Technological revolution in Industrial Automation using PLC

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ABSTRACT

In any industry having automation work have many devices which are interconnected through wires and making all of them work together and handling their features collectively is the work of PLC (Programmable logic Controller). They are most forwardly used as they are simplest forms of control structures that are now taking over the hard-wired Relays. PLCs which are computer-based controllers are the exceptional for handling systems, which requires excessive care and accuracy like small and medium scale industries for input and Output processes. Leaning a little in the direction the utilization of Automation in Industries will only give a beneficiary performance, flexibility, accuracy, least or null engagement of human interference. And for controlling and tracking of the large scale industries where PLCs are not enough, SCADA (Supervisory Control and Data Acquisition Systems) are used as they are more efficient, and can be handled without difficulty from the main control room/office which is remotely located at other place or at far area. One of critical function of PLC is that its input and output elements can be prolonged according to the requirement or motive. They are very easy to operate for those who are having even a basic Information.

Keywords : PLC, SCADA, DCS, AUTOMATION, INDUSTRY

I. INTRODUCTION

Automation is using management systems like computers or robots, and statistics technologies for dealing with unique methods and machineries in an industry to update a human being. It is the second step past mechanization in the scope of industrialization. It's far encompassing virtually every stroll of life. Automation is a necessity right from basics of agricultural to space era. It is delegation of human manage feature to technical equipment. Automation's main purpose is to lessen the cost of making, boom the amount of manufacturing, also to decrease the labour paintings, and for least mistakes excellent merchandise. Automation is the process where the gadget accepts the inputs which might be described and works accordingly to predefined series of operation in the sequenced way. Human stage sample reputation and language production potential are properly past capability of present day

mechanical and PC system. Duties requiring subjective evaluation or syntheses of complex sensory records such as sound as well as venture consisting of method planning, presently require human expertise.[2] Specialized harden computers has taken collection of transformation from Relay and Contractor Logic, Programmable logic controller (PLC), Supervisory Control and Data Acquisition (SCADA) and Distributed Control System (DCS) in steps. From the indexed tools one could use one according to the convenience and necessity. [1] The MODICON-084 is the first PLC commercially produced through Bedford accomplice.

Figure 1 : First PLC MODICON-084 [16]

II. PROGRAMABLE LOGIC CONTROLLER

PLC stands for "**Programmable Logic Controller**". PLC is specially designed for dependable operation in harsh business environments (for Ex; Humidity, Dry and/or Dusty situations, hot temperature). A programmable controller is a solid state user programmable control system that is used for extraordinary functions like control logic, arranging in order, timing, and arithmetic record manipulation and able to count. As PLC is a type of computer thus it also consists of CPU, memory regions like (RAM, ROM and so forth.), and appropriate circuits to acquire and transmit input/output data. We can truly consider PLC to be a field full of innumerable separate relays, counters, timers, and statistic storage

locations. They don't physically exist but rather they are simulated and can be considered software Counters, timers, etc. Use of Automation in commercial fields may be meeting in production flora, sorting of gadgets based totally on special sensors, wastewater remedy plants etc.

2.1 TYPES OF PLC

(1) Compact PLC: Compact PLC have PS, COMM, CPU and IOs in single unit. It may be prolonged by means of plugging in additional module. E.g. Mitsubishi

(2) Modular PLC: Modular PLC backplane incorporates the energy, address and data buses to the modules setup in the rack. Modules have separate functionality: PS, CPU, COMM and IOs. e.g. Allen Bradley

(3) Hybrid PLC: It is a miles of mixture of Compact PLC and Modular PLC having the advantages and functions of both PLCs.

PLC Type	Protocol	PLC needs Special Program	API	Middle Wear Runs At	Used At	Problems
Simatic S7	Siemens S7 Communication	Yes	Java Standard Library(java.net)	PC with JVM (Windows,Linux)	W7-X	None
Simatic S7	Siemens S7 Communication	Yes	C socket API	PC with VxWorks	W7-X	None
Simatic S7 with CP 343-1 Advanced	Siemens Beans	No	S7 Beans API	Solaris machine with JVM	JET	Needs High Speed Data Link
Schneider Modicon Premium	Unknown	No	factoryCast Library	Solaris machine with JVM	JET	None
Festa FC640	Festo Command Interpreter Over http	Yes	Java Third Party Library(apache http client)	Solaris machine with JVM	JET	None
IBHSoftec	Windows dll on Localhost	No	JNA Java Native access interface to plc32.dll	PC Windows (host where Soft PLC is running)	JET	SoftPLC freezes sometimes

Figure 1 : comparing different PLCs

2.2 PLC SCAN CYCLE:

From the below given figure 2 we can study about the Scan cycle that:

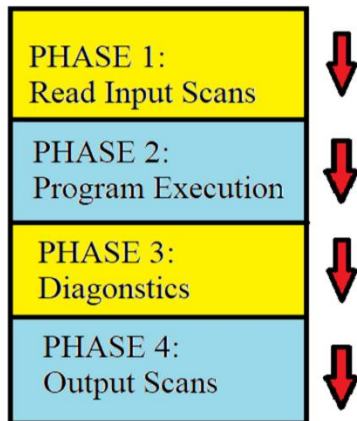(1) Input scan: Repute of external input is written to the input photo table (record or register)

Figure 2 : Scan Cycles

(2) Program Execution: Each ladder rung is scanned and solved using the data in the enter file. The resulting logic is written to the output photo table (record or register)

(3) Diagnostic: Internal assessments on memory, speed and operation. Serve any communication request.

(4) Output Scan: the output photo data is transferred to the external output circuits, turning the output gadgets ON or OFF.

2.3 PLC PROGRAMMING LANGUAGE

PLC programming is achieved in lots of type of languages like instruction list, ladder diagram, function block diagram, etc. Instruction list is much like assembly language. Structured text is much like higher level languages like C, C++. Structured text's gain is right for implementation of indexing an array, IF, CASE, WHILE, FOR, Constructs and math

operations. It has distractive risk like no visualization as given in Ladder diagram.
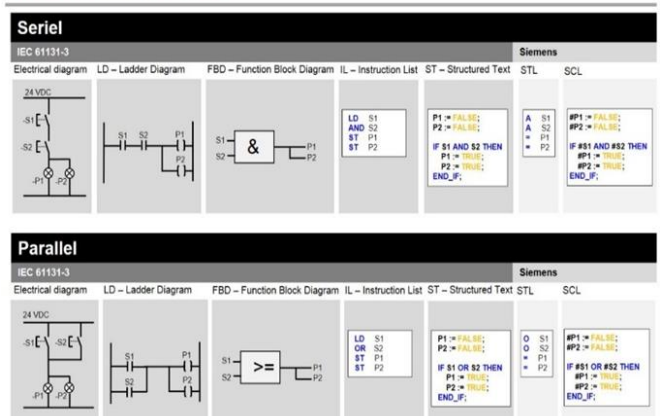

Figure 3. PLC programming language overview [15]

Ladder diagram is a far same as to the electrical circuits. Because it makes use of the same structure as relay logic that have been used earlier than the invention of PLC. Its benefit is it can be understood easily via each person having primary electrical knowledge. Software program ability are not much required for programming PLC. Its disadvantage is that no CASE, FOR, WHILE styles of loops or features are directly available. Function block diagrams are better visualized by signal flow and control loop A|1 went to P|1 controller whose output went to that AO1.

III. SCADA

SCADA stands for **Supervisory Control and Data Acquisition** system. SCADA is software program with essential hardware to finish precise responsibility assigned to it. Data Acquisition, controlling, data processing alerts (alarms) and historical reporting all are the features of SCADA. SCADA is computer software program which can be established in master computer of any plant and enterprise that's used for data collection and analysing data of real time processes. SCADA is used for monitoring and controlling diverse plant or enterprise's equipment including power system, oil and gases refining

machine, milk dairy, water and waste control, cement and ceramic industry and so forth. The role of SCADA is very important and crucial in any massive system. In present days, well-organized SCADA system gives most advantages for any plant or industry. SCADA have five vital composing parts: HMI, RTUs, PLCs, communications, field instrumentation.

(1) Human Machine Interface (HMI): SCADA component HMI is used for the connect customer directly with the system to be able to data control, data tracking and data acquisition and so forth. [4]

(2) Remote Terminal Unit (RTU): RTUs is tool installed inside the plant and enterprise or at a far of location in which gather data, codes and transmitting data to master system. All RTUs linked collectively through master computer in which SCADA is mounted. All RTUs gather data from the master device. RTUs have both type of communication wired and wireless and are used as per application of plant and industry requirement. [5]
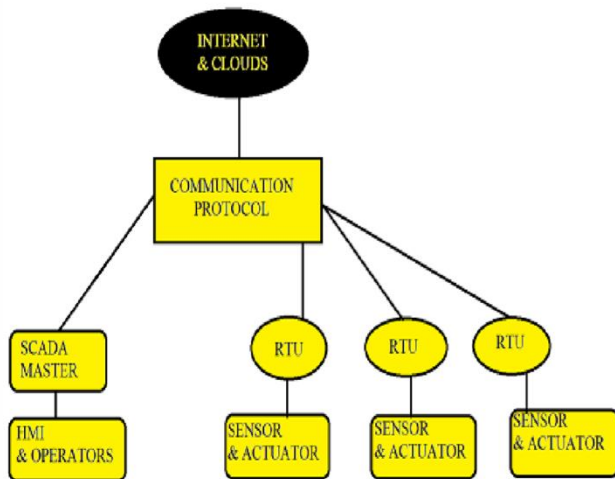

Figure 4: SCADA and its component

(3)Communication network: The most critical parts of SCADA system are master station, RTUs and PLCs that are communicating with each other. DNP3 and T101 are two most common protocols used in now a day's regular use. Now a days protocols that can be generally used in current SCADA system for power

application sector are IEC 60870-5-101 and IEC 60870-5-104. [6]

(4)Field instrumentation: In any industry work, as massive machineries and large systems are placed so tracking and controlling them is a must need process. Thus SCADA needs a numerous instruments like; sensors, actuator, switch, valve and other gadgets. All devices are tracked from the master station.

IV. DISTRIBUTED CONTROL SYSTEM (DCS)

A **Distributed control system** (DCS) is a entire included package deal from a single dealer together with hardware and software each. DCS consists of PC (computer), microcontroller and communication component or ports. Many machineries having PLC placed as default for the control and tracking are also controlled by means of the DCS. The communication between the PLCs and DCS is carried out via the Inputs and Outputs or the field buses. DCS is control system wherein controller unit isn't always in fixed location but it allotted throughout a plant and system [7]. In DCS, any components and sub system are controlled by using one or extra controller remotely. The computer system are the one that connects and communicates with the entire system. Additionally connects the machine with each other and to different systems simultaneously. The standard DCS system and its components diagram display in figure 5.
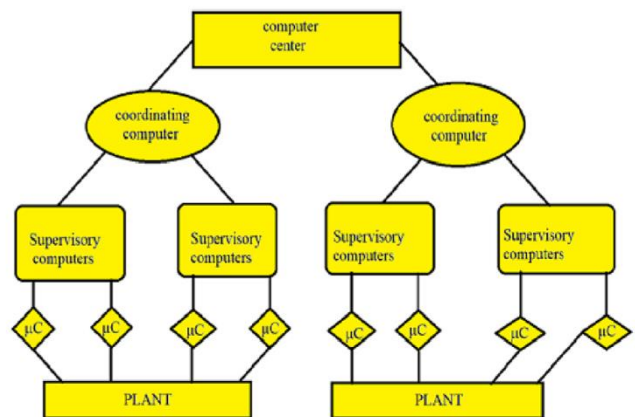

Figure 6 : DCS system diagram

SOME IMPORTANT FEATURES OF DCS:-

i. To address complicated procedures.
ii. Systems reliability.
iii. Greater enlightened HMI.
iv. A group of predefined function block.
v. Extensible platform.
vi. System Prolixity.

BASIC FEATURES OF DCS

1) Engineering PC or Controller.

Engineering PC is used as controller of all the distributed functions over the whole plant. Managing the algorithms and some configuration of various systems are done on this controller.

2) Distributed controller or local control unit.

This controllers are the next step of the Engineering PC, that is, this type of controllers are mounted near the sensors or actuators (Field devices) or at the locations where sensing and thus controlling of devices is needed One advantage is that both types of Analog and digital, IOs can be communicated as such modules are present. The main function of this controller or local control unit is to collect the data and send it to the Engineering PC.

3) Operating station or HMI.

HMI is basically used for controlling or analysing the whole process of the system. Each process's status can be obtained by setting and implementing the required tools according to the need. HMI can be also be an important feature as an alert signal where temperature or leakage are main factors.

4) Communication media and protocol.

Communication media is the hardware side which are the transmission cables used for transmitting and receiving the data which consists of coaxial cables, Optical fibres, WI-FI and copper wires. The DCS, has two or more communication protocols like one for the operating and the other for supervisory.

V. CONCLUSION & FUTURE SCOPE

The best automation and system management is very necessary in the competitive world. Rapid manufacturing adjustments and attainment of precise production with minimal waste is absolutely difficult. PLC and SCADA have turn out to be an integral part of industrial automation sector. Due to its traits inclusive of robustness and withstanding in the harsh environments, it is more preferable in the factories wherein the human effort is not sufficient for the operating of heavy machinery. On the other hand, SCADA is a system that helps inside the working of devices that are placed in remote location. PLC is an industry wide device that will enhance the value of control education with a more holistic approach.

VI. REFERENCES

[1]. Mallikarjun G. Hudedmani*, Umayal R M, Shiva Kumar Kabberalli, Raghavendra Hittalamani , Programmable Logic Controller (PLC) in Automation, Advanced Journal of Graduate Research ,ISSN:2456-7108 Volume 2, Issue 1, pp. 37-45, July 2017.

[2]. Amit Nandgave, Harshal Deshbhratar, Saket Khandare, Professor Lokesh Heda, Industrial Drives & Automation using PLC, International Journal of Engineering Research & Technology (IJERT) ,Vol. 3 ,Issue 2, February - 2014 ,ISSN: 2278-0181.

[3]. Al Amin, Mitu Mridha, A mini view of PLC, International Journal of Research in Advanced Engineering and Technology ISSN: 2455-0876; Impact Factor: RJIF 5.44 Volume 6; Issue 2; 2020; Page No. 23-25.

[4]. A Setiawan,Sugeng,K I Koesoema,S Bakhri,J Aditya,"THE SCADA system using PLC and HMI to improve the effectiveness and efficiency of producation processes" IOP

conference series: material science and engineering 550 012008, 2019

[5]. Ahmed, M. M., & Soo, W. L. (2008). Supervisory Control and Data Acquisition System (SCADA) based customized Remote Terminal Unit (RTU) for distribution automation system. 2008 IEEE 2nd International Power and Energy Conference. doi:10.1109/pecon.2008.4762744

[6]. Dong-joo Kan, Rosslin John Robles,"Compartmentalization of Protocols in SCADA Communication" International Journal Engineering & Technology (IJARCET), Vol 5 no 2, pp 280-285, 2016.

[7]. Arkadiusz Hulewicz, Krawiecki, Zbigniew, & Dziarski, Kryzsztof. (2019).Distributed Control Systems DCS using a PLC Cotroller. ITM Web of Conference, 28, 01041. DOI:10.1051/itmconf/20192801041.

[8]. Senthil Arumugam Muthukumaraswamy, Nikhita Nadgauda, Design and Development of Industrial Automated System using PLC-SCADA, IEEE 1oth GCC Conference & Exhibition (GCC), 2019.

[9]. Rahul Pawar, Application of PLC's for Automation of Processes in Industries. International Journal of Engineering Research and Applications www.ijera.com ISSN: 2248-9622, vol. 6, Issue 6, (Part - 3) June 2016, pp.53-59.

[10]. Sourabh V. Patil, Digvijay D. Patil, Sujit S. Malgave, A review on foundry Automation by using PLC, IJEDR, ISSN: 2321-9939|2017 IJEDR| Volume 5, Issue 3|2017.

[11]. Subhasini Dwivedi, Micheal Fernandes, Rohit D'souza, "A review on PLC based Automatic Waste Segregator" Internatin Journal of Advanced Research in Computer.

[12]. Helen Maria Sabu, Aravind V.B, Apurva Sullerey and Binson VA, "Online Monitoring of PLC Based Pressure Control System" International Journal of Research and Innovations in Science and Technology, Vol 2, no 2, pp 47-50, 2015.

[13]. Richa Netto, Aditya Bagri, "Programmable Logic Controllers" International Journal of Computer Applications, Vol\77, No.11, pp 27-31, 2013.

[14]. Alison Dunn, "The father of invention: Dick Morley looks back on the 40th anniversary of the PLC" Manufacturing Automation, 2008, accessed on May 23, 2017.

[15]. https://www.researchgate.net/publication/3442 24501_PLC_Programming_Languages.

[16]. https://library.automationdirect.com/history-of-the-plc of advanced Science and Technology Volume 8, July, 2009.

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