with computer screens in operator rooms generically referred to as SCADA systems.

SCADA

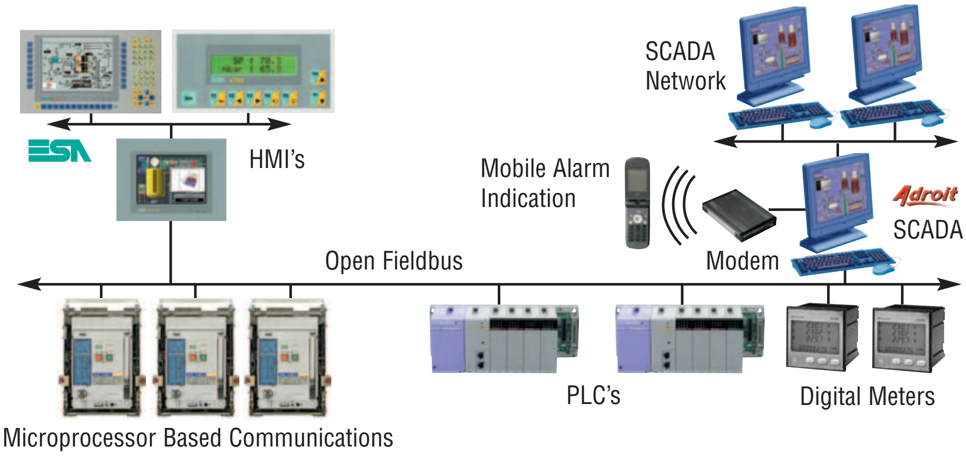
SCADA is the acronym for Supervisory Control And Data Acquisition. The terms SCADA system and automation system are often used interchangeably but there is a difference. SCADA is all about presenting the automation system in a graphical format so that an operator can "see" what is happening, and also logging all the data from around the control system and providing the means of accessing that data in a meaningful and easy way.

SCADA systems also provide a means of bringing many different automation systems together so that data can be shared between them.

INFORMATION ANYWHERE, ANYTIME

With the proliferation of the internet and mobile technology, plant operators can use mobile phones, pocket PCs (utilising wireless technology), and touch screens to access the information they need. Furthermore, management need not be bothered by production meetings and time zones to get the information they need. NHP's portfolio of automation products allows the manager to have the information they need whenever and wherever they need it. This can be done by use of web pages accessed over the internet, intranet, extranet or VPN. These developments have led to configurations as shown below and the emphasis on monitoring.

MULTIFUNCTION DEVICES



Although there is clear definition of all the different parts of automation, there are products available on the market today that blur the lines of delineation such as HMIs which come with a PLC and onboard inputs and outputs. Then there's NHP WAGO distributed input/output modules which can also come with PLC processing capabilities.

MAKING AUTOMATION AUTOMATIC

In the purest sense, an automation system is one where everything in the process happens automatically. This rarely happens in the real world. Take something as common and simple as the automatic door. While it automatically opens when you walk near it, few lock themselves. Human intervention is still required in this automatic procedure. There are often valid reasons why processes are not fully automatic and one of these historically has been the inability of different devices being able to communicate together. Either that or the owner didn't want to pay for that function.

There is a need when designing an automation system to look at the big picture and have a clear design brief. Automation systems are used because they:

- provide operational efficiencies
- increase product quality
- reduce energy usage and wastage
- improve reporting

Automation systems need to follow the axiom: horses for courses. Far too many automation systems have been sabotaged by operators who either felt threatened by the system, didn't understand it, or didn't see the value of it. Equally, the quality of our lives would be diminished if it were not for automation systems that work well.

Automation systems need to be designed with the future in mind. Future proofing the installation requires consideration of: modularity and expandability, choice of protocol, maintenance, system modification and ease of programming changes.

TALKING AUTOMATION: "COMMS"

As fundamental as communication is in our lives - personal and business, so it is with automation. Automation systems live and die by communication. If a device or controller stops communicating, the process begins to fail. There are a plethora of communication systems available today and this is not the forum to analyse each however, the basics are summarised below. Communication has 3 components, viz: the media, the carrier, and the protocol. Most discussion on comms for automation revolves around the protocol but this is just part of the story. A simple analogy is the way we communicate. We use a language - typically English. This is the protocol. We can communicate via spoken or written methods. When we speak to communicate, our voice can travel through the air, over wires, on radio waves or even along tensioned strings. And so when talking comms in automation systems we need to consider the whole picture. How will the data be transmitted - shielded, twisted pair, fibre optic, radio, telecommunication network or combination of these. The choice is dependent on the conditions, reliability issues, ease of installation, and required response times.

ETHERNET

With the abundance of Ethernet based computer networks installed today, automation systems are gravitating towards Ethernet as a means of comms however, it's not that simple. Ethernet is just the carrier. The media and protocol also need to be defined.

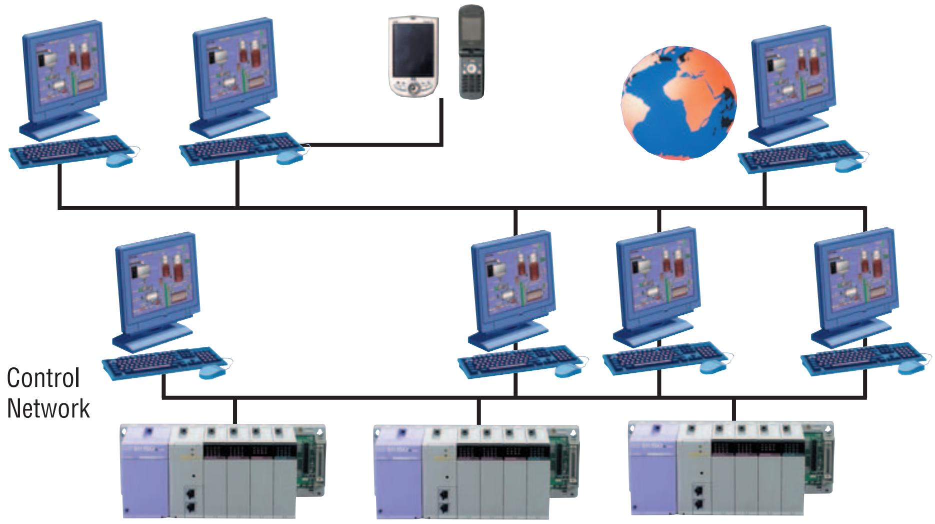
PROPRIETARY PROTOCOLS

Historically, protocols were proprietary i.e. developed and owned by individual companies. Some of these proprietary protocols have become de facto standards as the company owning them have released the details of the protocol to the market (e.g. Modbus, Profibus, DeviceNet). Unless the protocol is independently monitored and developed, variations of the protocol emerge (much like dialects). So in most cases it is necessary to determine exactly what the protocol is that a device/system employs.

PIECING IT ALL TOGETHER

Let's assume we have an industrial process that we need to automate to gain operational efficiencies, increase product quality, reduce energy usage and wastage, and improve reporting.

PART 1: PROJECT & SITE REQUIREMENTS



Power quality at the site is critical for the process. The process includes a large number of electric motors and quite a number of high operator risk operations. The facility is operated 24/7 and it is important that call out crews are notified as quickly as possible to minimise downtime. From time to time equipment is bought with its own controls which will need to be integrated into the site automation system.

PART 2: POWER QUALITY MONITORING

Monitoring and controlling the site power quality can be achieved by making use of the communication capability of today's circuit breakers, surge protectors and meters. NHP's Teraski range of breakers, Titan surge protectors and NEMO meters have this facility via a range of protocols and volt-free contacts.

PART 3: POWER & MOTOR CONTROL

Precise control and energy demand smoothing is facilitated via variable speed drives (VSD's) on the large electrical motors. VSD's have a lot of on board intelligence and also have communication ports. NHP's range of VSDs offers this facility.

PART 4: INTEGRATING OEM EQUIPMENT

With the use of specialised equipment with their own controls, distributed I/O can be implemented. The benefit of distributed I/O, such as NHP's WAGO range, is that a variety of protocol modules can be interchanged which enable the OEM equipment to be integrated into the site automation system.

PART 5: FIELD DEVICE SELECTION

Other parts of the process will need monitoring and controlling via switches, sensors, relays, and timers. As some of these are in hazardous locations, special consideration will need to be made in their selection. These can be connected to the PLC I/O or distributed I/O depending on the site layout and maintenance requirements.

PART 6: PROCESS MANAGEMENT

It will be necessary to have a number of HMI's located throughout the facility so that the operators have local points for monitoring and override control. Each operator will be provided with a site dedicated phone so that they are always just a phone call or text message away from addressing critical issues whether they are notified by a fellow worker or automatically from the automation system. NHP's Adroit software will provide the production management team with the information they need to assist how the process is working and highlight areas of improvement e.g. the report showed that Thursday's batches had a drop in quantity and quality after 3pm which corresponded to the site across the road flushing its system.

SAME GUY, DIFFERENT HAIRCUT

The fundamentals of all automation systems are the same, it's just the components that are different. Each system needs a processor (e.g. PLC), connection to the field devices via: inputs (switches, sensors), outputs (actuators), and smart devices, and a means of interrogation (HMI). On paper, all automation systems tend to look the same, it's just the actual components that are different. The difference between a good automation system and a poor automation system is the quality of product and the way they are implemented. NHP can help on both accounts.

So from the one button press to lock our car to the production and delivery of our daily newspaper, automation plays a part in our lives and it's really not that complicated after all once you know the jargon and how it all fits together.

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