Industrial Training Project Report

On

INDUSTRIAL AUTOMATION

At

Diac Educom Pvt. Ltd

(Training Division of Dyanamic Engineers Ltd.)

About The Company

Dyanamic Engineers an ISO 9000 Organization, established in 1996 is a Recognized system integrator (of ROCKWELL AUTOMATION) company engaged in providing highly efficient and reliable Automation solutions with lowest cost of ownership to customers. We offer turnkey solutions to our customers with highest service quality standards which exceeds customer's expectations. "DIAC is a group company of Dyanamic Engineers Ltd.

Dyanamic Engineers was established in New Delhi in 1996 with objective To provide efficient and cost-effective Industrial Automation Solutions to customers through latest technology.

To provide an informal yet highly professional environment to our employees and nurture them towards identifying the organisation's goals as their personal targets.

Dyanamic Engineers is a fast growing company committed to providing reliable and cost-effective Engineering solutions to organizations globally. Emphasis on quality, world-class human resources and leading edge solutions that drive our commitment.

Dyanamic Engineers have branch offices in Chandigarh & Hydrabad. Apart from this we are expanding beyond Indian horizon to cater to global places i.e. England, Indonesia, African Region, Gulf Countries & Nepal. We constantly enhance our service quality standards to match with the best in the world. With a successful track record of serving the most demanding needs, Dyanamic Engineers is focussed to provide solutions to exceed the expectation of the customers.

Area of Expertise

- BOTTLING LINE
- PACKAGING LINE
- BLENDING, CIG. MAKIN ETC
- INJ. & ROTO MOULDING
- BATCH PROCESS
- MASHING TANK TEMP. CONTROL
- RICE MILL
- NOODLE LINE
- DAIRY
- SOAP LINE
- CHEMICAL LINE CONTROL
- HVAC
- POWER MONITORING

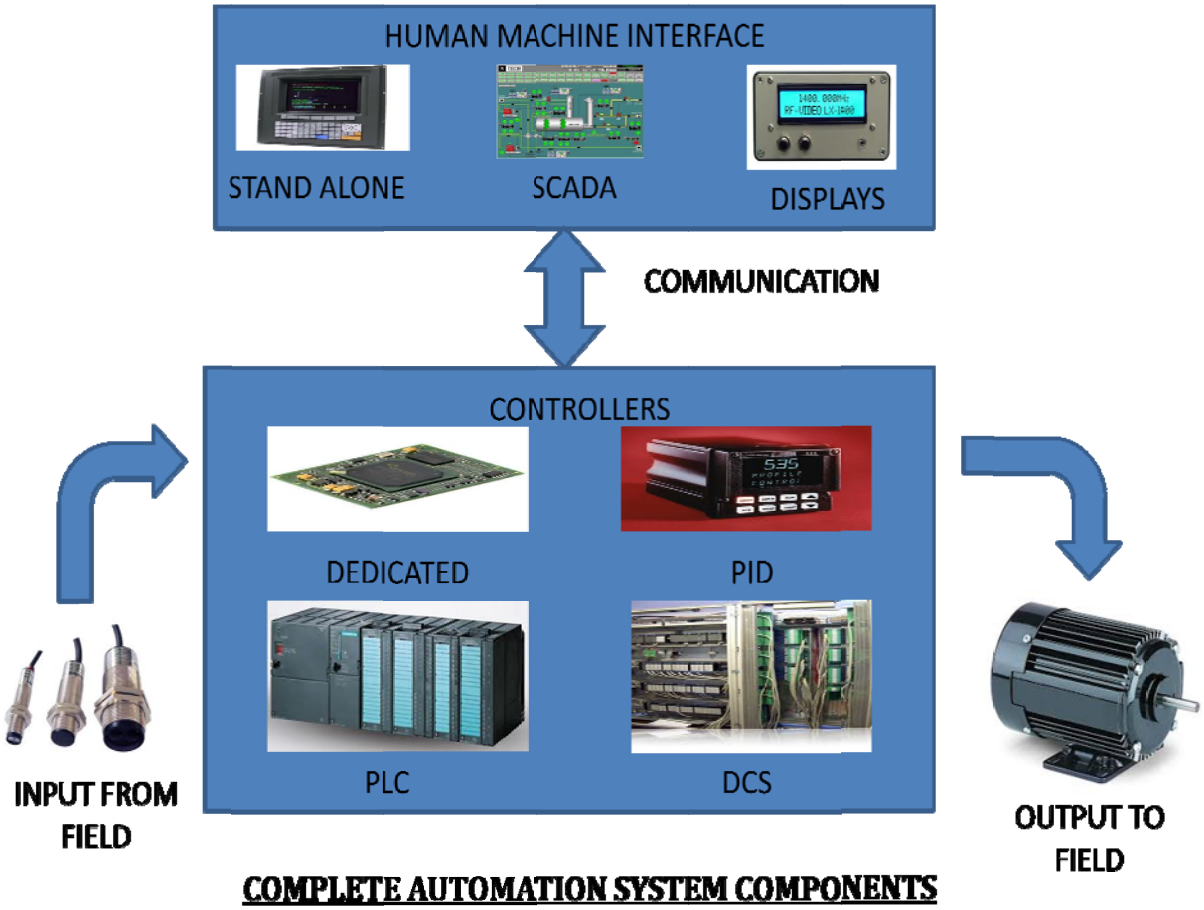
Automation :

Automation or industrial automation is the use of control systems such as computers, controllers to control industrial machinery and processes, to optimize productivity in the production of goods and delivery of services. Automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements.

Automation Impacts:

- It increases productivity and reduce cost.
- It gives emphasis on flexibility and convertibility of manufacturing process. Hence gives manufacturers the ability to easily switch from manufacturing Product A to manufacturing product B without completely rebuilt the existing system/product lines.
- Automation is now often applied primarily to increase quality in the manufacturing process, where automation can increase quality substantially.

- Increased consistency of output.
- Replacing humans in tasks done in dangerous environments.



COMPLETE AUTOMATION SYSTEM COMPONENTS

Introduction to Programmable Logic Controller(PLC)

- A PROGRAMMABLE LOGIC CONTROLLER (PLC) is an industrial computer control system that continuously monitors the state of input devices and make decisions based upon a custom program to control the state of output devices.
- It is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact.
- Almost any production process can greatly enhanced using this type of control system, the biggest benefit in using a PLC is the ability to change and replicate the operation or process while collecting and communicating vital information.
- Another advantage of a PLC is that it is modular. i.e. you can mix and match the types of input and output devices to best suit your application.

History of PLC’s

- The first Programmable Logic Controllers were designed and developed by Modicon as a relay replacer for GM and Landis.
- The primary reason for designing such a device was eliminating the large cost involved in replacing the complicated relay based machine control systems for major U.S. car manufacturers.
- These controllers eliminated the need of rewiring and adding additional hardware for every new configuration of logic.
- The first PLC, model 084, was invented by Dick Morley in 1969.
- The first commercial successful PLC, the 184, was introduced in 1973 and was designed by Michel Greenberg.
- Communications abilities began to appear in approximately 1973. The first such system was Modicon's Modbus. The PLC could now talk to other PLCs and they could be far away from the actual machine they were controlling.

What is inside a PLC ?

- The PLC, being a microprocessor based device, has a similar internal structure to many embedded controllers and computers. They consist of the CPU, Memory and I/O devices. These components are integral to the PLC controller. Additionally the PLC has a connection for the Programming and Monitoring Unit or to connect to other PLC's in the field.

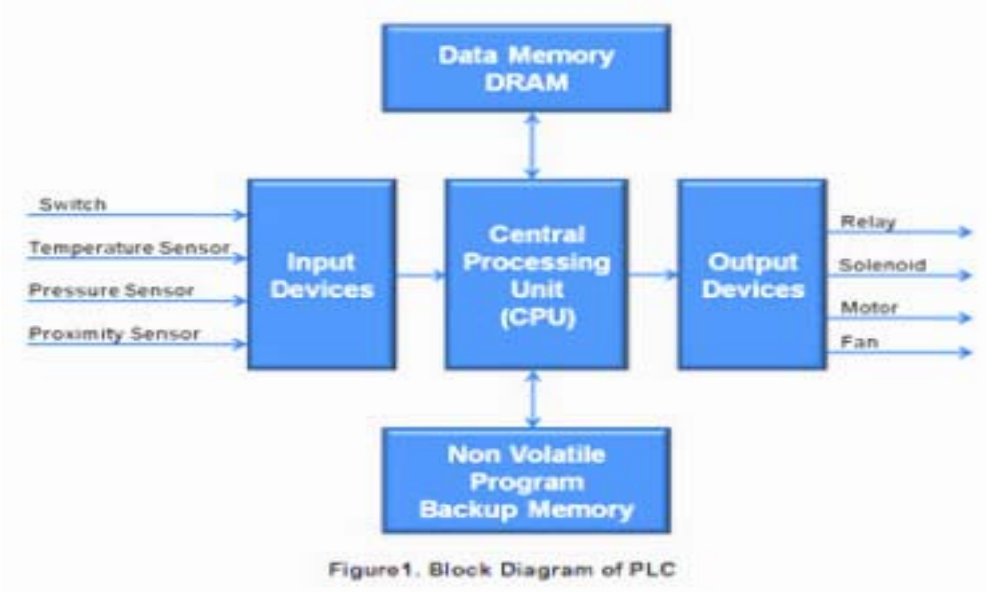


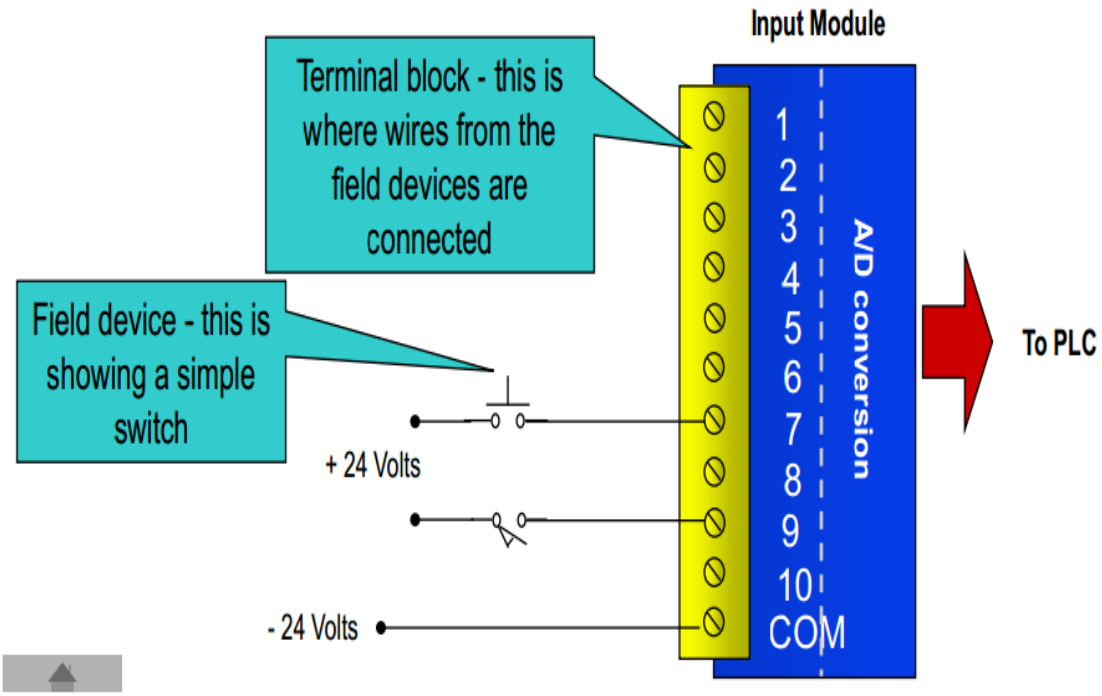
Figure1. Block Diagram of PLC

- **The CPU** is the brain of a PLC system. It consists of the microprocessor, memory integrated circuits, and circuits necessary to store and retrieve information from memory. It also includes communication ports to the peripherals, other PLC's or programming terminals.The job of the processor is to monitor status or state of input devices, scan and solve the logic of a user program, and control on or off state of output devices.

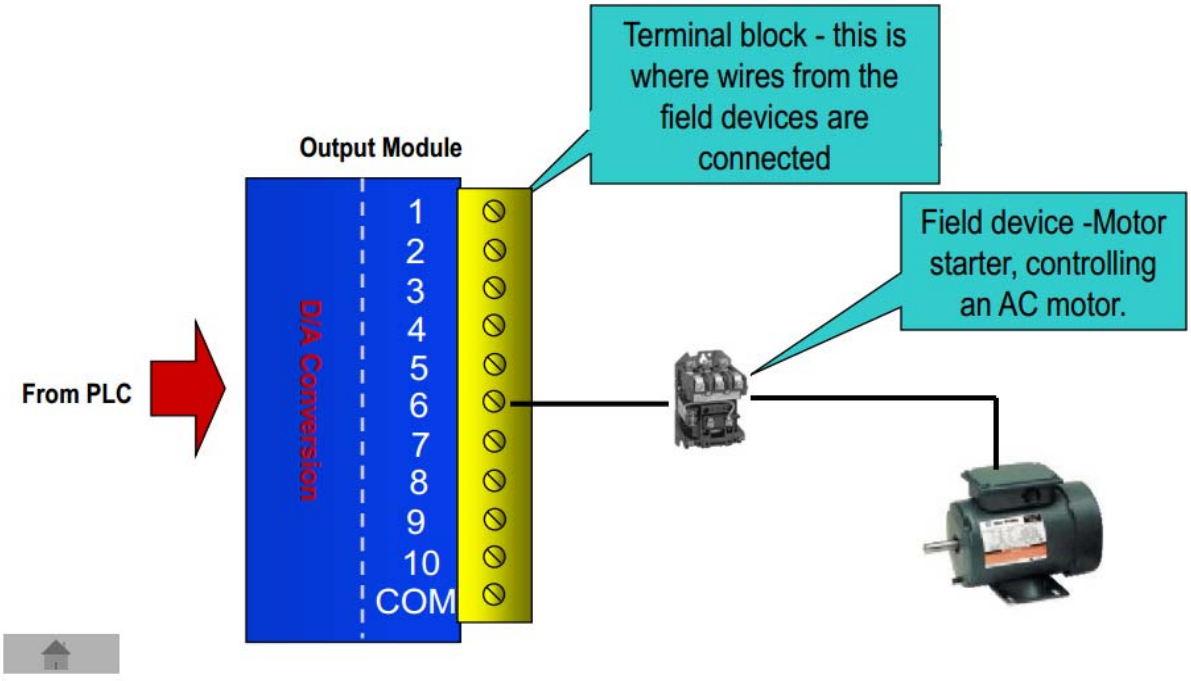
- **RAM** or Random Access Memory is a volatile memory that would loose its information if power were removed, hence some processor units are provided with battery backup. Normally CMOS(Complementary Metal Oxide Semiconductor) type RAM is used.
- **ROM** is a non volatile type of memory. This means it stores it's data even if no power is available. This type of memory information can only be read, it is placed there for the internal use and operation of processor units.
- **EEPROME or Electrically Erasable Programmable Read Only Memory** is usually an add on memory module that is used to backup the main program in CMOS RAM of the processor. In many cases, the processor can be programmed to load the EEPROM'S program to RAM, if RAM is lost or corrupted.

INPUT MODULE

- **Input Module** • Input modules interface directly to devices such as switches and temperature sensors.Input modules convert many different types of electrical signals such as 120VAC, 24VDC, or 4-20mA, to signals which the controller can understand.since all electrical systems are inherently noisy, electrical isolation is provided between input and processor. The component most often used for this purpose is optocoupler .Input signal from the field devices are usually 4 to 20 ma or 0-10 V.



- **<u>Output module</u>** interface directly to devices such as motor starters and lights Output modules take digital signals from the PLC and convert them to electrical signals such as 24VDC and 4 mA that field devices can understand. D to A conversion is carried out in there modules. Usually Silicon Controlled Rectifier(SCR), triac, or dry contact relays are used for this purpose. Normally the output signal is 0-10 V or 4-20 ma.



Operation of PLC

PLC operates by continually scanning the program and acting upon the instructions , one at a time, to switch on or off the various outputs. In order to do this PLC first scans all the inputs and stores their states in memory. Then it carries out program scan and decides which outputs should be high according to the program logic.

Then finally it updates these values to the output table, making the required outputs go high.

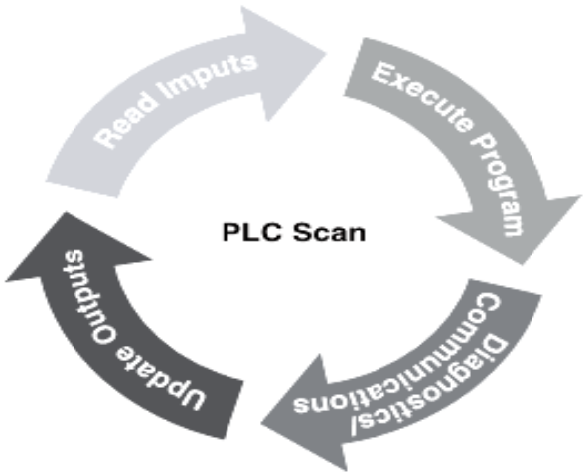
At his point PLC checks its own operating system and if everything is ok, it goes back to scanning inputs all over again.

PLC SCAN CYCLE

Whenever a program is executed in a PLC, before changing any output state, the processor scans the input table and the entire program, which gives rise to states of the output devices according to the program logic. These values are then updated to the output table making the devices connected to the output module on or off. Hence PLC scan cycle consists of three steps shown in the block diagram.

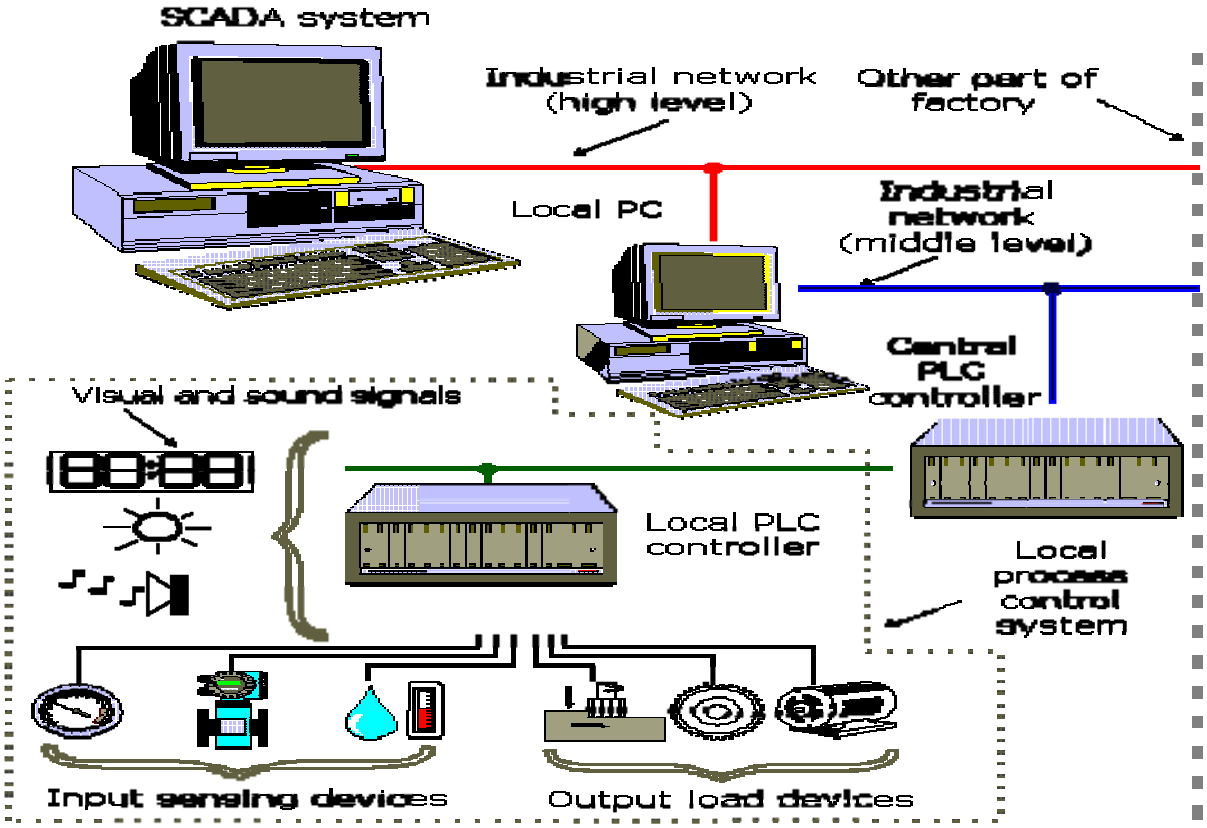
SCAN TIME

Time taken by plc to execute these three steps(Checking Input status, Executing Program, Updating Output Status) is denoted by its scan time.



COMMUNICATION

- There are several methods to communicate between a PLC and a Programmer or even between two PLC's.
- PLCs have built in communications ports, usually 9-pin RS-232, RS-485,TTY but optionally EIA-485 or Ethernet. Modbus, BACnetor DF1 is usually included as one of the communications protocols. Other options include various fieldbuses such as DeviceNet or Profibus.
- Most modern PLCs can communicate over a network to some other system, such as a computer running a SCADA (Supervisory Control And Data Acquisition) system or web browser.

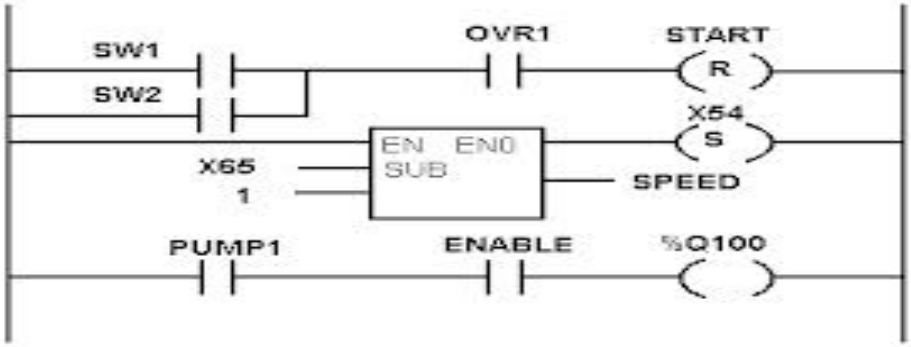


Programming Languages used to Program a PLC

- While Ladder Logic is the most commonly used PLC programming language, but it is not the only one. Following table lists some of the Languages that are used to program a PLC.
- Ladder Diagram()LD.
- Functional block Diagram (FBD)
- Structured Text (ST)
- Instruction List (IL)
- Sequential Functional Chart (SFC)

➢ LADDER DIAGRAM

It is a graphical programming language, initially programmed with simple contacts that simulates the opening and closing of relays. Ladder Logic programming has been expanded to include functions such as Counters, Timers, shift Registers and math operations.



SCADA

SCADA stands for Supervisory Control and Data Acquisition. It generally refers to an industrial control system: A computer system monitoring and controlling a process. The process can be industrial, infrastructure or facility based as described below.

A SCADA System consists of the following subsystems:

1. **HUMAN-MACHINE INTERFACE OR HMI :** It is the apparatus which presents process data to a human operator, and through this, the human operator, monitors and controls the process. A supervisory system, gathering data on the process and sending commands to the controller.
2. **REMOTE TRMINAL UNIT (RTU'S)** connecting to sensors in the process, converting sensor signals to digital data and sending digital data to the supervisory system.
3. **PROGRAMMABLE LOGIC CONTROLLER (PLC'S)** used as a field devices because they are more economical, versatile, flexible, and configurable than special-purpose RTUs.

SYSTEM CONCEPTS

The term SCADA usually refers to centralized systems which monitor and control entire sites, or complexes of systems spread out over large areas (anything from an industrial plant to a nation). Most control actions are performed automatically by RTUs or by PLCs. Host control functions are usually restricted to basic overriding or *supervisory* level intervention. For example, a PLC may control the flow of cooling water through part of an industrial process, but the **SCADA system may allow operators to change the set points for the flow, and enable alarm conditions**, such as loss of flow and high temperature, to be displayed and recorded. The feedback control loop passes through the RTU or PLC, while the **SCADA system monitors the overall performance of the loop**.

TAG OR POINTS

SCADA systems typically implement a distributed database, commonly referred to as a *tag database*, which contains data elements called *tags* or *points*. A point represents a single input or output value monitored or controlled by the system. Points can be either "hard" or "soft". A hard point represents an actual input or output within the system, while a soft point results from logic and math operations applied to other points. (Most implementations conceptually remove the distinction by making every property a "soft" point expression, which may, in the simplest case, equal a single hard point.) Points are normally stored as value-timestamp pairs: a value, and the time stamp when it was recorded or calculated. A series of value-timestamp pairs gives the

history of that point. It is also common to store additional metadata with tags, such as the path to a field device or PLC register, design time comments, and alarm information.

HUMAN MACHINE INTERFACE

- A human–machine interface or HMI is the apparatus which presents process data to a human operator, and through which the human operator controls the process.
- HMI is usually linked to the SCADA system's databases and software programs, to provide trending, diagnostic data, and management information such as scheduled maintenance procedures, logistic information, detailed schematics for a particular sensor or machine, and expert-system troubleshooting guides.
- The HMI system usually presents the information to the operating personnel graphically, in the form of a mimic diagram. This means that the operator can see a schematic representation of the plant being controlled. For example, a picture of a pump connected to a pipe can show the operator that the pump is running and how much fluid it is pumping through the pipe at the moment. The operator can then switch the pump off. The HMI software will show the flow rate of the fluid in the pipe decrease in real time. Mimic diagrams may consist of line graphics and schematic symbols to represent process elements, or may consist of digital photographs of the process equipment overlain with animated symbols.

- SCADA systems are used to control and monitor physical processes, examples of which are transmission of electricity, transportation of gas and oil in pipelines, water distribution, traffic lights, and other systems used as the basis of modern society. The security of these SCADA systems is important because compromise or destruction of these systems would impact multiple areas of society far removed from the original compromise. For example, a blackout caused by a compromised electrical SCADA system would cause financial losses to all the customers that received electricity from that source. How security will affect legacy SCADA and new deployments remains to be seen.

  You can use SCADA to manage any kind of equipment. Typically, SCADA systems are used to automate complex industrial processes where human control is impractical - systems where there are more control factors, and more fast-moving control factors, than human beings can comfortably manage.

  Where SCADA is used

  Electric power generation, transmission and distribution: Electric utilities use SCADA systems to detect current flow and line voltage, to monitor the operation of circuit breakers, and to take sections of the power grid online or offline.

- **Water and sewage:** State and municipal water utilities use SCADA to monitor and regulate water flow, reservoir levels, pipe pressure and other factors.

- **Buildings, facilities and environments:** Facility managers use SCADA to control HVAC, refrigeration units, lighting and entry systems.